



KERN-McGEE ENGINEERING CORPORATION

KERN-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

November 20, 1975

40-8027

INSPECTION AND ENFORCEMENT



Mr. R. B. Chitwood, Chief
Technical Support Branch
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Chitwood:

Please refer to your letter of October 6 requesting additional information to support our submission of September 11, 1975. Attached to this letter as an Appendix is an answer to the general comments raised in your letter. The specific comments are answered below. Where appropriate an enclosure is provided.

1. Please see a copy of Regulation #15, "Control of Emissions of Organic Materials," of the OSHD, Air Quality Services. Page 6 provides the paragraph 15.33 which applies to our use.
2. Table III attached adds a reference for the column titled "Limits."
3. The calculation of the fluoride concentration in Table III was found to be in error. We have been unable to determine the source of the error. It has been corrected as shown by calculations in Enclosure 3, along with the revised Table III.
4. The UTL designation is that described in the reference noted and means the value which no more than one result in twenty samples shall exceed.
5. A revised Table V is enclosed showing the dilution at minimum flow.

As you will observe in the tables attached, we have discovered that several errors were made which have been corrected. We regret that these mistakes were not discovered on our earlier review.

Please let us know if we can supply additional information.

Very truly yours,

W. J. Shelley, Director
Regulation and Control

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Attachment

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Enclosure 1

Regulation No. 15

Control of Emissions of Organic Materials

15.1 Purpose

The purpose of this regulation is to control the emission of organic materials from stationary sources to protect and enhance the air quality to insure that the Oklahoma air quality standard is not exceeded and significant deterioration prevented.

15.2 Organic Materials

15.21 Storage of Organic Materials

15.211 No person shall build, sell, or install or permit the building or installation of any new stationary tank, reservoir or other container of more than 40,000 gallons (150,000 liters) capacity which will be used for storage of any organic materials, unless such tank, reservoir or other container is to be a pressure tank capable of maintaining working pressures sufficient at all times to prevent organic vapor or gas loss to the atmosphere or is designed, and will be built and equipped with one of the following vapor-loss control devices:

a. A floating roof, consisting of pontoon type, internal floating cover or double-deck type roof, which will rest on the surface of the liquid contents and be equipped with a closure seal, or seals, to close the space between the roof edge and tank wall. Such floating roofs are not appropriate control devices if the organic materials have a vapor pressure of 11 pounds per square inch absolute (568 mm Hg) or greater under actual conditions. All gauging and sampling devices shall be gastight except when gauging or sampling is taking place.

b. A vapor-recovery system consisting of a vapor-gathering system capable of collecting 85 percent or more of the uncontrolled organic material that would otherwise be emitted to the atmosphere; and vapor-disposal system capable of processing such organic material so as to prevent their emission to the atmosphere and with all tank gauging and sampling devices gastight except when gauging or sampling is taking place.

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c. Other equipment or means of equal efficiency for purposes of air pollution control as may be approved by the Commissioner.

- 15.212 No person shall build, sell, or install or permit the building or installation of a new stationary organic material storage tank with a capacity of 250 gallons (950 liters) or more unless such tank is equipped with a permanent submerged fill pipe or is equipped with an organic material vapor-recovery system as required in subsection 15.211.

15.22 Loading of Organic Materials

- 15.221 Loading facilities with through put greater than 40,000 gallons/day. No person shall build or install or permit the building or installation of a stationary organic material loading facility having a through put greater than 40,000 gallons per day from its aggregate loading pipes unless such loading facility is equipped with a vapor-collection and disposal system or bottom loading with closed hatches, properly installed, in good working order and in operation.

When loading in a vapor-collection and disposal system is effected through the hatches of a tank truck or trailer with a loading arm equipped with a vapor-collecting adaptor; pneumatic, hydraulic or other mechanical means shall be provided to force a vapor-tight seal between the adaptor and the hatch.

A means shall be provided in either system to prevent organic material drainage from the loading device when it is removed from any tank truck or trailer, or to accomplish complete drainage before removal.

When loading is effected through means other than hatches, all loading and vapor lines shall be equipped with fittings which make vapor-tight connections and which must be closed when disconnected or which close automatically when disconnected.

The vapor-disposal portion of the system shall consist of one of the following:

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a. A vapor-liquid absorber system with a minimum recovery efficiency of 90 percent by weight of all the organic material vapors and gases entering such disposal system.

b. A variable-vapor space tank, compressor, and fuel-gas system of sufficient capacity to receive all organic material vapors and gases displaced from the tank trucks and trailers being loaded.

15.222 Loading facilities with through put equal to or less than 40,000 gallons per day. No person shall build or install or permit the building or installation of a stationary organic material loading facility having a through put of 40,000 gallons (150,000 liters) per day or less from its aggregate loading pipes unless each is equipped with a system for submerged filling of tank trucks or trailers properly installed, in good working order and operating in such a manner that a 97 percent submergence factor is maintained.

Subsection 15.222 shall apply to any facility which loads organic materials into any tank truck or trailer designed for transporting organic materials and having a capacity in excess of 200 gallons (760 liters).

