UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

November 24, 1978

Mrs. Leo Drey
515 West Point Avenue
University City, MO 63130

Dear Mrs. Drey:

This is in response to your letters dated October 13 and 18, 1978, requesting additional information about our inspection program for the Combustion Engineering uranium fuel fabrication plant at Hematite, Missouri.

Enclosed with this letter is a copy of our most recent confirmatory measurements inspection of September 20 and October 17, 1978. Included in that report are results of environmental and effluent samples which were collected in May of 1978. Additionally, we are enclosing a copy of the final Environmental Impact Appraisal as requested in your letter.

The NRC has accepted the invitation of the Missouri Clean Water Commission to participate in a public hearing regarding public concerns over Combustion Engineering's radioactive effluent discharges. The meeting is tentatively scheduled for 1:00 p.m. on November 30, 1978, in Hillsboro, Missouri.

We hope the enclosed information will be helpful in resolving your concerns about this facility.

Sincerely,

James G. Keppler

James G. Keppler
Director

Enclosures:
1. Responses to questions
2. Final Environmental Impact Appraisal
3. IE Inspection Rpt No. 70-36/78-07

cc w/encl 1:
W. Lamar Miller, Ph.D., USEPA Region VII
Richard F. Rankin, MCWC
J. G. Davis, Acting Director, IE
J. H. Sniezek, IE
J. B. Martin, NMSS

Question 1, Paragraph 1 (not restated due to its length)

Answer

The attached inspection report, IE Report No. 70-036/78-07, paragraph 5 answers this question.

Question 1, Paragraph 2

Since sending my letter in June, I have become aware of the fact that chelates and other complexing agents are routinely used at many nuclear facilities to reduce the buildup of corrosion products within the pipes, etc. Furthermore, studies now indicate that these very chemicals have been found to cause an unexpected acceleration in the migration of radionuclides which had been discarded into liquid waste disposal pits and trenches (e.g., at the Oak Ridge burial grounds). Does Combustion Engineering use similar decontaminating chemicals at Hematite, and if so, how often and in what quantity?

Answer

The Combustion Engineering facility does not use chelates or other complexing agents for decontamination of the piping system.

Question 2

With regard to your answer to Question B.2: Would you please tell me what levels of uranium, thorium, and their daughter products were detected most recently in samples taken from the site evaporation pond monitoring wells? When you say the concentrations found were "well below permissible levels," am I correct in assuming you are referring to the levels permitted to be released beyond a plant's boundaries - - that is, based on the 500-millirem annual maximum allowed under 10 CFR 20.105?

Answer

The attached inspection report contains results of monitoring wells sampled in May of 1978. Table I also lists the appropriate MPC for those nuclides detected. The "permissible levels" to which we referred were the maximum permissible concentrations contained in 10 CFR 20, Appendix B, Table II. Further discussion on this point is contained in our answer to Question 4.e.

Question 3

Re. your answer to B.3: My copy of the draft EIA does not include Figure 1 which apparently lists the locations of the environmental monitoring stations for air, water, soil and vegetation - - including the two locations you mention at which soil samples were taken during the recent annual inspection. I noticed on page 5-12 of the EIA that at one of those stations the gross alpha in the soil increased from 8 picocuries per gram in September 1975 to 26 pCi/gm nine months later.

Is that a significant increase? Have core samples ever been taken from the sediments within the evaporation ponds, and if so, when were the most recent samples taken and with what results?

Answer

During the May 1978 inspection, the licensee and inspector split soil and vegetation samples from location 13 (see Figure 1). The results of these samples are in Table I of the attached inspection report. During the October 1978 inspection, the licensee and the inspector split another soil and vegetation sample and the inspector also collected a soil and vegetation sample from Pevely, MO. The Pevely sample will be used as a control (background) sample to compare with samples collected near the plant.

At this time, we have not received the licensee's results of the October 10 split samples. However, our results of the soil and vegetation samples show no statistical difference between the plant sample and the control sample.

