OFFSITE DOSE CALCULATION MANUAL (ODCM)

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1.0 PURPOSE

1.1 The Offsite Dose Calculation Manual (ODCM) is a supporting document of the Fort St. Vrain Nuclear Station Decommissioning Technical Specifications. The ODCM describes the methodology and parameters to be used in calculation of offsite doses due to radioactive gaseous and liquid effluents. This document also describes the methodology used for calculation of the liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints. Liquid and gaseous radioactive waste treatment system configurations are described in the Decommissioning Plan (Ref. 4.1).

1.2 This ODCM provides the information and methodologies to be used by Fort St. Vrain (FSV) to assure compliance with 10CFR20 (Sections 20.1 - 20.601, as approved by NRC letter dated April 26, 1993 (G-93059)), 10CFR50.36a, 10CFR50 Appendix A (GDC 60 & 64), 10CFR50 Appendix I, and 40CFR190 with respect to liquid and gaseous radiological effluents.

1.3 This ODCM is based on "Radiological Effluent Technical Specifications for PWR's (NUREG-0472, Draft)," and follows the methodology and models suggested by NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," and other inputs from the Nuclear Regulatory Commission (NRC). Regulatory Guide 1.109 is used for guidance and ICRP-30 dose conversion factors are used for dose calculations.

1.4 This ODCM is maintained at Fort St. Vrain for use as a reference guide and training document of accepted methodologies and calculations. Changes in the calculation methods or parameters will be incorporated to ensure this ODCM represents the present methodology in all applicable areas. Changes to this ODCM will be reviewed and approved in accordance with Section 5.10, Fort St. Vrain Decommissioning Technical Specifications.

1.5 Also included in this manual is a description of the FSV Radiological Environmental Monitoring Program (REMP) in Attachment F. This designates specific sample types and locations currently used to comply with FSV Decommissioning Technical Specification requirements for the REMP. They are subject to change based on the results of the annual land use census.

2.0 APPLICABILITY

This procedure is applicable to all routine, planned liquid and gaseous effluent releases made pursuant to the FSV Decommissioning Technical Specifications and unplanned liquid and gaseous effluent releases.

3.0 GENERAL

3.1 The Radiation Protection Manager (RPM) shall be responsible to assure that the ODCM is utilized in accordance with the FSV Decommissioning Technical Specifications. The RPM is also responsible for ensuring that all radioactive waste is handled, stored, and disposed of in accordance with NRC requirements and FSV procedures.

3.2 All radioactive liquid waste is discharged via a common line, is monitored by a liquid waste activity monitor, and therefore, there are no multiple release points and monitor settings do not have to be reduced to account for multiple releases.

3.3 Liquid effluent monitor alarm setpoints are determined in order to assure compliance with 10CFR20. The setpoints ensure that the concentration of radionuclides in the liquid effluent at the site boundary (unrestricted area) does not exceed the concentrations specified in 10CFR20, Appendix B.

3.4 If the calculated alarm setpoint for any of the FSV radiation monitors exceeds the range of the instrument, appropriate lower setpoints will be determined by the RPM. In all cases, since the setpoint is reduced, compliance with the limits in this procedure will be assured.

3.5 The alarm setpoints as calculated in this procedure are the maximum allowable; setpoints may be set lower than the calculated values if so desired.

3.6 Surveillance requirements must be completed within +25% of the specified frequency. Should this frequency be exceeded, the applicable instrument shall be declared inoperable until such time that the required test or calibration is successfully performed.

3.7 The appropriate portions of the liquid and gaseous effluent treatment systems shall be used to reduce releases of radioactivity.

3.8 The LLD is defined for purposes of these specifications as the lowest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

3.9 For a particular measurement system which may include radiochemical separation:

$$LLD = \frac{2.71 + 4.66\sqrt{B}}{T \cdot E \cdot V \cdot 2.22E6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above as microcuries per unit mass or volume,

$\sqrt{B}$ is the standard deviation of the total background counts or of the total counts of a blank sample, as appropriate, as counts,

T is the count time of background in minutes,

E is the counting efficiency as counts per disintegration or counts per gamma for gamma spectroscopy,

V is the sample size in units of mass or volume,

2.22E6 is the number of disintegrations per minute per microcurie, (dpm/μCi),

Y is the fractional radiochemical yield when applicable and/or the gammas per disintegration when applied to gamma spectroscopy,

λ is, if radioactive decay correction is applicable, the radioactive decay constant for the particular radionuclide,

Δt is the elapsed time between the sample collection and time of counting.

3.10 Values of E, V, Y, and Δt, which are appropriate to the sample, should be used in the calculation.

3.11 It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

4.0 REFERENCES

4.1 FSV Decommissioning Plan

4.2 10CFR20, "Standards for Protection Against Radiation"

4.3 Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I," October, 1977

4.4 10CFR50, "Domestic Licensing of Production and Utilization Facilities"

4.5 NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October, 1978

4.6 40CFR190, "Environmental Radiation Protection Standards for Nuclear Operation"

4.7 40CFR141, "EPA Interim Drinking Water Standards for Radionuclides"

4.8 Decommissioning Technical Specifications

4.9 ICRP-30, "Limits for Intakes of Radionuclides by Workers"

4.10 ORNL-4992, "A Methodology for Calculating Radiation Doses from Radioactivity Released to the Environment"

4.11 NUREG/CR-4007, "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements"

4.12 USNRC Regulatory Guide 4.16, "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants", December, 1985

4.13 USNRC Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants",June, 1974

4.14 USNRC Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light Water Cooled Reactors"

4.15 USNRC Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants"

4.16 NUREG-0472 (DRAFT), "Radiological Effluent Technical Specifications for PWR'S"

4.17 Tritium Discharge Understanding between Public Service Co. of Colorado and the Colorado Department of Health, Water Quality Control Division, August, 1992

4.18 10CFR61 "Licensing Requirements for Land Disposal of Radioactive Waste"

5.0 <u>ATTACHMENTS</u>

5.1 DPP 5.4.2-A A_{ir} Values (Dose Factors) for Fort St. Vrain.

5.2 DPP 5.4.2-B P_i Values for FSV.

5.3 DPP 5.4.2-C R Values for FSV.

5.4 DPP 5.4.2-D Monthly South Platte River Low Flow Rates.

5.5 DPP 5.4.2-E ODCM Background Information.

5.6 DPP 5.4.2-F Radiological Environmental Monitoring Program.

6.0 PROCEDURE

6.1 Liquid Effluent Release Requirements

6.1.1 The maximum instantaneous release rate of radioactive liquid effluents from the site shall be such that the concentration of radionuclides in the unrestricted area does not exceed the values specified in 10CFR20. If plant conditions exist such that the concentration of radioactivity in the liquid effluent from the plant exceeds the specified limits, immediate action shall be taken to terminate the release.

6.1.2 Liquid effluent releases will also be controlled so that the EPA Safe Drinking Water Standard of 20,000 pCi/ℓ for tritium will not be exceeded in the South Platte River on a monthly average basis. This is in accordance with the Tritium Discharge Understanding between PSC and the Colorado Department of Health.

6.1.3 Prior to initiating a release, a sample of liquid to be released via the radioactive liquid effluent discharge pathway shall be analyzed for principal gamma emitters, tritium, and for other radioisotopes of concern as identified by previous experience. The results of these analyses shall be used to ensure that the concentrations at the point of release to the unrestricted area are maintained within the limits described in 6.1.1 and 6.1.2 above.

6.1.4 The lower limits of detection (LLD) for the radioactive liquid waste sampling and analysis program shall satisfy the following:

Principal Gamma Emitters	5E-7 μCi/mℓ
Tritium	1E-5 μCi/mℓ

LLDs for other radioisotopes shall be determined as appropriate.

6.1.5 The principal gamma emitters for which the LLD specification applies are the following radionuclides: Mn-54, Co-60, Cs-134, Cs-137, Eu-152 and Eu-154. This list does not mean that only these nuclides are to be considered. Other reactor produced gamma emitters that are identified shall also be analyzed and reported in the Annual Radioactive Effluent Release Report.

6.1.6 System 62 and Reactor Building Sump effluent discharges shall not occur simultaneously.

6.1.7 All liquid effluent releases shall be continuously monitored by a gamma activity monitor and its associated recorder.

6.1.8 Equipment shall be operable to automatically terminate the release on high gamma activity or low blowdown flow and give a Control Room alarm.