15.23 Effluent Water Separators

No person shall build or install or permit the building or installation of a single- or multiple-compartment organic material water separator which received effluent water containing 200 gallons (760 liters) a day or more of any organic material from any equipment processing, refining, treating, storing or handling organic materials unless the compartment receiving said effluent water is equipped with one of the following vapor-loss control devices, properly installed, in good working order and in operation:

a. A container having all openings sealed and totally enclosing the liquid contents. All gauging and sampling devices shall be gastight except when gauging or sampling is taking place. The oil removal devices shall be gastight except when manual skimming, inspection and/or repair is in progress.

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b. A container equipped with a floating roof, consisting of a pontoon type, double-deck type roof, or internal floating cover, which will rest on the surface of the contents and is equipped with a closure seal, or seals, to close the space between the roof edge and container wall. All gauging and sampling devices shall be gastight except when gauging or sampling is taking place. The oil removal devices shall be gastight except when manual skimming, inspection and/or repair is in progress.

c. A container equipped with a vapor-recovery system, consisting of a vapor-gathering system capable of collecting the organic material vapors and gases discharged and a vapor-disposal system capable of processing such organic material vapors and gases so as to prevent their emission to the atmosphere and with all tank gauging and sampling devices gastight except when gauging or sampling is taking place. The organic material removal devices shall be gastight except when manual skimming, inspection and/or repair is in progress.

d. Containers equipped with controls of equal efficiency provided such equipment is submitted to and approved by the Commissioner.

15.24 Pumps and Compressors

No person shall build or install or permit the building or installation of any pump or compressor handling organic material compounds unless rotating type pumps and compressors are equipped with mechanical seals or other equipment of equal efficiency; or reciprocating type pumps and compressors are equipped with packing glands properly installed and in good working order such that the emissions from the drain recovery systems are limited to two cubic inches of liquid organic material in any 15 minute period at standard conditions per pump or compressor.

15.25 Waste Gas Disposal

15.251 Ethylene Manufacturing Emissions

No person shall build or install or permit the building or installation of any ethylene manufacturing plant unless the waste-gas stream under normal operating conditions is properly burned at 1,300°F. for 0.3 seconds or greater in a direct-flame afterburner equipped with an indicating pyrometer which is positioned in the working area for the operator's ready monitoring or an equally effective catalytic vapor

incinerator also with pyrometer. Proper burning of the waste-gas stream is defined as reduction by 98 percent of the ethylene emissions originally present in the waste-gas stream.

15.252 Vapor Blowdown

Except where inconsistent with the "Minimum Federal Safety Standards for the Transportation of Natural and Other Gas by Pipeline," or any State of Oklahoma regulatory agency, no person shall emit organic gases to the atmosphere from a vapor recovery blow-down system unless these gases are burned by smokeless flares, or an equally effective control device as approved by the Commissioner.

15.26 Fuel-Burning and Refuse-Burning Equipment

No person shall cause or allow the emission of hydrocarbons or other organic materials from any fuel-burning or refuse-burning equipment. All such equipment shall be operated as to minimize such emissions. Among other things, such operation shall assure that the equipment is not overloaded, that it is properly cleaned and maintained, and that temperature and available air are sufficient to provide essentially complete combustion.

15.27 Exemptions and Definitions

Organic materials as used in subsections 15.21 through 15.26 will not include:

- a. Methane (CH_4) or any material otherwise included which has a vapor pressure of less than 1.5 pounds per square inch absolute under actual storage conditions.
- b. Crude oil defined as follows: Produced, non-refined hydrocarbon which has a gravity equal to or less than 50°API at 60°F. as measured in the stock tank, and when flashed to the atmospheric stock tank from the final lease separator and/or treating facility loses no more than 1.5 percent of the stock tank volume or 25 standard cubic feet per barrel of stock tank oil.
- c. The storage, loading, processing, manufacturing or burning of organic materials used for agricultural purposes on farms and ranches is exempted from all provisions of subsections 15.21 through 15.26.

15.3 Organic Solvents

15.31 Heat Drying

No person shall cause or allow the discharge into the atmosphere of more than 15 pounds of organic materials in any

one day, or more than 3 pounds in any one hour, from any article, machine, equipment or other contrivance in which any organic solvent or any material containing organic solvent comes into contact with flame or is baked, heat cured, or heat polymerized in the presence of oxygen, except as provided in subsections 15.35 and 15.36. Those portions of any series of articles, machines, equipment or other contrivances designed for processing a continuous web, strip or wire which emit organic materials and using operations described in this subsection shall be collectively subject to compliance with it.

15.32 Other Uses

No person shall cause or allow the discharge into the atmosphere of more than 40 pounds of organic materials in any one day, or more than 8 pounds in any one hour, from any article, machine, equipment or other contrivance for employing, applying, evaporating or drying any photochemically reactive solvent, or material containing such photochemically reactive solvent except as provided in subsections 15.35 and 15.36. Emissions of organic materials into the atmosphere resulting from air or heated drying of products for the first 12 hours after their removal from any article, machine, equipment or other contrivance described in this subsection shall be included in determining compliance with it. Emissions resulting from baking, heat curing, or heat polymerizing as described in subsection 15.31 shall be excluded from determination of compliance with this subsection. Those portions of any series of articles, machines, equipment or other contrivances designed for processing a continuous web, strip or wire which emit organic materials and using operations described in this subsection shall be collectively subject to compliance with it.