Core samples have been taken from the sediment within the evaporation ponds. Samples were taken by the licensee during the first quarter of 1977. The results indicated a uranium concentration of 1840 ppm (wet weight). This corresponds to a total uranium activity of about 4200 pCi/gram.

The soil sample results to which you refer were as follows (Station No. 15):

Date	Gross alpha conc. in soil, pCi/g
9/75	8.0
11/75	26
2/76	15
5/76	26
3/77	4.2
6/77	10
9/77	14
10/77	14
3/78	5.9
6/78	3.2
9/78	6.6

When soil is selected as an environmental medium to be sampled, it is usually done because soil acts as a reservoir of radioactivity. Accordingly, data such as above are used to indicate trends, i.e., a buildup of radioactivity. The increase from 8 to 26 pCi/gram appears to be a normal fluctuation and is reasonably consistent with world-wide soil data, which indicate that a typical range of gross alpha activity is 4 to 18 pCi/gram.*

* "Environmental Radiation Measurements," National Council on Radiation Protection and Measurements (NCRP-50), December 27, 1976.

Question 4

Re. your answer to B.4: You mention that the license limits for discharges to the site evaporation ponds are 3 x 10^{-5} µCi/ml gross alpha and 2 x 10^{-5} µCi/ml gross beta, the same as the 10 CFR 20 maximum permissible concentrations for releases to unrestricted areas of uranium-235 and thorium-234, respectively.

a. *Does that mean the NRC allows Combustion Engineering to release radioactive liquid wastes to be evaporation ponds which could contain enough radioactivity to cause a 500-millirem annual whole body dosage, allows CE in addition to release liquid wastes to Joachim Creek which could cause a 500-millirem annual dosage, and further allows CE to release gaseous and particulate wastes through the plant's nine exhaust stacks which could cause an annual dose of 500 millirems? Please note that I have said, "could cause," not will cause. If this description of a potential tripling of the maximum permissible concentrations does not reflect the effluent monitoring and control system at the Hematite plant, would you please explain where I have erred? That is, must the technician who monitors CE's releases to the air, for example, also factor in the simultaneous releases to Joachim Creek and to the evaporation ponds in order to make certain that the total emissions from the plant stay within the 500-millirem maximum of 10 CFR 20.105? If so, how does he do this?*

Answer

The 500 mrem per year dose value contained in 10 CFR 20.105 and the MPC values in Appendix B require some elaboration:

(1) The 500 mrem (0.5 rem) per year value contained in 10 CFR 20.105(a) is an implied limit and is intended for radiation sources external to the body.

(2) The limits for radiation levels for sources external to the body are contained in 10 CFR 20.105(b)(1) and 20.105(b)(2), viz., 2 mrem per hour and 100 mrem per 7 consecutive days, respectively.

(3) The MPC values in 10 CFR 20, Appendix B, Table II are the permissible concentrations of individual radionuclides in unrestricted areas (e.g., offsite) and are applicable (except for noble gases) to sources internal to the body. A licensee such as Combustion Engineering is permitted by 10 CFR 20.106(d) to take credit for any dilution incurred from the point of release within a restricted area to the boundary of that area. The concentrations at the boundary of the restricted area must not, when averaged over a period not to exceed one year, exceed Appendix B, Table II values. Appendix B requires that for a

radionuclide mixture, the sum (for all radionuclides) of each radionuclide concentration divided by its respective MPC shall not exceed unity. The following example should serve to illustrate this point:

A licensee discharges Sr-90, Cs-137, and natural uranium through several vents to the atmosphere. Based on samples taken from these vents and by applying the appropriate atmospheric dispersion factor, the licensee determines that, based on an annual average, the highest concentrations of these nuclides at the boundary of the restricted area (e.g., the licensee's property line) are:

		MPC
Sr-90:	1E-11 μCi/cc	3E-11 μCi/cc
Cs-137:	7E-10 μCi/cc	2E-9 μCi/cc
U-nat:	1E-12 μCi/cc	5E-12 μCi/cc

Part 20, Appendix B requires that:

$$\frac{\text{Sr-90}}{\text{MPC(Sr-90)}} + \frac{\text{Cs-137}}{\text{MPC(Cs-137)}} + \frac{\text{U-nat}}{\text{MPC(U-nat)}} \leq 1.0$$

thus,

$$\frac{1\text{E-}11}{3\text{E-}11} + \frac{7\text{E-}10}{2\text{E-}9} + \frac{1\text{E-}12}{5\text{E-}12} \leq 1.0$$

and,

$$0.33 + 0.35 + 0.20 \leq 1.0$$

and,

$$0.88 \leq 1.0$$

Therefore, the licensee (in this example) is in compliance with 10 CFR 20, Appendix B, Table II, Column 1.