6.1.9 If the gamma activity monitor becomes inoperable, liquid effluent releases may continue provided that prior to initiating a subsequent release, at least two technically-qualified members of the facility staff independently verify the release rate calculations.

6.1.10 If the gamma activity monitor becomes inoperable during a Reactor Building Sump release, the release may continue provided that a grab sample is taken every 12 hours during the release and analyzed for principal gamma emitters and tritium.

6.1.11 With the radioactive liquid effluent monitoring instrument inoperable, best efforts shall be exerted to return the instrument to operable status within thirty days and if unsuccessful, the failure to correct the inoperability in a timely fashion shall be explained in the next Annual Radioactive Effluent Release Report.

6.1.12 If the recorder associated with the gamma activity monitor becomes inoperable, liquid effluent releases may continue provided the count rate of the monitor is recorded at least once per four hours during actual releases.

6.1.13 Best efforts shall be exerted to return the recorder to operable status within thirty days and if unsuccessful, the failure to correct the inoperability in a timely fashion shall be explained in the next Annual Radioactive Effluent Release Report.

6.1.14 If the blowdown flow measuring devices become inoperable, liquid effluent releases may continue provided the flow rate is estimated at least once per four hours during actual releases. Flow rate can be estimated using the Parshall Flume in the liquid discharge pathway.

6.1.15 Releases of shield water from the PCRV may be performed when the shield water has been processed to the extent that the concentrations of all radionuclides would result in a calculated total dose less than 0.545 mrem, when calculated in accordance with Section 6.4.5. After all the water in the PCRV has been processed to this extent, releases may be made directly from the PCRV to the dilution point, provided there are no activities in progress inside the PCRV that could stir up additional contaminants and release them into the PCRV Shield Water System.

6.1.16 If the liquid waste system effluent flow indicator (bull's eye) becomes inoperable, the release may continue provided that a grab sample is taken every 12 hours during the release and analyzed for principal gamma emitters and tritium. Subsequent releases may be made provided that prior to the release, at least two technically qualified members of the facility staff independently verify the release rate calculations.

6.1.17 If the liquid waste system effluent flow rate measuring device becomes inoperable, releases may continue provided the flow rate is estimated once per hour.

6.1.18 Flow rate from the liquid waste holdup system can be estimated by performing a level decay evaluation.

6.2 Liquid Effluent Surveillance Requirements

6.2.1 The level alarms and pump interlocks on the two liquid waste receiver tanks and monitoring tank shall be tested once per year.

6.2.2 The liquid effluent discharge blocking valve shall be functionally tested prior to each release.

6.2.3 The gamma activity and Circulating Water blowdown flow rate monitors and their associated recorders shall be channel-checked during each release, functionally tested prior to each release or quarterly whichever is more frequent, and calibrated once per 18 months.

NOTE: **For the gamma activity monitor, the channel functional test shall also demonstrate that Control Room or local alarm annunciation occurs if any of the following conditions exist:**

1. **Instrument indicates measured levels above the alarm setpoint.**
2. **Circuit failure.**
3. **Instrument indicates a downscale failure.**

6.2.4 The Radioactive Liquid Waste discharge flow rate measuring device and recorder shall be channel checked daily during releases and calibrated once per 18 months.

6.2.5 The Radioactive Liquid Waste discharge flow indicating device (bull's eye) shall be channel checked at the beginning of each release.

6.2.6 Channel check of flow instrumentation shall consist of verifying indication of flow during periods of release.

6.3 Liquid Effluent Compliance with 10CFR20

6.3.1 In order to show compliance with 10CFR20, the concentration of radionuclides in liquid effluents will be determined and compared to maximum permissible concentrations (MPC) as defined in Appendix B, Table II, of 10CFR20.

6.3.2 Concentrations of radioactivity in effluents prior to dilution will be determined by sampling and analysis.

6.3.3 The concentration of the various radionuclides in the liquid effluent prior to dilution will be divided by the minimum dilution flow to obtain the concentration at the unrestricted area. This calculation is shown in the following equation:

$$Conc_i = \frac{C_i \ R}{MDF}$$

Where:

$Conc_i$ = Concentration of radionuclide, i, at the unrestricted area in μCi/mℓ;

C_i = Concentration of radionuclide, i, in the potential batch release in μCi/mℓ;

R = Release rate of the batch in gpm;

MDF = Minimum Dilution Flow in gpm.

6.3.4 The projected concentration in the unrestricted area will be compared to the concentration in Appendix B, Table II, of 10CFR20 as follows:

$$\sum \frac{(Conc_i)}{(MPC_i)} \leq 1$$

Where:

MPC_i = Maximum Permissible Concentration of radionuclide, i, from 10CFR20 in μCi/mℓ.

6.4 <u>Liquid Effluent Doses - Compliance with 10CFR50</u>

6.4.1 Doses resulting from liquid effluents will be calculated monthly to show compliance with 10CFR50. A cumulative summation of total body and the maximum exposed organ doses for each calendar quarter and calendar year will be maintained.

6.4.2 Dose calculations will be performed for any radionuclides whose undiluted concentration exceeds 1% of their respective MPC.

6.4.3 Dose calculations will be performed for the most reasonably conservative pathways identified in the Environmental Report Supplement. These include doses resulting from radionuclides after dilution in downstream surface or ground water as follows:

a) Drinking water from Gilcrest town wells;

b) Ingestion of beef or poultry watered from surface water;

c) Drinking milk from cows that drink surface water;

d) Ingestion of vegetables irrigated with surface water;

e) Ingestion of fish from surface water.

6.4.4 Pathways involving consumption of effluent water in the Goosequill Ditch are minimized by posting of 'NO HUNTING' and 'NO FISHING' areas. These pathways were evaluated in the Environmental Report Supplement, and will not be re-evaluated in accordance with this ODCM.

6.4.5 The dose contribution from the release of liquid effluents will be calculated monthly, as follows:

$$D_\tau = \sum_k \sum_i A_{i_\tau} t_k C_{i_k} F_k$$

Where:

D_τ = The dose commitment to the total body or any organ from the liquid effluents for the period, mrem;

C_{ik} = The average concentration of radionuclide, i, in undiluted liquid effluent for the release k, μCi/mℓ;

$A_{i\tau}$ = The site-related ingestion dose commitment factor to the total body or maximum exposed organ, τ, (Attachment A);

F_k = The near field average dilution factor for C_{ik} during release, k, as determined in 6.4.6;

t_k = The length of time for release, k, hours.

6.4.6 The average dilution factor (F_k) for each release will be calculated as follows:

$$F_k = \frac{R_k}{ADDF_k}$$

Where:

R_k = Release rate during time period, k, gpm;

$ADDF_k$ = Actual downstream dilution flow rate during release k, gpm, from Attachment D.

<u>NOTE:</u> **This is the low monthly flow downstream of the confluence of the South Platte River and St. Vrain Creek and applies to both batch and continuous releases.**

6.4.7 The dose contributions from batch and continuous releases will be summed to determine the total dose contribution from liquid effluents and compare with quarterly and annual limits.

6.4.8 The monthly results will be added to the doses cumulated from the other months in the quarter of interest and in the year of interest.

6.4.9 The following relationships should hold:

a) Dose < 1.5 mrem/qtr total body

b) Dose < 5 mrem/qtr any organ

c) Dose < 3 mrem/yr total body

d) Dose < 10 mrem/yr any organ

6.4.10 If these quarterly or annual limits are exceeded, a special report should be submitted to the NRC stating the reason and corrective action to be taken. If twice these limits are exceeded, a special report will be submitted showing compliance with 40CFR190.

6.5 Liquid Effluent Releases - Compliance with Tritium Discharge Understanding

6.5.1 Releases of liquid effluent containing tritium from PCRV Shield Water shall be controlled to ensure that the monthly average tritium concentration in downstream surface water does not exceed 20,000 pCi/l, in compliance with the Tritium Discharge Understanding between PSC and the Colorado Department of Health.

6.5.2 Tritium release rates shall be based on the following mass balance calculations:

First, a calculated maximum tritium concentration in the Goosequill ditch shall be determined, based on available dilution flows in the surrounding surface waters. This calculation is described in Section 6.5.4.

Then, a maximum release rate shall be determined from the calculation in Section 6.5.5.

6.5.3 The Goosequill ditch represents the calculational point for determining tritium concentration to be released to the surface waters.