15.33 Use of Non-reactive Solvents

No person shall discharge into the atmosphere more than 3,000 pounds of organic materials in any one day, nor more than 450 pounds in any one hour, from any article, machines, equipment or other contrivance in which any non-photochemically reactive organic solvent or any material containing such solvent is employed or applied, unless said discharge has been reduced by at least 85 percent. Emissions of organic materials into the atmosphere resulting from air or heated drying of products for the first 12 hours after their removal from any article, machine, equipment, or other contrivance described in this section shall be included in determining compliance with this section. Emissions resulting from baking, heat-curing, heat-polymerizing as described

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in section 15.31 shall be excluded from determination of compliance with this section. Those portions of any series of articles, machines, equipment or other contrivances designed for processing a continuous web, strip or wire which emit organic materials and using operations described in this section shall be collectively subject to compliance with this section.

15.34 Clean Up with Reactive Solvents

Emissions of organic materials to the atmosphere from the clean up with photochemically reactive solvents, as defined in Regulation No. 3, of any article, machine, equipment or other contrivance described in sections 15.31 or 15.32 shall be included with the other emissions of organic materials from that article, machine, equipment or other contrivance for determining compliance with this rule.

15.35 Alternate Standard

Emissions in excess of those permitted by subsections 15.31 and 15.32 of this regulation are allowable if both the following conditions are met:

15.351 Emissions that would result in the absence of control are reduced by:

- a. 90 percent, by incineration; or
- b. 85 percent, by absorption or any other process of equivalent reliability and effectiveness, and

15.352 No air pollution, as defined by the Clean Air Act, results.

15.36 Exceptions

The provisions of subsections 15.31 through 15.34 shall not apply to:

- a. The spraying or other employment of insecticides, herbicides, or other pesticides for agricultural purposes on farms and ranches, or control of vectors detrimental to human health and welfare.
- b. The use of a "non" photochemically reactive solvent as defined and published by the Commissioner. Such

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publication should recognize the fact that all organic materials as defined in this regulation have been found to be reactive to a certain degree. Also included should be procedures for substitution of certain quantities of "non" reactive solvents allowed in subsections 15.31, 15.32, and 15.33 based on a comparison in reactivity of the various organic compounds.

15.4 Compliance Schedules

- a. All equipment and processes originally regulated under Regulation No. 15 and its effective date of July 1, 1972 must still abide by that date.
- b. In all areas except AQMA's, this regulation shall apply to all new installations of any equipment or processes described herein after the adoption of these amendments by the Oklahoma State Board of Health and submittal to the Secretary of State.
- c. Provisions of this regulation shall apply to all existing installations of any equipment or processes in use and described in this regulation only in Air Quality Maintenance Areas (AQMA's) as classified by the Environmental Protection Agency with regard to hydrocarbons and photochemical oxidants, and become effective on adoption by the Oklahoma State Board of Health and submittal to the Secretary of State; provided, however, that existing installations shall have six (6) months from the effective date within which to comply with this regulation.

APPENDIX

Response to general comments in letter of October 6, 1975, from R. B. Chitwood to W. J. Shelley, and reference to environmental information supplied by letter of September 11, 1975.

The basis used for the information on the tables has been developed generally from history of the operation of the plant where history is determinable. In some cases, sampling of effluent streams of very small concentrations of effluent contaminants has not been determined. In these cases, the calculations are made from a total material balance prepared by the architect engineering firm doing the detailed engineering on the plant expansion.

The basis for each table will be discussed individually.

Table I

On this table the data presented and compared with the submissions previously in regard to the original production plant originates from data measured at plant site.

1. NO_x

Regular measurements (30) of NO_x concentrations in stack gases were made in 1974. NO_x concentration averaged 317 ppm. The calculation attached allows for doubling the amount of NO_x released due to the production increase.

It should be noted that no allowance had been made for the generation of NO_x from the boiler. We have examined the available literature and stack concentrations during periods when the NO_x evaporator has not operated and conclude that the standard estimates made for gas-fired boilers of NO_x generation are in excess of our experience. It is believed that omitting an allowance for this source provides a conservative calculation of NO_x release.

2. SO_2

This contaminant originates from the need to add sulfuric acid to the uranyl nitrate hexahydrate in order to secure the optimum reactivity from

from the UO_3 produced. This reactivity permits more complete reaction in the hydrofluorination and fluorination steps. The amount added has varied from 1500 to 3000 ppm. The amount released has been calculated from the sulfuric acid added at a rate of 3,000 ppm on a uranium basis and allowing for approximately 10% of the sulfate to remain with the UO_2 from the reduction reactors. The balance is released with the burned excess H_2 after combustion to SO_2 (see calculation page).