The MPC values in 10 CFR 20 were taken from values recommended by the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, and The Federal Radiation Council (the FRC no longer exists, but its radiation standard setting authority has been assumed by the USEPA). The values in Appendix B are for the critical organ (i.e., the one receiving the highest exposure) for the particular radionuclides in question. The limits used by these advisory bodies in calculating MPC values are as follows:

	limit, mrem/year
Whole Body	500
Thyroid	1500 (3000 for members of the population greater than 16 years old)
Bone	3000
Other Organs	1500

Thus, for the above example, the dose from atmospheric releases to the individual standing at the fenceline all year is:

Radionuclide	Critical Organ	(Col. a) Limit	(Col. b) MPC Fract.	(Col. a) x (Col. b) Organ Dose
Sr-90	Bone	3000	0.33	990 mrem/yr
Cs-137	Whole Body	500	0.35	175 mrem/hr
U-nat	Lung	1500	0.20	300 mrem/yr

Therefore, for the radionuclide mixture released to the atmosphere, different doses were received by the three critical organs, and each has been within the respective limits.

(4) A similar calculation would be required for liquid effluents, i.e., the licensee must show that concentrations in water at the boundary of the restricted area are within those permitted by 10 CFR 20, Appendix B, Table II, Column 2.

(5) A licensee must show, therefore, that gaseous and liquid effluent concentrations at the boundary of the restricted area do not exceed the Appendix B, Table II, Column 1 and Column 2 values, respectively.

The above example, although somewhat of a tutorial, was necessary to explain the relationship between effluent releases, permissible offsite concentrations, and radiation doses. It was a theoretical exercise - what could happen. The actual situation, however, is very different. The NRC Office of Nuclear Material Safety and Safeguards (NMSS) performed an analysis of the environmental impact of routine operation of the Combustion Engineering facility which was summarized in the Environmental Impact Appraisal. This analysis, which included the calculation of doses received from several environmental exposure pathways (drinking water, fish consumption, inhalation, and consumption of locally grown crops, meat, and milk), indicated that the bone and lung doses received by the nearest resident were less than 0.02 and 0.01 mrem per year, respectively. This dose is based on actual facility releases (gaseous and liquid) experienced

during 1975 (the values in the EIA), and is well within the 25 mrem per year environmental dose limit for uranium fuel cycle facilities to be imposed by the USEPA (40 CFR 190) on December 1, 1979.

Question 4.b

b. *According to your letter of July 19, 1978, Combustion Engineering was discharging an average of 35 gallons per day of radioactive waste water into its two evaporation ponds at that time. A year earlier when the draft EIA was published (February 14, 1977), apparently 100 gallons were being discharged per day into the ponds. Is there a limit on the number of gallons CE is allowed to discharge per day or year to the ponds -- or may any number of gallons be discharged as long as the concentration level in each gallon (in microcuries per milliliter of gross alpha or gross beta) is kept within the limits you mention? Would an increase in the number of gallons per day not cause an increase in the buildup of radioactivity accumulating in the pond? If there is a limit to the number of gallons allowed for the present plant, will this limit be increased when the plant's capacity is doubled as planned?*

Answer 4.b

There is no limit to the number of gallons that may be discharged to the evaporation ponds. An increase in gallons would result in an increase in radioactivity in the ponds, assuming concentrations remained unchanged.