6.5.4 The calculated maximum tritium concentration for discharge into the Goosequill ditch shall be determined from the following mass balance equation:

$$M_{GQ}=\frac{Q_{DSP}M_{DSP}-(Q_{USP}M_{USP}+Q_{USV}M_{USV})}{Q_{GQ}}$$

Where,

M_{GQ} = Calculated Maximum Tritium Concentration for discharge into the Goosequill Ditch (pCi/l);

Q_{GQ} = 4.45 cfs (2000 gpm), conservatively assumed Goosequill Ditch flow rate;

Q_{DSP} = S. Platte River monthly low flow rate, Downstream, from Attachment D;

M_{DSP} = 20,000 pCi/l, Tritium Concentration in S. Platte River, Downstream;

Q_{USP} = S. Platte River monthly low flow rate, Upstream, from Attachment D (cfs);

M_{USP} = Tritium Concentration in S. Platte River, Upstream (pCi/l), from weekly sample data; if less than lower limit of detection, this will be considered zero;

Q_{USV} = St. Vrain Creek monthly low flow rate, Upstream, from Attachment D (cfs);

M_{USV} = Tritium Concentration in St. Vrain Creek, Upstream (pCi/l), from weekly sample data; if less than lower limit of detection, this will be considered zero.

6.5.5 The maximum in-plant release rate shall be determined from the following mass balance equation:

$$Q_{RLW} = \frac{Q_{GQ}M_{GQ} - Q_{BD}M_{BD}}{M_{RLW}}$$

Where,

Q_{RLW} = Radioactive Liquid Waste release flow rate (gpm);

M_{RLW} = Tritium concentration in Radioactive Liquid Waste (pCi/l), based on sampling prior to release;

Q_{GQ} = 1100 gpm, conservative Goosequill Ditch flow rate;

M_{GQ} = Maximum Tritium Concentration for discharge into the Goosequill Ditch (pCi/l), obtained from Step 6.5.4 above;

Q_{BD} = Bypass/Blowdown flow rate (gpm);

M_{BD} = Tritium concentration in Bypass/Blowdown water (pCi/l), based on weekly sample data from storage pond; if less than the lower limit of detection, this will be considered zero.

6.5.6 Monthly flow rates for the S. Platte River (upstream), the St. Vrain Creek (upstream), and the combined downstream flow are based on the Monthly Low Flow Rates in Attachment D.

6.5.7 Upstream tritium concentrations in the S. Platte River, the St. Vrain Creek, and the storage ponds will be determined from weekly sampling and analysis.

6.5.8 During each batch release, or once per day during continuous releases, a sample from the Goosequill ditch downstream of the release point shall be collected and analyzed for tritium concentration.

6.5.9 Copies of the analysis results shall be provided to the PSC Radiation Protection Manager and the WT Project Radiation Protection Manager.

6.5.10 Actual tritium concentrations in the downstream S. Platte River shall be determined by analyzing water samples taken at the Milliken bridge.

6.5.11 A representative grab sample of downstream S. Platte River water shall be taken once per week during releases of PCRV Shield Water. A sample of downstream S. Platte River water was taken once per day during the first 90 days of releases from the PCRV Shield Water.

6.5.12 If tritium concentration in the downstream So. Platte River Water exceeds 19,000 pCi/l, both the PSC Radiation Protection Manager and the WT Radiation Protection Manager shall be notified.

6.6 Liquid Effluent Monitor Alarm Setpoints

6.6.1 The alarm setpoints for RT-6212 and/or RT-6213 will be evaluated prior to each batch release from the Liquid Waste Monitoring Tank, Receivers, Reactor Building Sump, or PCRV Shield Water System as applicable.

6.6.2 The liquid activity monitor setpoints are determined based on an NIST traceable gamma source isotopic calibration of the monitors.

6.6.3 Unless revised in accordance with Section 6.7, the liquid activity monitor alarm setpoints are as follows:

RT-6212	3,300 cpm
RT-6213	12,000 cpm

6.7 Liquid Effluent Monitor Alarm Revised Setpoint Determination

6.7.1 If the concentration of total gamma activity is greater than 1E-4μCi/ml the RPM or designee will evaluate whether revised setpoints are required.

6.7.2 If required, the monitor setpoint will be determined, taking into account the amount of tritium and other isotopes that would not be detected by RT-6212 and/or RT-6213, as follows:

a) For the isotope identified in the sample analysis above that has the most restrictive MPC per 10CFR20,

$$\text{Alarm Setpoint (cpm)} = B \left[\frac{MPC(\mu Ci/m\ell)}{\text{Monitor Sensitivity } (\mu Ci/m\ell/cpm)} \right]$$

Where:

Monitor Sensitivity$_i$ = the sensitivity of the monitor in μCi/mℓ/cpm, and

B = Adjustment factor to account for tritium and any other isotopes not detected by RT-6212 and/or RT-6213. The value used for "B" will be provided by the PSC Radiation Protection Manager and must be based on the requirement to maintain the total concentration of all nuclides at or below MPC i.e., $\Sigma C_i/MPC_i \leq 1$, with appropriate adjustment for ALARA.

6.8 Gaseous Effluent Generic Release Requirements

6.8.1 The lower limits of detection (LLD) for the radioactive gaseous waste sampling and analysis program shall satisfy the following:

Principal Gamma Emitters	1E-11 μCi/ml
Tritium	1E-06 μCi/ml

6.8.2 The principal gamma emitters for which the lower limits of detection (LLD) specification applies are the following radionuclides: Mn-54, Co-60, Cs-134, Cs-137, and Eu-152 and Eu-154 for particulate emissions. This list does not mean that only these nuclides are to be considered. Other reactor produced gamma emitters that are identified shall also be analyzed and reported in the Annual Radioactive Effluent Release Report.

6.8.3 At least one Reactor Building exhaust fan shall be operating whenever gaseous effluent releases are taking place.

6.8.4 During gaseous effluent releases from the Reactor Building Ventilation Exhaust Stack, one particulate sampler shall be operable.

6.8.5 If the required particulate sampler becomes inoperable, gaseous effluent releases from the Reactor Building Ventilation Exhaust Stack may continue provided an alternate sampler is placed in operation during gas releases.

6.8.6 If the Reactor Building Exhaust Stack flow rate measuring device becomes inoperable, releases may continue provided the flow rate is estimated at least once per four hours.

6.8.7 The flow rate from the Reactor Building Exhaust Stack can be estimated by observing how many Reactor Building exhaust fans are operating.

6.9 Gaseous Effluent Batch Release Requirements

6.9.1 The allowable batch release rate, r, is calculated as follows:

$$r \cdot \frac{C_{H3}}{(MPC)_{H3}} \leq 2.18E9\,cm^3/sec$$

Where:

C_{H3} = concentration in μCi/cm^3 of tritium,

MPC_{H3} = maximum permissible concentration of tritium, per 10CFR20, in μCi/cm^3,

r = release rate in cm^3/sec.

2.18E9 cm^3/sec = The inverse of the annual average dilution factor of 4.59E-10 sec/cm^3 at 100 meters.

NOTE: **If this condition cannot be met, immediate action shall be taken to terminate release from the gas waste system.**

6.9.2 Prior to a batch radioactive release, the contents shall be sampled and analyzed for tritium to determine that releases will be in compliance with 6.9.1 above.

6.10 Gaseous Effluent Surveillance Requirements

6.10.1 During continuous gaseous effluent releases, a grab sample shall be obtained once per week from the Reactor Building Ventilation Exhaust Stack and analyzed for tritium.

6.10.2 The gaseous effluent particulate sample filter shall be analyzed once per week for gamma emitters described in 6.7.2 above.

6.10.3 The gaseous effluent particulate sampler shall be channel-checked daily, and flow indicator calibrated once per 18 months and following maintenance on the flow indicator.

6.10.4 The gaseous effluent tritium sampler flow indicator shall be calibrated once per 18 months and following maintenance on the flow indicator.

6.10.5 Reactor Building Ventilation Exhaust flow recorders and flow indicators shall be channel-checked daily and calibrated once per 18 months.

6.11 Gaseous Effluent Dose Rate - Compliance with 10CFR20

6.11.1 Dose rates resulting from the release of tritium and particulates with half lives greater than eight days shall be calculated monthly to show compliance with 10CFR20.

6.11.2 The limits of 10CFR20 is conservatively applied on an instantaneous basis at the hypothetical worst case location.

6.11.3 The dose rate in unrestricted areas resulting from the release of tritium and particulates with half lives greater than eight days is limited to 500 mrem/yr to any organ.