3. Fluoride

Fluoride released to the off-gas is based upon fluoride found in the off-gas stack for the year 1974 which averaged $9.25 \mu\text{gm F/l}$ multiplied by the ratio of the production increase. The loss of fluorine and fluoride from the emergency vent is caused by the instrumented interruption of fluorine production (Q circuit trip) and the pressure in the fluorine headers is reduced from positive one-half inch of water to a negative one-half inch of water. The loss is only that which escapes from a volume of 800 ft^3 . For the expanded plant, the number of Q circuit trips per day has been doubled from the 6 per day now experienced to an estimated 12 per day. Each Q circuit trip releases 2.0 ft^3 . The fluorine upon hydrolysis by air is immediately converted to hydrofluoric acid.

The emergency vent is opened in each prolonged shutdown, approximately for 7 days, and it is estimated that 60% of the fluorine is displaced.

In addition to fluorine, hydrofluoric acid is lost from the fluorine side of the cells during prolonged shutdowns, and it is estimated that since the fluoride side is not purged as is the hydrogen side, 10% of the HF lost from the fluorine cells is estimated to be lost through the fluoride vent.

During initial operation, the fluorine vent header was purged on each Q circuit trip and during a prolonged shutdown. This purging was eliminated after some experience, and therefore the increase in fluoride released to the high stack is not proportional to the increase in production.

4. Hexane

The hexane loss assumes that all hexane consumed was lost by evaporation to the atmosphere and is proportional to the hours of operation of the solvent extraction plant. The calculation was then made as shown in the attached by expanding the 1974 losses to an estimated loss rate of 1978 based upon the hours of operation.

No credit was included for the effect of the installation of a hexane house condenser which will treat all vent gases from the hexane building. It is expected that this house condenser will be installed by January 1976.

Table II

Table II has been revised in its entirety. The assumptions made were entirely in error. All stack releases have been adjusted for 1974 experience and where applicable, expanded in accordance with the calculations shown for increased production.

Table III

This table presents the concentration of liquid effluent components measured on a routine basis and released at a point in the Illinois River channel of Robert S. Kerr Reservoir. Nominal dead water level of the reservoir is located between the outfall and the Highway 64 bridge.

1. Temperature

The inlet of raw water and the outfall temperature are measured daily as a part of the environmental sampling program. 1974 records illustrate a temperature difference which varies from 1.1° to 8.7° , depending upon the quantity of water and the period of the year. The 1974 average rate was 1,598 gallons per minute with an average temperature rise of 5.1° .

Approximately 50% of the heat is released from operations directly connected with production, the balance being released primarily from air conditioning and electrical cooling systems.

It is estimated that an additional 3.5×10^6 BTU/hr will be released by the increase in production provided by the expansion. While the addition of this amount of heat would have raised the water temperature by an additional 4.6° on the average, it was felt unwise to plan on this due to the variation in observed water temperatures at current heat loads. Consequently, provisions were made to increase the cooling water flow to 2500 gpm. As a consequence, the calculated temperature increase of the total effluent upon completion of the expansion is calculated to be 6° as compared to the current 5.1° . The temperature rise will not significantly change the receiving water temperature.

2. pH

pH of the outfall stream is determined by the operation of the fluoride treatment system. This system treats the fluoride containing waste with an excess of lime in order to reduce the solubility of calcium fluoride. After settling, the clarified stream from the system is adjusted by the addition of sulfuric acid to provide a controlled pH to meet Oklahoma Water Quality Criteria. The pH level is tested once each shift by sampling and laboratory analysis. No change in the present system is contemplated.

3. The next four items on Table III are total dissolved solids, dissolved oxygen, calcium carbonate, and chlorine. The level of these items is established by the incoming water supply and will continue to be the nominal value shown.

4. Sulfate

Sulfate in the outfall stream originates from the sulfuric acid consumed in adjusting the pH of the fluoride from the fluoride treatment basins. It is assumed that with two cell rooms, the water flow to the HF scrubber tower was doubled to maintain the current HF concentration and approximately double the amount of sulfuric acid will be needed to control the pH into the desired release range. Therefore, this quantity of sulfate originating from the fluoride pond is doubled to which is added a sulfate content of raw water of approximately 7.9 mg/l.

5. NH_3 and NO_3

No ammonia is released to the outfall and therefore we do not expect any change. Nitrate occurs naturally due to the background content of the water. The quantity shown is the average in raw water during 1974.

6. Fluoride

Fluoride in the outfall stream originates with the soluble fluoride remaining after treatment with calcium oxide to precipitate calcium fluoride. It is expected that with the addition in capacity that the amount of water to the HF scrubber will double and therefore the quantity of fluoride released will also double. However, since the quantity of outfall is not doubled the fluoride concentration will increase slightly in the outfall stream.

7. Uranium

In 1974 approximately .1% of uranium fed to the system as yellowcake appears in the outfall stream though no uranium containing process stream is discharged to this system. We have estimated that this proportion will continue in the future.

Comparison with FES

The data supplied on previous Environmental Reports have been used in all cases by the NRC staff to prepare the FES except for the quantity released to the atmosphere and the resultant dose levels. Since we do not have their worksheets, we cannot reconcile this difference. We are undertaking further work to better understand why in their independent review of data supplied different conclusions. We cannot explain this discrepancy at this time.