Question 4.c

c. *According to the formula on page 3-13 of the EIA, it seems that the concentration limits of gross beta and gross alpha must each be reduced if both beta and alpha emitters are present in the wastes. The method mentioned is to keep the waste "quarantined in 55-gallon drums until the contained radionuclides decay to acceptable levels," before discharging the wastes to the ponds. With the half-lives of uranium and thorium lasting for millenia, I cannot imagine how many drums would be needed to store the radwaste until sufficient decay has taken place. Do you know how many drums are at the Hematite site now, and how many more are planned for the expanded facility? Is there a limit?*

Answer

The situation that you are referring to in your question has been resolved. An elevated gross beta activity in waste solution from UF_6 cylinder heel washing was discovered in early 1976. At that time, the licensee believed the source of the activity to be coming from Th-234 (first daughter of U-238). It was expected that this activity (half-life of 24 days) present in the wash solution would decay to acceptable levels in less than one year. Therefore, the licensee planned to store approximately 5000 gallons of this waste solution in 55 gallon drums. The first 600 gallons were stored for six months and the expected decay did not take place. The

licensee then sent samples to a consultant laboratory for analysis. The results indicated that the elevated gross beta activity was due to Tc-99 (half life of 2.1×10^5 years).

The licensee pursued this matter with NRC's Office of Nuclear Material Safety and Safeguards to clarify authorization to possess and process this waste. NRC granted permission to dispose of this waste. The waste was filtered through an ion exchange column and disposed of via the site evaporation ponds. All discharges were within the limits of 10 CFR 20, Appendix B, Table II. No credit was taken for adsorption on the soil beneath the ponds or for dilution in the ground water.

Question 4.d

d. *Would you please tell me what levels of beta and alpha the NRC inspectors have found when they have tested the liquid radwaste discharge prior to its release into the ponds? When were these tests last performed?*

Answer

We did not collect a sample of radwaste discharge to the evaporation ponds. Samples were collected from the laundry waste tank and the site pond for comparison with the licensee's results. These comparisons are presented in Table II of the attached inspection report.

Samples were taken from these sources because they represent the majority of radwaste liquid discharge directly to the environment. Comparative samples of radwaste discharges to the evaporation ponds will be collected during a future inspection.

Question 4.e

e. *Is fresh water used to dilute the liquid radwaste prior to its being measured for discharge to the ponds? If so, what is the ratio of fresh-to-contaminated water?*

Answer

Effluents from the wet scrubber system and UF_6 cylinder heel washing and processing operations in Building 240 are discharged to evaporation ponds located within the fenced plant area. Prior to discharge, this waste water is analyzed to ensure that uranium concentrations are within 10 CFR 20, Appendix B, Table II limits. There is no fresh water added for dilution purposes to the discharges to the evaporation ponds.

Question 4.6

6. Has an estimate ever been made of the quantity of undiluted radioactive materials released to the ponds in any one year?

Answer

Yes, uranium discharges to the site evaporation ponds for the period 7/1/74 to 7/31/78 totaled 12,418 grams. This represents an average of 253 grams of uranium per month. Because of the recent installation of an additional in-line filter, discharges for August and September 1978 averaged about 85 grams of uranium per month.

Question 5

5. Re. your answer to B.5: Can you tell me how much of the following nonradioactive chemicals were discharged to the site evaporation ponds in 1976 or 1977: fluorides, ammonium compounds, and nitrates? Do you know what quantity of each of these materials were released to Joachim Creek in 1976 or 1977? How much of an increase do you expect when the plant's capacity is doubled?