6.11.4 Dose calculations will be performed for any radionuclides whose undiluted concentration exceeds 1% of their respective MPC.

6.11.5 To show compliance with 10CFR20, the equation below will be evaluated for tritium and radioactive particulates with half lives greater than eight days identified in gaseous effluent releases.

$$\Sigma[P_{iI}(X/Q_{s}Q_{is}) + (P_{ig}+P_{icm}+P_{igm})(D/Q_{s}Q_{is})] +$$

$$\Sigma[(P_{3_{HI}}+P_{3_{Hcm}}+P_{3_{Hgm}})(X/Q_{s}Q_{is})] \leq 500 mrem$$

Where:

P_{iI} = Infant critical organ dose parameter for radionuclide, i, other than tritium for the inhalation pathway mrem/yr per μCi/m^3 (ATTACHMENT B) use P_{3HI} for tritium;

P_{ig} = Infant critical organ dose parameter for radionuclide, i, other than tritium for the ground plane pathway mrem/yr per μCi/sec per m^{-2} (ATTACHMENT B);

P_{icm} = Infant critical organ dose parameter for radionuclide, i, other than tritium for the cow milk pathway mrem/yr per μCi/sec per m^{-2} (ATTACHMENT B) use P_{3Hcm} for tritium;

P_{igm} = Infant critical organ dose parameter for radionuclide, i, other than tritium for the goat milk pathway mrem/yr per μCi/sec per m^{-2} (ATTACHMENT B) use P_{3H} for tritium;

$(\chi/Q)_s$ = 4.59E-04 sec/m^3, Annual average dilution factor at 100 meters;

Q_{is} = The release rate of tritium from the stack for the period of interest, μCi/sec;

$(D/Q)_s$ = 2.63E-07 m^{-2}, annual average deposition factor at 100 meters.

6.11.6 Utilizing Tables E-5 and E-14 of Regulatory Guide 1.109, the critical age group for tritium for inhalation is teen, and for ingestion of cow and goat milk, the critical age group is infant.

6.11.7 Attachment A contains the ICRP-30 dose conversion factor for tritium of 6.4 E-8 mrem/pCi.

6.11.8 Dose calculations will be made once per month.

6.11.9 The source term Q_{i} will be determined from the results of the Gas Waste Surge tank and Reactor Building Ventilation Exhaust stack tritium analyses, and the analysis of weekly reactor stack particulate filters.

6.11.10 These source terms include all gaseous releases from FSV and will be recorded and reported as the total dose for compliance with 10CFR20.

6.12 <u>Gaseous Effluents - Compliance with 10CFR50</u>

6.12.1 Doses resulting from the release of tritium and particulates with half lives greater than eight days must be calculated monthly to show compliance with Appendix I of 10CFR50.

6.12.2 Dose calculations will be performed for any radionuclides whose undiluted concentration exceeds 1% of their respective MPC.

6.12.3 Dose calculations will normally only be performed for tritium. Dose calculations for any other radionuclides will only be performed if their undiluted concentration exceeds 1% of their respective 10CFR20 MPC.

6.12.4 The worst case dose to an individual from tritium and particulates with half lives greater than eight days in gaseous effluents released to unrestricted areas is determined by the following expression:

$$3.17E{-}8\sum_j\sum_i R_{ijak}(W_s Q_{is})$$

During any calendar quarter or year the following relationships should hold:

Dose < 2.5 mrem per quarter

Dose <5 mrem per calendar year

Where:

3.17E-8 = The inverse of seconds in a year.

R_{ijak} = The dose factor for each identified radionuclide i, pathway j, age group a, and organ k, mrem/yr per μCi/m^3.

W_s = Dispersion parameter for estimating dose to an individual from stack releases. For radionuclides other than tritium, χ/Q is used for the inhalation pathway and D/Q is used for food and ground plane pathways. For tritium, χ/Q is used for all pathways.

The annual average χ/Q value, 4.59E-04 sec/m^3 and D/Q value, 2.63E-07 m^{-2} at 100 meters, will be used for each gas waste release period.

Q_{is} = Release of radionuclide i for stack releases, μCi.

6.12.5 The above equation will be applied to each combination of age group and organ.

6.12.6 Values of R_{ijak} have been calculated using the methodology given in NUREG-0133 and are given in Attachment C.

6.12.7 The equation will be applied to a controlling location which will be one of the following: residence, vegetable garden, meat animal, milk animal.

6.12.8 Doses calculated monthly will be summed for comparison with quarterly and annual limits.

6.12.9 The monthly results will be added to the doses cumulated from the other months in the quarter of interest and in the year of interest, and compared to the limits given in 6.12.1.

6.12.10 If these limits are exceeded, a special report should be submitted stating the reason and the corrective action to be taken.

6.12.11 If twice the limits are exceeded, a Special Report showing compliance with 40CFR190 will be submitted as described in 6.13.

6.12.12 The critical receptors for compliance with 10CFR50, Appendix I, will be selected and identified. This location will be the off site location with the highest χ/Q and will be used for showing compliance with 10CFR20 and remain the same unless meteorological data is re-evaluated or the site boundary changes.

6.12.13 The critical location for the tritium and particulate pathway will be selected once per year. This selection will follow the annual land use census performed within five miles of FSV.

6.12.14 Each of the following locations will be evaluated as potential critical receptors:

a) Residences in each sector.

b) Vegetable garden producing leafy green vegetables.

c) All identified milk animal locations.

6.12.15 Following the annual land use census, doses will be calculated for all newly-identified receptors and those receptors whose characteristics have changed significantly.

a) The calculation should include appropriate information shown to exist at each location.

b) The dispersion parameters given in this manual should be employed.

c) The total releases reported for the previous calendar year should be used as the source term.

6.13 Information Related to 40CFR190 and 40CFR141

6.13.1 When the calculated doses associated with the effluent releases exceed twice the limits of any section, the licensee shall prepare and submit a Special Report to the Commission and limit subsequent releases such that the dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to <25 mrem to the total body or any organ (except the thyroid which is limited to <75 mrem) over 12 consecutive months. This Special Report is to include an analysis which demonstrates that radiation exposures to all real individuals from all uranium fuel cycle sources (including all liquid and gaseous effluent pathways and direct radiation) are less than the standards in 40CFR190, Environmental Radiation Protection Standards for Nuclear Power Operations. If analysis indicates that releases resulting in doses that exceed the 40CFR190 Standard may have occurred, then a variance from the Commission to permit such releases will be requested or, if possible, action will be taken to reduce subsequent releases.

6.13.2 The "Uranium Fuel Cycle" is defined in 40CFR Part 190.02(b) as: "Uranium fuel cycle means the operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel, to the extent that these directly support the production of electrical power for public use utilizing nuclear energy but excludes mining operations, operations at waste disposal sites, transportation of any radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and by-product materials from the cycle."

6.13.3 For the purposes of this ODCM, Fort St. Vrain shall be construed to be part of the "Uranium Fuel Cycle."

6.13.4 The Special Report will contain:

a) A determination of which uranium fuel cycle facilities or operations, in addition to Fort St. Vrain contribute to the annual dose to the maximum exposed member of the public.

NOTE: Nuclear fuel facilities over five miles from FSV need not be considered in this determination.

b) A determination of the maximum exposed member of the public.

c) A determination of the total annual dose to this person from all existing pathways and sources of radioactive effluents and direct radiation using the methodologies described in this ODCM. Where additional information on pathways and nuclides is needed, the best available information will be used and documented.

d) A determination of the dose resulting from direct radiation from the plant and storage facilities.

6.13.5 The total body and organ doses resulting from liquid effluents from FSV will be summed with the doses resulting from gaseous releases.

6.13.6 These doses will be based upon releases from FSV during the past three quarters and from the quarter in which twice the specification was exceeded.

6.13.7 The doses from FSV will be summed with the doses to the maximum exposed individual contributed from other operations of the uranium fuel cycle.

6.13.8 The direct dose components will be determined by either calculation or actual measurement.

6.14 Radiological Environmental Monitoring Program

6.14.1 The Radiological Environmental Monitoring Program is conducted to provide data on levels of radiation and radioactive material in the site environs. The program discriminates between those changes in environmental radiation and radioactivity levels resulting from radioactive releases from the Fort St. Vrain Station and those changes attributed to other sources such as worldwide fallout from weapons testing. The program evaluates the relationship between quantities of radioactive material released in liquid and gaseous effluents and resultant radiation doses to individuals from principal pathways of exposure. The results of this program are used to verify the effectiveness of inplant measures applied to control the release of radioactive materials.