TABLE I

AIR-BORNE EFFLUENT SUMMARY

Level of Production

Present Level = 5000 Short Tons U/Yr., Expanded Level = 10,000 Short Tons U/Yr.

ITEM	Metric Tons per Month Level of Production		Grams per second Level of Production		Highest Concentration, $\mu\text{g}/\text{m}^3$ Distance: 1/2 mile Level of Production		Ambient Air Qty. Stds.
	Present	Expanded ⁽¹⁾	Present	Expanded	Present	Expanded	$\mu\text{g}/\text{m}^3$
NO _x	10.4 ⁽³⁾	18.6	3.96	7.07	1.98	3.54 WSW	100 ⁽⁴⁾
SO ₂	1.51 ⁽²⁾	4.13	0.574	1.56	0.287	0.78 WSW	60 ⁽⁵⁾
Fluoride	0.101 ⁽²⁾	0.174	0.12	0.066	Combined 0.115	0.252 SW	.5 ⁽⁶⁾
Fluoride (Ground)	0.030 ⁽²⁾	0.032	0.004	0.012			
Hexane	8.8 ⁽²⁾	14.0	3.69	5.33	*	*	15.88g/sec ⁽⁷⁾

(1) Information Source: Table II - page 24 June 1975 Environmental Information on Expansion.

(2) Information Source: Table XI(Revised) - page 12 Jan. 1973 App. Environmental Report Supplemental #2.

(3) Information Source: Historic Records - 1974 - No Allow. for Boiler Gen.

(4) EPA National Primary and Secondary Ambient Air Quality Standard.

(5) EPA National Secondary Ambient Air Quality Standard

(6) State of Washington Ambient Air Fluoride Standard

(7) Oklahoma State Health Department, Air Quality Services, Environmental Service - Guidelines for Interpretation and Enforcement of Regulation No. 15 (15.33)

TABLE I

NO_x CALCULATION

1974 Stack - Ave NO_x = 317 ppm
 Stack Ave Exhaust = 21,600 ACFM @ 360°F.
 Steam Rate = 36,000 pph

$$\frac{21,600 \text{ ACF}}{\text{min}} \times \frac{492^{\circ}\text{F}}{(460+360)^{\circ}\text{F}} \times \frac{60 \text{ min/hr}}{359 \text{ ft}^3/\text{lb mole}} \times \frac{317}{10^6} \times 46 \text{ lb/mole}$$

$$= 31.6 \text{ lbs NO}_2/\text{hr}$$

$$31.6 \text{ lb NO}_2/\text{hr} \times 2 \times .886 \text{ OT} \times 730 \text{ hr/mo} \times \frac{\text{MT}}{2200 \text{ lb}}$$

$$= 18.6 \text{ MT/mo}$$

$$18.6 \text{ MT/mo} \times \frac{10^6 \text{ gm}}{30.4 \text{ da} \times 24 \text{ hr} \times 3600 \text{ sec/hr}} = 7.07 \text{ gm/sec}$$

MAXIMUM GROUND LEVEL CONCENTRATION

$$7.07 \text{ gm/sec} \times \frac{.991 \text{ } \mu\text{g/M}^3 \text{ (1)}}{1.98 \text{ g/sec}} = 3.54 \text{ } \mu\text{g/M}^3$$

(1) Ratio Data from Dames & Moore Report, Applicants Environmental Report, June 1972

TABLE I

SO₂ CALCULATION

UNH to Boildown: 765 MT/mo

S added as H₂SO₄: .003 x 765 = 2.3 MT/mo

S released as SO₂: .9 x 2.3 = 2.06

SO₂ formed: $\frac{64}{32} \times 2.06 = 4.13$

Release Rate

$$\frac{4.1 \text{ MT/mo} \times 10^6 \text{ gm/MT}}{30.4 \text{ da/mo} \times 24 \text{ hr/da} \times 3600 \text{ sec/hr}} = 1.56 \text{ gm/sec}$$

Point of Maximum Concentration

$$1.56 \times \frac{.130 \text{ } \mu\text{gm/m}^3(1)}{.260 \text{ gm/sec}} = .78 \text{ } \mu\text{gm/m}^3$$

(1) Ratio Data from Dames & Moore Report, Applicants Environmental Report, June 1972

TABLE 1

AIRBORNE FLUORIDE RELEASED

ELEVATED

Scrubber Stack

1974 Average = 9.25 $\mu\text{g}/\text{l}$ F^-

1974 Release Rate

$$\frac{9.25 \text{ g}}{(10^6 \text{ l} \times 10^6 \text{ g/MT})} \times 28.32 \text{ l/ft}^3 \times 3000 \text{ ft}^3/\text{min} \times 60 \text{ min/hr} \times 730 \text{ hr/mon} = .0344 \text{ MT/mon}$$

$$\text{Expanded: } .0344 \times \frac{754 \text{ MTU}}{211 \text{ MTU}} = .123 \text{ MT/mon}$$