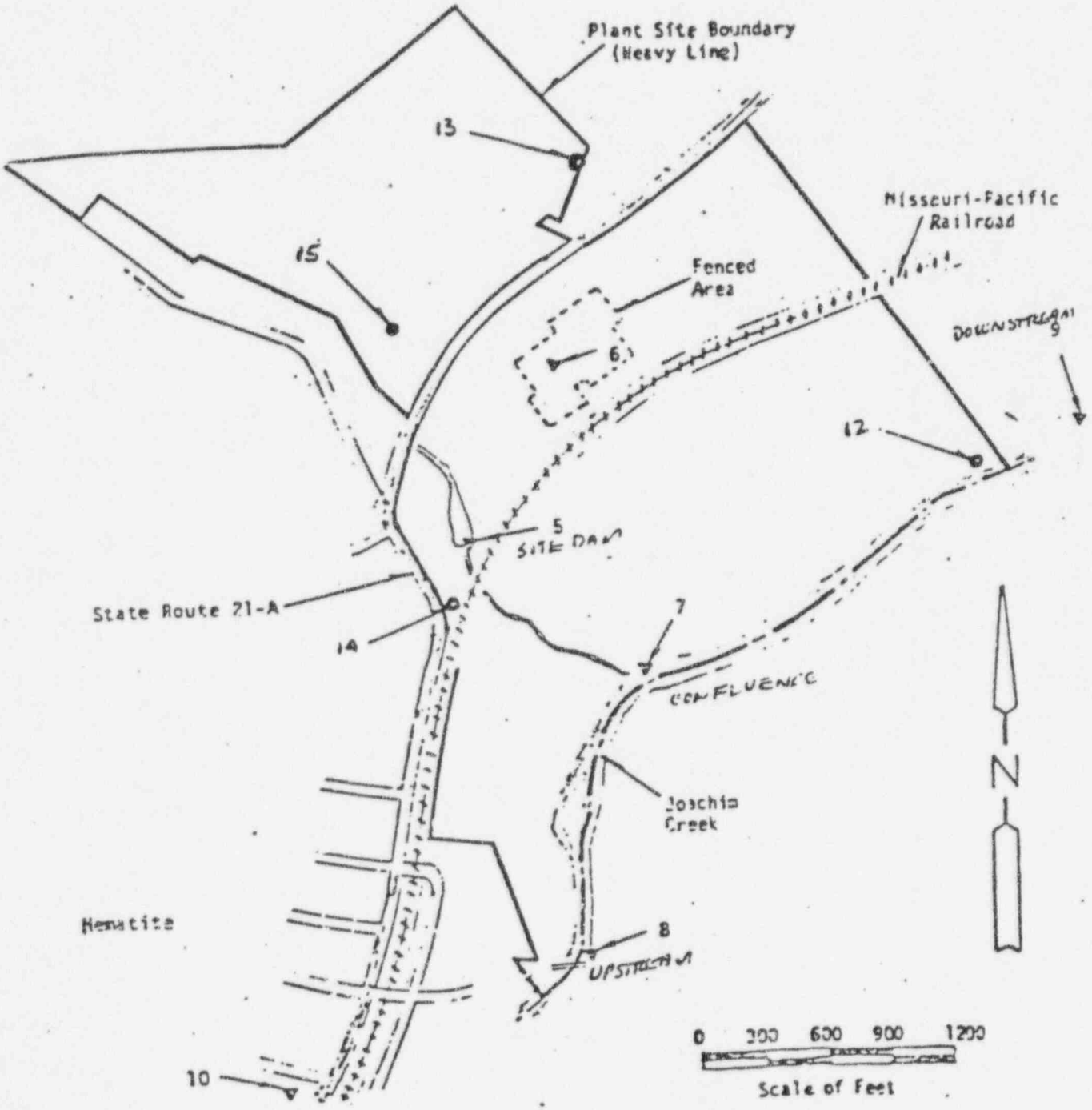
Answer

Currently, the licensee releases the following nonradioactive chemicals to the evaporation ponds. Nitrates are not released to these ponds.

Ammonium Fluoride	4.29 lbs/day
Potassium Fluoride	2.13 lbs/day
Potassium Hydroxide	0.45 lbs/day

Ammonium nitrate and potassium nitrate are released to the site pond which eventually flows into Joachim Creek. Quantities released of each of these materials are reported by the licensee to the Department of Natural Resources. We do not have these records and suggest that you contact the Missouri DNR.

We do not yet have an estimate of the quantities of fluoride compounds and potassium hydroxide that will be released to the evaporation ponds when the plant capacity is increased. This matter is undergoing a licensing review by NRC at this time.



12, 13, 14, 15 - Location of Soil and Vegetation Samples

Figure 1
Location of Environmental Samples