6.14.2 The Radiological Environmental Monitoring Program is described in ATTACHMENT F.

6.14.3 A pre-operational environmental radiation surveillance program for the Fort St. Vrain Station environs has been conducted for Public Service Company of Colorado by Colorado State University. Continuous operation of this program since March, 1969, has provided baseline data which will be utilized as control values for statistical analysis of the results of the decommissioning radiological surveillance program.

6.14.4 This ODCM specifies the requirements for the Radiological Environmental Monitoring Program which will continue to be the responsibility of Public Service Company of Colorado.

6.14.5 Additional monitoring in the vicinity of the facility may be conducted or coordinated by other organizations, notably the Colorado Department of Health.

6.14.6 The results of the radiological environmental monitoring are intended to supplement the results of the radiological effluent monitoring by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. Thus, the specified environmental monitoring program provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures to individuals resulting from station decommissioning.

6.14.7 Sampling locations were selected on the basis of local meteorological conditions and airborne concentrations calculated from those conditions, proximity of the plant to residences and communities, and other considerations. Each radiological environmental monitoring report shall contain a map and tables which present detailed information regarding sampling station locations.

6.14.8 The sampling and collection frequencies indicated in Table F-1 were selected on the basis of filter loading, crop harvest time, calculated potential human doses from plant effluents, and other considerations.

6.14.9 Samples will be analyzed in accordance with Table F-1 for radionuclides which may be attributable to effluents released from the facility. Table F-2 indicates the achievable detection capabilities for environmental sample analysis based upon the instrumentation and analytical procedures used.

6.14.10 The requirement for participation in the Environmental Protection Agency crosscheck program or similar program is based on the need for independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

6.14.11 The land use census of milk animals and gardens producing broad leaf vegetation is based on the requirement in Appendix I of 10CFR50 to "Identify changes in the use of unrestricted areas (e.g., for programs for evaluating doses to individuals from principal pathways of exposure)."

6.14.12 The 65 square meter garden considering 20% used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage) and a vegetation yield of 2 kilograms per square meter will produce the 26 kilograms per year assumed in Regulatory Guide 1.109, Appendix E for child consumption of leafy vegetation.

7.0 REPORTING REQUIREMENTS

7.1 An Annual Radiological Environmental Operating Report shall be submitted before May 1 of each year. The report shall include summaries, interpretations, and analyses or trends of the results of the REMP for the reporting period. The material provided shall be consistent with Sections IV.B.2, IV.B.3, and IV.C of Appendix I to 10CFR50.

7.2 An Annual Radioactive Effluent Release Report covering activities during the previous 12 months shall be submitted within 90 days after January 1 of each year. The report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit during the reporting period. The report shall also include a copy of the ODCM if any changes were made during the reporting period as required by Decommissioning Technical Specification 5.10. The material provided shall be in conformance with 10CFR50.36a and Section IV.B.1 of Appendix I to 10CFR50.

7.3 Within 30 days after each calendar month after releases of PCRV Shield Water have been initiated and until all PCRV Shield Water has been released, a report shall be submitted to the Colorado Department of Health Water Quality Control Division summarizing the release calculations and sampling results for tritium releases made during the month.

A_{ir} Values (Dose Factors) for Fort St. Vrain

A_{ir} is calculated for an adult using the following equation:

$$A_{ir} = 1.34\ E6\ (IF_i)\ (DF_{ir})$$

Where:

1.34 E6 = Unit conversion factor, (1 E6 pCi/μCi)(1 E3 ml/l)(1 month/744 hr)

IF_i = Intake factor, based on consumption rates in Regulatory Guide 1.109. Since tritium does not affect any one organ more than the rest, IF_i for tritium is determined by converting the various pathways identified in 6.4.3 to an equivalent intake of tritiated water (HTO) for the month of the calculation, as follows:

Beef/Poultry
= (110 kg/yr)(1 yr/12 mo)(0.6 ℓ HTO/kg)
= 5.5 ℓ/month

Milk
= (400 ℓ/yr)(1 yr/12 mo)
= 33.3 ℓ/month

Vegetables
= (340 kg/yr)(1 yr/12 mo) (0.75 ℓ HTO/kg)
= 21.2 ℓ/month

Fish
= (21 kg/yr)(1 yr/12 mo)(0.9 ℓ HTO/kg)
= 1.6 ℓ/month

Drinking water: Assume Gilcrest well water with a tritium concentration 1/20 of that in surface water, times a conservative factor of 2.

= (2 ℓ/day)(31 days/month)(1/20)(2)
= 6.2 ℓ/month

Total IF_i = 67.8 ℓ HTO/month

DF_{ir} = Dose conversion factor, from ICRP-30. For tritium, DF = 6.4 E-8 mrem/pCi

For tritium,

A_{ir} = (1.34 E6 pCi-mℓ-mo/µCi-ℓ-hr))(67.8 ℓ/mo)(6.4E-08 mrem/pCi)
= 5.81 mrem/hr per µCi/mℓ

The A_{ir} factors for other radionuclides may be calculated, based on the same intake factor, IF_i, determined for tritium, 67.8 ℓ/month, and using ICRP-30 dose conversion factors.

A_{ir} dose factors for other identified radionuclides are as follows:

Mn-54

A_{ir} = 7.40E2 mrem/hr per μCi/ml

Co-60

A_{ir} = 4.70E3 mrem/hr per μCi/ml

Ba-133

A_{ir} = 1.31E3 mrem/hr per μCi/ml

Cs-134

A_{ir} = 7.73E3 mrem/hr per μCi/ml

Cs-137

A_{ir} = 5.04E3 mrem/hr per μCi/ml

Eu-152

A_{ir} = 3.36E3 mrem/hr per μCi/ml

Eu-154

A_{ir} = 6.05E3 mrem/hr per μCi/ml

Eu-155

A_{ir} = 1.14E3 mrem/hr per μCi/ml

Sr-90

A_{ir} = 1.41E5 mrem/hr per μCi/ml

Cl-36

A_{ir} = 3.70E2 mrem/hr per μCi/ml

Fe-55

A_{ir} = 1.88E2 mrem/hr per μCi/ml

DOSE CONVERSION FACTORS (P_i VALUES) FOR FORT ST. VRAIN				
Isotope	Teen Inhalation	Ground Plane	Infant Cow Milk	Infant Goat Milk
H-3	5.11E2	0	1.44E3	2.93E3
CO-60	1.01E7	2.62E13	2.12E9	2.55E8
CS-137	2.81E5	6.98E12	3.78E9	1.13E10

Units are mrem/yr per $\mu Ci/m^3$ for the inhalation pathway and for tritium for cow and goat milk pathways, and mrem/yr per $\mu Ci/sec$ per m^{-2} for the food and ground plane pathways.

DOSE CONVERSION FACTORS (R VALUES) FOR FORT ST. VRAIN*

PATHWAY = VEGET
AGE GROUP = ADULT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.39E 03	1.39E 03	0.00E 00	1.39E 03	1.39E 03	1.39E 03	1.39E 03	1.39E03

PATHWAY = VEGET
AGE GROUP = TEEN

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.59E 03	1.59E 03	0.00E 00	1.59E 03	1.59E 03	1.59E 03	1.59E 03	1.59E03

PATHWAY = VEGET
AGE GROUP = CHILD

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	2.46E 03	2.46E 03	0.00E 00	2.46E 03	2.46E 03	2.46E 03	2.46E 03	2.46E03

*R Values in units of mrem/yr per $\mu Ci/m^3$

DOSE CONVERSION FACTORS (R VALUES) FOR FORT ST. VRAIN*

PATHWAY = MEAT
AGE GROUP = ADULT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.99E 02	1.99E 02	0.00E 00	1.99E 02	1.99E 02	1.99E 02	1.99E 02	1.99E02

PATHWAY = MEAT
AGE GROUP = TEEN

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.19E 02	1.19E 02	0.00E 00	1.19E 02	1.19E 02	1.19E 02	1.19E 02	1.19E02

PATHWAY = MEAT
AGE GROUP = CHILD

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.44E 02	1.44E 02	0.00E 00	1.44E 02	1.44E 02	1.44E 02	1.44E 02	1.44E02