 F_2 Emergency Vent

Q-Circuit Trips

$$2.01 \text{ ft}^3 \times 12 \text{ trips/da} \times 30.4 \text{ da/mon} \times \frac{.886 \text{ On Time}}{2200 \text{ lb/MT}} \times \frac{38 \text{ lb/mole}}{380 \text{ ft}^3/\text{mole}} = .0295 \text{ MT/mon}$$

Shutdown Fluorine

$$\frac{365 \text{ da}(1-.886 \text{ O.T.})}{12 \text{ mon} \times 7 \text{ day}} \times .60 \text{ Release} \times \frac{800 \text{ ft}^3}{2200 \text{ lb/MT}} \times \frac{38 \text{ lb/mole}}{380 \text{ ft}^3/\text{mole}} = .0108 \text{ MT/mon}$$

HF - Historical Loss/Cell = .053 lb/hr HF

$$\frac{8760 \text{ hr}(1-.886)}{\text{yr.}} \times \frac{60 \text{ cells}}{2200 \text{ lb/MT}} \times \frac{.053 \text{ lb/hr}}{12 \text{ mon}} \times .1 \times \frac{19}{20} = .011 \text{ MT/mon}$$

TOTAL F^- ELEVATED RELEASE = .174 MT/mon

GROUND LEVEL

1974 Cell Rework Stack = .45 $\mu\text{g}/\text{l}$

Fan Rate = 15900 cfm

$$\frac{.45 \text{ gm}}{10^6 \text{ l}} \times \frac{1.59 \times 10^4 \text{ ft}^3}{\text{min}} \times \frac{28.32 \text{ l}}{\text{ft}^3} \times \frac{60 \text{ min}}{\text{hr}} \times \frac{730 \text{ hr}}{\text{mon}} \times \frac{\text{MT}}{10^6 \text{ gm}} \times \frac{754}{211} = .032 \text{ MT/mon}$$

TABLE I

FLUORIDE RELEASE RATE

$$\text{GROUND} \quad .032 \text{ MT/mon} \quad \frac{10^6 \text{ gm}}{\text{MT}} \quad \frac{1}{30.4 \text{ da/mo} \quad 24 \text{ hr/da} \quad 3600 \text{ sec/hr}} = .012 \text{ gm/sec}$$

$$\text{ELEVATED} \quad .174 \text{ MT/mon} \quad \frac{10^6 \text{ gm}}{\text{MT}} \quad \frac{1}{30.4 \times 24 \times 3600} = .066 \text{ gm/sec}$$

Maximum Ground Level Concentration

Combine ground level and elevated release and dilution per Dames & Moore Report, page 7, APP. ER June 1972

$$\begin{aligned} \text{Conc.} &= \left(\frac{X}{Q_G} Q_G + \frac{X}{Q_E} Q_E \right) 1 \times 10^6 \\ &= (1.93\text{E} - 5 \times .012 + 3.12\text{E} - 7 \times .066) 1 \times 10^6 \\ &= (2.316\text{E} - 7 + .205\text{E} - 7) 10^6 \\ &= 2.521\text{E} - 1 = .252 \text{ } \mu\text{gm/M}^3 \end{aligned}$$

TABLE I

HEXANE

1974 DATA

Consumption	32, 516 gals
Solvent Extraction Operation	3,769 hrs.

Calculated Release Rate

$$\frac{32,516 \text{ gal/yr}}{12 \text{ mon/yr}} \times \frac{8760 \text{ hr}}{\text{yr}} \times \frac{.886 \text{ O.T.}}{3769 \text{ hr/yr}} \times \frac{5.53 \text{ lb/gal}}{2200 \text{ lb/MT}} = 14 \text{ MT/mon}$$

$$14 \frac{\text{MT}}{\text{mo}} \times \frac{10^6 \text{ gm}}{30.4 \times 24 \times 3600} = 5.33 \text{ gm/sec}$$

TABLE II
RADIOLOGICAL AIRBORNE EFFLUENT

	1974 Measured g/mo	Estimate after Expansion g/mo	Release Rate $\mu\text{Ci/sec}(10^{-4})$	
			Insoluble	Soluble
Elevated				
Main Stack	21	75	.19	
Scrubber Stack	698	2494		6.36
			<hr/> .19	<hr/> 6.36
Ground Level				
Samp. Room	39	135	.34	
Roof Vents	1217	1217	2.79	.31
Roof Hatches	503	503	1.15	.13
Dust Collector	45	45	.10	.01
			<hr/> 4.04	<hr/> .45

DOSE - SW 1/2 Mile

Kidney .624 mrem
Bone .156 mrem
Lung 6.28 mrem

Table II

URANIUM RELEASE

Elevated

Main Stack

1974 x Prod Ratio = Est. Expanded

$$21 \times \frac{760}{212} = 75 \text{ gms/mo.}$$

$$\frac{72 \text{ gm/mo} \times .62 \text{ } \mu\text{Ci/gm}}{30.4 \text{ da/mo} \times 24 \text{ hr/da} \times 3600 \text{ sec/hr}} = .19 \times 10^{-4} \text{ } \mu\text{Ci/sec}$$

Scrubber

$$698 \times \frac{754}{211} = 2494 \text{ gm/mo}$$

$$\frac{2494 \times .67}{2.627 \times 10^6} = 6.36 \times 10^{-4} \text{ } \mu\text{Ci/sec}$$

Ground Level

$$\text{Sample Room } 39 \times \frac{756}{219} \times \frac{.67}{2.627 \times 10^6} = .34 \times 10^{-4} \text{ } \mu\text{Ci/sec}$$

$$\text{Roof Vents}^{(1)} 1217 \times 2.55 \times 10^{-7} = 3.11 \times 10^{-4}$$

$$\text{Roof Hatches}^{(1)} 503 \times 2.55 \times 10^{-7} = 1.28 \times 10^{-4}$$

$$\text{Dust Collector}^{(1)} 45 \times 2.55 \times 10^{-7} = .11 \times 10^{-4}$$

(1) Assume no change with production and 10% soluble.

Table II

DOSE FROM COMBINED ELEVATED AND GROUND LEVEL EFFLUENT AT POINT
OF MAXIMUM CONCENTRATION

$$\text{Dose} = (\text{DF}) \text{BR Time} \left(\frac{X}{Q_E} Q_E + \frac{X}{Q_G} Q_G \right)^{(1)}$$

SOLUBLE

$$\begin{aligned} \text{Dose} &= (\text{DF}) 2.32 \times 10^{-4} \times 3.154 \times 10^7 (3.12 \times 10^{-7} \times 6.36 \times 10^{-4} + \\ &\quad 1.93 \times 10^{-5} \times .45 \times 10^{-4}) \\ &= (\text{DF}) 7.31 \times 10^3 (1.98 \times 10^{-10} + 8.69 \times 10^{-10}) \\ &= (\text{DF}) 7.80 \times 10^{-6} \end{aligned}$$

$$\begin{aligned} \text{Dose: Kidney} &= 80 \times 7.80 \times 10^{-6} = .624 \text{ mrem} \\ \text{Bone} &= 20 \times 7.80 \times 10^{-6} = .156 \text{ mrem} \end{aligned}$$

INSOLUBLE

$$\begin{aligned} \text{Dose} &= (\text{DF}) 7.31 \times 10^3 (3.12 \times 10^{-7} \times .19 \times 10^{-4} + 1.95 \times 10^{-5} \times 4.04 \times 10^{-4}) \\ &= (5.93 \times 10^{-12} + 7.80 \times 10^{-9}) \\ &= (7.806 \times 10^{-9}) \\ &= (\text{DF}) 5.71 \times 10^{-5} \end{aligned}$$

$$\text{Dose: Lung} = 110 \times 5.71 \times 10^{-5} = 6.28 \text{ mrem}$$

⁽¹⁾ See Dames & Moore Report, June 1972 ER, p. 6.

TABLE III

LIQUID EFFLUENT SUMMARY

Level of Production
 Present Level = 5000 Short Tons U/yr. Expanded Level = 10,000 Short Tons U/yr.

ITEM	UNITS	AVG. (\bar{X}) RANGE (R)	Level of Production		ILL ^(*) ppm	ROBERT S. KERR ⁽⁵⁾	LIMITS	UTL ⁽¹⁾ ILL	UTL ⁽¹⁾ ARK
			PRESENT ⁽¹⁾	EXPANDED					
Temp	F	R	49°-78°	49°-78°	*	43.8-80.5	+5.0 entire stream ⁽³⁾		
pH		R	7.1-8.1	7.1-8.1	7.1-8.4	7.6-8.2	6.5 to 8.5 ⁽³⁾	6.5-8.5	6.5-8.5
TDS	mg/l	\bar{X} R	121 104-152	(²)	220-731	197-434	127 ILL. ⁽³⁾ 665 ARK. ⁽³⁾	144	860
D-02	mg/l	R	6.4-11.2	(²)		7.6-11.6	>6 ⁽³⁾		
CACO ₃	mg/l	R	55-80	(²)	92-410	88-102			
Cl	mg/l	\bar{X} R	7.5 1.05-20	(²)	1.2-300	48-150	12.1 ILL. ⁽³⁾ 1487 Ark. ⁽³⁾	17.2	1876
SO ₄	mg/l	\bar{X} R	15.83 11-21	22.8	3.2-33.0	29-56	12.5 ILL. ⁽³⁾ 139 Ark. ⁽³⁾	15.9	172
NH ₃	mg/l	R	0.2-0.7						
NO ₃	mg/l	\bar{X} R	1.4 0.8-2.0	1.4	0.0-7.8	1.7-17	10.16 ⁽⁶⁾		
F	mg/l	\bar{X} R	.72	.88	*	*	1.7 ⁽⁶⁾		
U	µci/ml	\bar{X} R	.05x10 ⁻⁵	.13x10 ⁻⁵		*	3x10 ⁻⁵ (7)		

* Information not available.

(1) Actual measurements, reported monthly to OWRB

(2) No increase is present due to nature of plant operations. Contaminants levels due to raw water concentrations.

(3) State of Oklahoma Standards, Okla. Water Quality Standards, 1973.