*R Values in units of mrem/yr per $\mu Ci/m^3$

DOSE CONVERSION FACTORS (R VALUES) FOR FORT ST. VRAIN*

PATHWAY = COW MILK
AGE GROUP = ADULT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	4.69E 02	4.69E 02	0.00E 00	4.69E 02	4.69E 02	4.69E 02	4.69E 02	4.69E02

PATHWAY = COW MILK
AGE GROUP = TEEN

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	6.10E 02	6.10E 02	0.00E 00	6.10E 02	6.10E 02	6.10E 02	6.10E 02	6.10E02

PATHWAY = COW MILK
AGE GROUP = CHILD

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	9.63E 02	9.63E 02	0.00E 00	9.63E 02	9.63E 02	9.63E 02	9.63E 02	9.63E02

PATHWAY = COW MILK
AGE GROUP = INFANT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.46E 03	1.46E 03	0.00E 00	1.46E 03	1.46E 03	1.46E 03	1.46E 03	1.46E03

*R Values in units of mrem/yr per $\mu Ci/m^3$

DOSE CONVERSION FACTORS (R VALUES) FOR FORT ST. VRAIN*

PATHWAY = GOAT MILK
AGE GROUP = ADULT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	9.57E 02	9.57E 02	0.00E 00	9.57E 02	9.57E 02	9.57E 02	9.57E 02	9.57E02

PATHWAY = GOAT MILK
AGE GROUP = TEEN

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.24E 03	1.24E 03	0.00E 00	1.24E 03	1.24E 03	1.24E 03	1.24E 03	1.24E03

PATHWAY = GOAT MILK
AGE GROUP = CHILD

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	1.97E 03	1.97E 03	0.00E 00	1.97E 03	1.97E 03	1.97E 03	1.97E 03	1.97E03

PATHWAY = GOAT MILK
AGE GROUP = INFANT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	2.99E 03	2.99E 03	0.00E 00	2.99E 03	2.99E 03	2.99E 03	2.99E 03	2.99E03

*R Values in units of mrem/yr per $\mu Ci/m^3$

DOSE CONVERSION FACTORS (R VALUES) FOR FORT ST. VRAIN*

PATHWAY = INHALATION
AGE GROUP = ADULT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	7.68E 02	7.68E 02	0.00E 00	7.68E 02	7.68E 02	7.68E 02	7.68E 02	7.68E02

PATHWAY = INHALATION
AGE GROUP = TEEN

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	5.11E 02	5.11E 02	0.00E 00	5.11E 02	5.11E 02	5.11E 02	5.11E 02	5.11E02

PATHWAY = INHALATION
AGE GROUP = CHILD

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	6.83E 02	6.83E 02	0.00E 00	6.83E 03	6.83E 02	6.83E 02	6.83E 02	6.83E02

PATHWAY = INHALATION
AGE GROUP = INFANT

NUCLIDE	TOTAL BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
H3	3.94E 02	3.94E 02	0.00E 00	3.94E 02	3.94E 02	3.94E 02	3.94E 02	3.94E02

*R Values in units of mrem/yr per $\mu Ci/m^3$

MONTHLY SOUTH PLATTE RIVER LOW FLOW RATES
(in cubic feet per second)

Month	Upstream S. Platte Q_{UPS}	Upstream St. Vrain Q_{USV}	Downstream Total Q_{DSP}
January	308	97	405
February	147	102	249
March	56	84	140
April	46	72	118
May	46	72	118
June	77	68	145
July	44	174	218
August	58	118	176
September	5	114	119
October	5	114	119
November	21	109	130
December	250	97	347

Actual Downstream Dilution Flow Rates

Month	Flow Rate (gpm)
January	182,000
February	112,000
March	63,000
April	53,000
May	53,000
June	65,000
July	98,000
August	79,000
September	53,000
October	53,000
November	58,000
December	156,000

ODCM BACKGROUND INFORMATION

Radioactive Liquid and Gaseous Waste System Background

1. The radioactive liquid and gaseous waste treatment systems are designed to ensure compliance with 10 CFR 20 and 10 CFR 50, Appendix I.

2. The Radioactive Liquid Waste System, System 62, is designed to collect, treat, and permit sampling, analysis and monitoring of all potentially radioactive liquid wastes discharged from the reactor plant, and is described in Section 2.3.3.10 of the Decommissioning Plan. Radioactive liquid waste is collected, monitored, and processed, if necessary, by the radioactive liquid waste system before being discharged from the plant. Effluent from the radioactive liquid waste system is diluted in the cooling tower blowdown/bypass line. The activity in the cooling tower blowdown/bypass line is maintained below the maximum permissible concentration (MPC) specified in 10 CFR 20.

3. The Radioactive Gas Waste System, System 63, (Decommissioned in mid-1993), was designed to collect, treat, and permit sampling, analysis, and monitoring of potentially radioactive gases discharged from the plant, and is described in Section 2.3.3.11 of the Decommissioning Plan. All radioactive gases currently being released are directed to the reactor building ventilation system, filtered, and discharged at high velocity at the top of the reactor building, about 180 ft. above grade. Averaga offsite radioactivity concentrations are significantly less than the MPCs specified in 10 CFR 20.

4. Solid radioactive wastes may be processed onsite or sent offsite for volume reduction or other processing. These processing activities, as well as activities associated with the packaging, storing, and shipping of radioactive wastes, are described in Section 3.3 of the Decommissioning Plan.

Equipment Descriptions

1. Liquid Effluent Activity and Flow Rate Monitors, RT-6212, RT-6213, FS-4101-1

   Two redundant activity monitors, RT-6212 and RT-6213, are provided in the radioactive liquid waste discharge line, arranged in one-out-of-two logic. Upon detection of high concentrations of gross gamma activity, these activity monitors will automatically alarm, shutdown the Liquid Waste Transfer Pumps, shutdown the Reactor Building sump pumps, and shut the block valves in the liquid waste discharge line. A flow switch, FS-4101-1, is provided in the cooling tower bypass/ blowdown line to automatically alarm, shutdown the Liquid Waste Transfer Pumps, shutdown the Reactor Building sump pumps, and shut the block valves in the liquid waste discharge line in the event of low cooling tower bypass/ blowdown flow conditions that would not provide sufficient dilution of radioactive liquid effluent.

2. Air Flow Measurement

   Ventilation system flow is measured at the outlet of the system. Above-normal flow rates are alarmed to ensure that allowable activity release rates are not exceeded.

1.0 Radiological Environmental Monitoring Program

1.1 A Radiological Environmental Monitoring Program shall be conducted in accordance with Table F-1.

1.2 The radiological environmental monitoring samples shall be collected from the specific locations given in table F-1, and shall be analyzed pursuant to the requirements of Table F-1 and the detection capabilities required by Table F-2.

1.3 If a confirmed measured radionuclide concentration in an environmental sampling medium averaged over any quarter sampling period exceeds the reporting level given in Table F-3, a special report shall be submitted to the Nuclear Regulatory Commission within 30 days.

1.4 Analytical techniques used shall be such that the detection capabilities in Table F-2 are achieved.

1.5 Radiological sampling station locations shall be delineated in maps and in written descriptions contained in each Annual Radiological Environmental Monitoring Report. All changes in sampling station locations which occur through the year shall be explained in each annual report.

1.6 Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment, and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the annual report.

1.7 If milk or fresh leafy vegetable samples are unavailable from one or more of the sample locations required by Table F-1, locations for obtaining replacement samples shall be identified and added to the Radiological Environmental Monitoring Program within 30 days. The specific locations from which samples were unavailable may then be deleted from the monitoring program. The cause of the unavailability of samples and the new location(s) for obtaining replacement samples shall be identified in the next Annual Radiological Environmental

Monitoring Report. The report shall also include a revised figure(s) and table for the ODCM reflecting the new location(s).

1.8 Analyses shall be performed on radioactive materials supplied as part of a documented inter-laboratory comparison program.

1.8.1 Analysis shall be performed on radioactive samples supplied by the EPA crosscheck program. This program involves the analysis of samples provided by a control laboratory as well as with other laboratories that receive portions of the same samples. Media used in this program (air, milk, water, etc.) may be limited to those found in the radiation monitoring program.

1.8.2 A summary of the results of analysis performed as part of the cross- check program shall be included in the Annual Radiological Environmental Monitoring Report.

1.8.3 The EPA uses the term, Estimated Laboratory Precision (ELP), calculated as $3\sigma/N$, as the control parameter where N= the number of analyses. Whenever mean values fall outside this limit, the sample calculations are rechecked and the sample reanalyzed if possible.

__NOTE:__ **If analysis are not being performed as required, corrective actions taken to prevent recurrence shall be reported to the Nuclear Regulatory Commission in the Annual Radiological Environmental Operating Report.**

1.9 A land use census shall be conducted annually during the growing season to determine the location of the nearest resident, the nearest milk animal, and the nearest garden greater than 65 square meters producing broad leaf vegetation within a distance of 8 kilometers (5 miles). The results of the land use census shall be reported in the Annual Radiological Environmental Operating Report.

1.9.1 When the land use census identifies a location(s) that yields a calculated dose or dose commitment greater than the values currently being calculated in the ODCM, the new location(s) will be identified in the next Annual Radiological Environmental Operating Report.

1.9.2 If it is learned from this census that the milk animals or gardens are present at a location which yields a calculated dose or dose commitment 20% greater than those previously calculated, or if the census results in changes in the sampling location, a written report shall be submitted in the next Annual Radiological Environmental Operating Report identifying the new location (distance and direction). Milk animals or garden locations resulting in 20% higher calculated doses shall be added to the monitoring program within 30 days or as soon as practicable.

1.9.3 The sampling location (excluding the control sample location) having the lowest calculated dose may then be dropped from the surveillance program at the end of the grazing or growing season during which the census was conducted. Any location from which milk can no longer be obtained may be dropped from the monitoring program after notifying the Nuclear Regulatory Commission in writing that milk samples are no longer obtainable at that location.

TABLE F-1
DECOMMISSIONING RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations	Sampling Collection Frequency	Type and Frequency of Analysis
AIRBORNE			
Tritium and Particulates	Samples from seven locations: Four samples from offsite locations(in different sectors) of the highest historic calculated annual average airborne X/Q and resultant ground level D/Q. One sample from the vicinity of a community having the highest historic calculated annual average ground level D/Q. Two samples from control location 15 to 30 kilometers (10 to 20 miles) distant and in the direction of the lowest historic calculated X/Q.	Continuous sampler operation with sample collection weekly or as required by dust loading, whichever is more frequent.	Liquid scintillation counting for tritium in water vapor extracted from silica gel on each sample collected. Particulate Sampler: Gross beta radioactivity following filter change, gamma isotopic quarterly on composite (by location).*

*If gross beta activity is greater than ten times the yearly mean of control samples for any medium, gamma isotopic analysis should be performed on the individual samples.

TABLE F-1 (Continued)
DECOMMISSIONING RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations	Sampling Collection Frequency	Type and Frequency of Analysis
DIRECT RADIATION	Forty-one stations with two or more dosimeters to be placed as follows: 1) an inner ring of stations in the general area of the site boundary and an outer ring in the 1.6 to 8 kilometer range from the site with at least one station in each sector of each ring; others shall be placed in special interest areas such as population centers, nearby residences, schools, and control stations.	Quarterly	Gamma Exposure Rate on each dosimeter collected.

TABLE F-1 (Continued)
DECOMMISSIONING RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations	Sampling Collection Frequency	Type and Frequency of Analysis
WATERBORNE Surface	Samples from 9 locations:		
	One sample upstream from each stream, one sample downstream from each stream	Samples collected monthly	Gamma isotopic analysis and tritium on each sample collected
	o One sample in immediate area of farm pond discharge	Composite continuous sample over one week period. Composite collected weekly	Gamma isotopic analysis and tritium on each sample collected

TABLE F-1 (Continued)
DECOMMISSIONING RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations	Sampling Collection Frequency	Type and Frequency of Analysis
Ground	Samples from two sources down gradient from the plant	Quarterly	Gamma isotopic and tritium on each sample collected
Drinking	One sample from the nearest drinking water supply which could be affected by facility's discharge	Weekly	Tritium, gross beta*, and gamma isotopic analyses on composite, every 2 weeks
	One sample from a control location	Weekly	Tritium, gross beta*, and gamma isotopic analyses on composite, every 2 weeks
SEDIMENT	Samples from 2 locations:		
	One sample from downstream area with existing or potential recreational value	Semi-annually	Gamma isotopic analyses on each sample collected
	One sample in effluent pathway	Monthly	Gamma isotopic analyses on each sample collected

*If gross beta activity is greater than ten times the yearly mean of control samples for any medium, gamma isotopic analysis should be performed on the individual samples.

TABLE F-1 (Continued)
DECOMMISSIONING RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations	Sampling Collection Frequency	Type and Frequency of Analysis
MILK	Samples from 5 locations:		
	One sample from each dairy in at least two locations, within 5 kilometers.	Monthly	Gamma isotopic and tritium on each sample collected.
	One sample from each dairy in at least two locations between 5 to 8 kilometers.	Monthly	Gamma isotopic and tritium on each sample collected.
	One sample from a dairy at a control location 15 to 30 kilometers distant and in the direction of the lowest historic calculated X/Q.	Monthly	Gamma isotopic and tritium on each sample collected.

TABLE F-1 (Continued)
DECOMMISSIONING RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations	Sampling Collection Frequency	Type and Frequency of Analysis
FISH	Samples from 3 locations:		
	One in vicinity of effluent discharge point, one sample upstream and one sample downstream.	Semi-annually	Gamma isotopic analyses on each sample collected
FOOD PRODUCTS	One sample each of at least five varieties of vegetables that are commonly grown in the area for human consumption which is irrigated by water in which liquid plant wastes have been discharged and/or are in the direction of the historic highest calculated X/Q.	Annually, at time of harvest	Gamma isotopic analyses on each sample type collected
	Tissue samples (muscle and liver) from one head of beef cattle that graze near effluent discharge pathway.	Semi-annually	Tritium and gamma isotopic analyses on each sample collected

TABLE F-2
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS
LOWER LIMIT OF DETECTION (LLD)[a,b]

Analysis	Water (pCi/ℓ)	Airborne Particulate or Gas (fCi/m³)	Fish (pCi/kg,wet)	Milk (pCi/ℓ)	Food Products (pCi/kg,wet)	Sediment (pCi/kg,dry)
Gross Beta	4	5				
H-3	2000					
Cs-134	15	9	130	15	60	150
Cs-137	18	8	150	18	80	180
Mn-54	15		130			
Co-60	15		130			
Zn-65	30		260			

NOTE: This list does not mean that only these nuclides are to be detected and reported. Other peaks which are identifiable and measurable, together with the above nuclides, shall also be identified and reported.

See footnotes on the following page.

* The LLD is defined for purposes of these specifications as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

a.1 For a particular measurement system which may include radiochemical separation:

$$LLD = \frac{2.71 + 4.66\sqrt{B}}{T \cdot E \cdot V \cdot 2.22E6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above as microcuries per unit mass or volume,

$\sqrt{B}$ is the standard deviation of the total background counts or of the total counts of a blank sample, as appropriate, as counts,

T is the count time of background in minutes,

E is the counting efficiency as counts per disintegration or counts per gamma for gamma spectroscopy,

V is the sample size in units of mass or volume,

2.22E6 is the number of disintegrations per minute per microcurie, (dpm/μCi),

Y is the fractional radiochemical yield when applicable and/or the gammas per disintegration when applied to gamma spectroscopy,

λ is, if radioactive decay correction is applicable, the radioactive decay constant for the particular radionuclide,

Δt is the elapsed time between the sample collection and time of counting.

a.2 Values of E, V, Y, and Δt, which are appropriate to the sample, should be used in the calculation.

a.3 It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLD's will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLD's unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.

[b]Lower limit of detection for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

TABLE F-3
REPORTING LEVELS FOR NON-ROUTINE OPERATING REPORTS
REPORTING LEVEL (RL)

Analysis	Water (pCi/ℓ)	Airborne Particulates or Gas (fCi/m^3)	Fish (pCi/kg,wet)	Milk (pCi/ℓ)	Broad Leaf Vegetation (pCi/kg, wet)
H-3	20000*				
Mn-54	1000		30000		
Co-60	300		10000		
Zn-65	300		20000		
Cs-134	30	10	1000	60	1000
Cs-137	50	20	2000	70	2000

*For drinking water samples. This is 40 CFR Part 141 value.