(4) Appraisal of the water and related land resources of Oklahoma, Region Nine, OWRB Report 1971

(5) Water Resources Data for Okla., USGS, 1974.

(6) USPHS Drinking Water Standards 1962.

(7) 10 CFR 20, App. B, Table II.

TABLE III

WATER TEMPERATURE

$$\text{Temperature Change} = \frac{\text{Heat Release}}{\text{Gpm} \times \frac{\#}{\text{g}} \times \frac{\text{min}}{\text{hr}} \times \frac{\text{BTU}}{^\circ\text{F} \times \text{lb}}}$$

Incremental

$$\Delta T = \frac{3.5 \times 10^6 \text{ BTU/hr}}{2450 - 1500 \times 8.33} = 7.37^\circ$$

Full Flow

$$\frac{1500 \times 5.1 + 950 \times 7.37}{2450} = 5.98^\circ$$

SO₄

$$\frac{5.81 \text{ MT}}{\text{mon}} \times \frac{10^9 \text{ mg}}{\text{MT}} \times \frac{\text{mon}}{103 \times 10^6 \text{ gal}} \times \frac{\text{gal}}{3.785 \text{ lb}}$$

$$= \frac{\text{Raw Water} \quad 14.9 \text{ mg/l}}{7.9}$$

$$\text{Total} \quad 22.8 \text{ mg/l}$$

TABLE III

FLUORIDE

1974 Discharge

Conc. - .72 mg/l

Avg. Water Flow - 1500

$$\frac{1500 \times .72 \times 2 \text{ times current}}{2450} = .88 \text{ mg/l}$$

URANIUM

1974 Feed - 2.623×10^6 kgs U as Yellowcake

Outfall - 2545 kgs

$$\frac{.001 \times 756 \text{ MT/mon} \times 10^9 \text{ mg/MT} \times .67 \times 10^{-3} \text{ } \mu\text{Ci/mg}}{103 \times 10^6 \text{ gal/mon} \times 3.785 \text{ l/gal} \times 10^3 \text{ ml/gal}} = .13 \times 10^{-5} \text{ } \mu\text{Ci/ml}$$

TABLE IV
1974 ILLINOIS RIVER ENVIRONMENTAL SAMPLES
(N,F - mg/l; U - $\mu\text{Ci}/\text{ml}$ $\times 10^{-6}$; α,β,Ra - pCi/l)

Upstream	Analysis	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Nitrate	0.2	0.2	0.5	0.8	0.6	0.2	0.5	0.3	0.2	0.2	0.1	0.6
	Fluoride	<0.5	<0.5	<0.5	<0.5	0.4	0.8	0.5	0.9	0.7	0.2	0.2	0.9
	Gross α	<8.	<8.	<8.	<8.	<8.	<8.	<7.	<8.		<14.		
	Gross β	<22.	<25.	<20.	<25.	<26.	<19.	<15.	<16.		<38.		
	Uranium	3.2	2.7	.7	.7	.7	.5	.5	.5	1.1	.5	3.1	.9
	226-Ra			<0.07			0.30						
Downstream	Nitrate	0.6	<0.2	0.4	0.7	0.4	0.2	0.5	0.3	0.1	0.4	0.1	0.6
	Fluoride	<0.5	<0.5	<0.5	0.7	0.8	0.2	0.3	0.3	0.6	0.3	0.2	0.3
	Gross α	<8.	<8.	<8.	<8.	15.	<8.	9.	20.		<14.		
	Gross β	<22.	<25.	<20.	<25.	<26.	<19.	<15.	<16.		<38.		
	Uranium	5.2	5.4	.9	.8	.6	.5	.7	.7	.5	.5	3.2	.5
	226-Ra			<0.07			0.14						

TABLE V

LIQUID EFFLUENT DISPERSION
(Chemical - mg/l, U - $\mu\text{Ci/ml}$)

	Combination Stream	Complete Mixing ⁽¹⁾	
		Avg.	Min.
Uranium	$.13 \times 10^{-5}$	$.0005 \times 10^{-5}$	$.097 \times 10^{-5}$
SO ₄	22.8	.087	16.9
NO ₃	1.4	.0054	1.04
Fluoride	.88	.0033	.65

- (1) Complete Mixing - is that portion of the contaminants attributable to the combination stream. As clearly indicated in Table III, this is a fraction of the contaminants in the river.

Dilution Factor:

Average Flow - 35 Yr. Avg. 1506 cfs

35 yr. Avg. Discharge Rate of Illinois River (Water Resources Data for Oklahoma, U.S. Geological Survey, 1973) = 1506 cfs
x 60 sec. = 90,360 cfm = 675,892.8 gpm.

$$\frac{\text{Seq. Disch. Rate (gpm)}}{\text{Ill. + Seq. River Disch. (gpm)}} = \frac{2600}{2600 + 675,892.8} = .0038$$

Minimum Flow - 9/16/59 - 2 cfs

$$\frac{\text{Seq Disch.}}{\text{Ill. Disch.}} = \frac{2600}{2 \times 448.8 + 2600} = .743$$