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS
(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
Direct Radiation	F-1	Pole by gate to Goosequill road on dirt extension of CR 21.	1	1.3
	F-2	21st pole N of ditch on dirt extension of CR21 just before road drops down to river bottom.	2	1.1
	F-3	17th pole N of ditch on dirt extension of CR 21 or first pole N of East-West road.	3	0.7
	F-4	15th pole N of ditch on dirt extension of CR 21, S of pump road, midway between F-3 and F-5.	4	0.7
	F-5	11th pole N of ditch on dirt extension of CR 21, near drive to pump house.	5	0.6
	F-6	8th pole N of ditch on dirt extension of CR 21, by East-West concrete Ditch, S of bridge	6	0.8
	F-7	Old dairy barn, 1st pole N after crossing ditch on dirt extension of CR 21.	7	1.2
	F-8	1st pole W of pump house on N side of road, 0.4 km E of CR 19-1/2.	8	1.3
	F-9	Pole East of first shed south side of intersection of CR 19-1/2 and CR 34.	9	1.5

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS
(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
	F-10	Pole on NW corner of intersection of dirt extension of CR 19 and 34.	10	1.5
Direct Radiation	F-11	7th pole N of intersection of dirt extension of CR 19 with CR 34.	11	1.2
	F-12	0.5 km S of FSV Visitor Center, take dirt road W across field, go into farmyard of Aristocrat Angus. (If chain across road, enter from CR 36). TLD is located on pole at SE corner of corral across from Aristocrat Angus office.	12	1.0
	F-13	Take first dirt road S of Visitor Center. Go W across railroad tracks, follow dirt road to metal staircase going down off dike. TLD is taped to railing.	13	0.5
	F-14	2nd pole 0.1 km S intersection CR 36-1/2 and Rd 19.	14	1.5
	F-15	2nd pole 0.7 km S of intersection of CR 38 on CR 19.	15	1.5
	F-16	Pole at NE corner of potato cellar at 3 Bar Ranch (Russell's).	1	1.2
	F-17	Visitor Center, on N end of cross beam over entrance.	13	0.2
	F-18	Pole closest to house on SW corner, 17250 CR 19-1/2. The address of 17250 is taped to the Mountain Bell underground cable warning post.	16	0.8

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS
(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
	A-1	Pole on NW corner of intersection of CR 44 and CR 21.	1	6.7
Direct Radiation	A-2	Pole on NE corner of intersection of CR 42 and CR 25-1/2	2	6.8
	A-3	Pole on NE corner of intersection of CR 42 and CO 60.	3	7.5
	A-4	1st pole NE of intersection of CR 29 and CR38, take CR 29 E out of Gilcrest to CR 38.	4	7.4
	A-5	SE corner of CR 34 and CR 29. Taped to road sign on SW corner of intersection.	5	7.2
	A-6	Pole on S side of CR 32 near drive to dairy 13278 CR 32.	6	7.1
	A-7	Niles Miller dairy. 0.4 km E of US 85 on 12854 CR 30. TLD is located on pole at NE corner of house.	7	7.3
	A-8	On CO 66 (CR 30) farm on S side of road (address 9476) Pole in front of house.	8	4.7
	A-9	Corner of CO 66 (CR 30) and CR 19, Miller produce stand. Second pole S on CR 19, on E side of road.	9	4.6
	A-10	Pole on SE corner at intersection CR 26-1/2 and CR 15.	10	7.8

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS
(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
	A-11	At intersection of CO 66 and CR 13, 2nd pole N of intersection on E side of CR 13.	11	7.2
Direct Radiation	A-12	On CR 34, pole E of house N of Lake Thomas 2 km from I-25.	12	7.2
	A-13	Pole opposite lake, N of silage pits E side of CR 13 2.9 km N of CR 34.	13	5.8
	A-14	Intersection of CR 13 and CR 40, NW corner.	14	6.9
	A-15	Intersection of CR 42 and CR 15, NW corner.	15	6.7
	A-16	Intersection of CR 44 and CR 19, SW corner.	16	6.8
	A-17	Platteville school (S edge of town on Main Street) pole on NW corner just outside school intramural field.	6	5.9
	A-20	1st pole N of white picket fence and driveway into turkey farm on S end of building that is parallel with CR 19.	9	2.5
	R-1	Milliken School, on CR 21-1/2. TLD is located on pole located at SE corner of Lola Park, across the street from school.		9.3
	R-2	Johnstown school (Letford Elementary), turn left at school crossing on Idaho St. onto Jay Ave. and proceed to school. TLD is located on pole at SE corner of main entrance to school on W side of town.		10.8

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS
(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
	R-3	CSU dairy farm on W Drake, N of Vet Hospital, Fort Collins, CO. Pole is E of hay barn next to railroad tracks on east side of road.		45.1
Direct Radiation	R-4	Air sampler corner US 287 and CO 66, Longmont Dairy Store. TLD is located on pole directly behind air sampler.		20.5
	R-7	Behind Gilcrest School quonset auditorium, pole on SW end of school property, just before garage.		9.3
Sediment	F-1	Sediment from confluence of Goosequill Ditch and Jay Thomas Ditch.	1	1.3
	R-10	Sediment from S. Platte River at bridge on CO 60.		10.1
Airborne	F-7	Farm at intersection of CR 21 and CR 34. Air sampler is located on west side of shop. Silica gel in mailbox next to air sampler.	7	1.5
	F-9	First shed along drive at end of Rd 19-1/2 intersection with Rd 34. Silica gel is located in shed.	9	1.5
	F-16	Potato cellar at 3 Bar Ranch (Russell's). Silica gel in mailbox on tree to S of pump.	16	1.2
	A-19	Hunting cabin between Goosequill ditch and Platte River. Air sampler is on W side of cabin, silica gel is in box on tree north of air sampler.	1	1.7

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS
(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
Airborne	R-11	Air sampler located on the North side of Johnstown Services Building, silica gel is inside mailbox.		10.5
	R-3	Colorado State University Dairy, W Drake Rd., Fort Collins, CO. W side of shed directly N of main dairy building. Silica gel inside mailbox.		45.1
	R-4	Intersection of US 66 and US 287, E side of dairy store, north edge of Longmont. Silica gel is in mailbox attached to utility pole.		20.5
Waterborne Surface	F-19	S Platte at dam located on dirt road E of pump house #3 directly E of reactor.	4	1.2
	F-20	St. Vrain creek on Rd 19-1/2, 0.3 km from discharge into St. Vrain Creek. Directly N of reactor.	16	1.5
	A-21	St. Vrain creek at bridge on Rd 34, E of Rd [illegible].	11	2.4
	R-10	S. Platte river at bridge on CO 60 where highway has just turned and headed south.		10.1
	A-25	Farm Pond outlet. Continuous sampler located in green box adjacent to the green shed on N end of pond.	1	2.2

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS

(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
Ground	F-16	Well behind residence at 3 Bar Ranch (Russell's), 17578 WCR 19-1/2.	1	1.2
	R-5	Well at 108 S. Grace, Milliken.		9.5
Drinking	R-6	Gilcrest U.S. Post Office located on Birch St. and Rd 40 off Hwy 85. Water taken from utility sink inside Post Office or outside hydrant.		9.3
	R-3	CSU dairy W. Drake Rd, Fort Collins, CO, North of Vet Hospital. Water sample is taken from hydrant in milking parlor or hydrant ~ 50 yds. north of air sampler.		45.1
Milk	A-18	Boos Dairy, 11258 W Rd 40, W of US 85 behind modular home.	2	4.7
	A-23	Leroy Odenbaugh Dairy, 11733 Rd 36, W of Rd 25.	4	4.1
	A-6	Henrickson Dairy, 13278 Rd 32 (Grand Avenue), 1.6 km E of US 85.	6	7.1
	A-28	Colorado Dairy, 7388 Hwy. 66	10	5.5
	A-26	James Docheff Dairy, 4513 WCR 32	11	7.8
	R-8	Borba Dairy, 2252 S CR 7, located off exit 255, West of I-25.		22.5
Fish	A-25	Farm pond outlet.	1	2.2

TABLE F-4
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING SITE DESCRIPTIONS

(F: Facility Area 0-1.6 km. A: Adjacent Area 1.6-8 km. R: Reference Area)

Exposure Pathway	Site No.	Location Description (see map)	Sector	Distance, km
Fish	F-19	S. Platte at dam located on dirt road E of pump house 3 directly E of plant.	4	1.1
	R-10	S. Platte River at bridge on CO 60.		10.1
Food Products	A-27	11247 Weld County Road 36.	4	4.3
	A-28	Residence 11399 WCR 40-1/2.	2	5.3
	R-6	Hernandez Produce Stand, Highway 85, Gilcrest		9.6
	F-16	Houston or Russell Ranch	15 or 16	1.2