DOCKET NO. 40-8027

KERR-McGEE CORPORATION

KERR-McGEE BUILDING • OKLAHOMA CITY, OKLAHOMA 73102

April 10, 1970

For Div. of Compliance

Mr. Donald F. Harmon
Source and Special Nuclear Materials Branch
Division of Materials Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Reference: Source Material License SUB-1010, Docket 40-8027, Kerr-McGee Sequoyah Facility

Dear Mr. Harmon:

Kerr-McGee Corporation hereby files revised pages and a new Appendix B, dated April 10, 1970, for the reference license application and requests the issuance of an amended license which authorizes the disposal of liquid waste containing radioactive constituents by injection into the Sequoyah Disposal Well.

This revision and amendment request reflect only the proposed changes in our liquid waste disposal plan. The information and safety assessment requested by Mr. Nussbaumer's letter of February 11 are presented.

Attachment "A" to this letter lists the new and revised replacement pages, including a new Appendix B, which are submitted for incorporation in the license application.

We trust that this filing will facilitate an early issuance of an amended license authorizing the use of the Sequoyah Disposal Well.

Sincerely,

G. E. Wuller

G. E. Wuller
Nuclear Division-Staff Engineer
Licensing and Regulation

GEW:jws

Enclosure (12 copies)

1104

15

KERR-McGEE CORPORATION

NUCLEAR OPERATIONS

APRIL 10, 1970

ATTACHMENT "A"

Reference: License SUB-1010, Docket 40-8027
Kerr-McGee Sequoyah Facility

Subject: Summary list of replacement pages, Revision 4/10/70

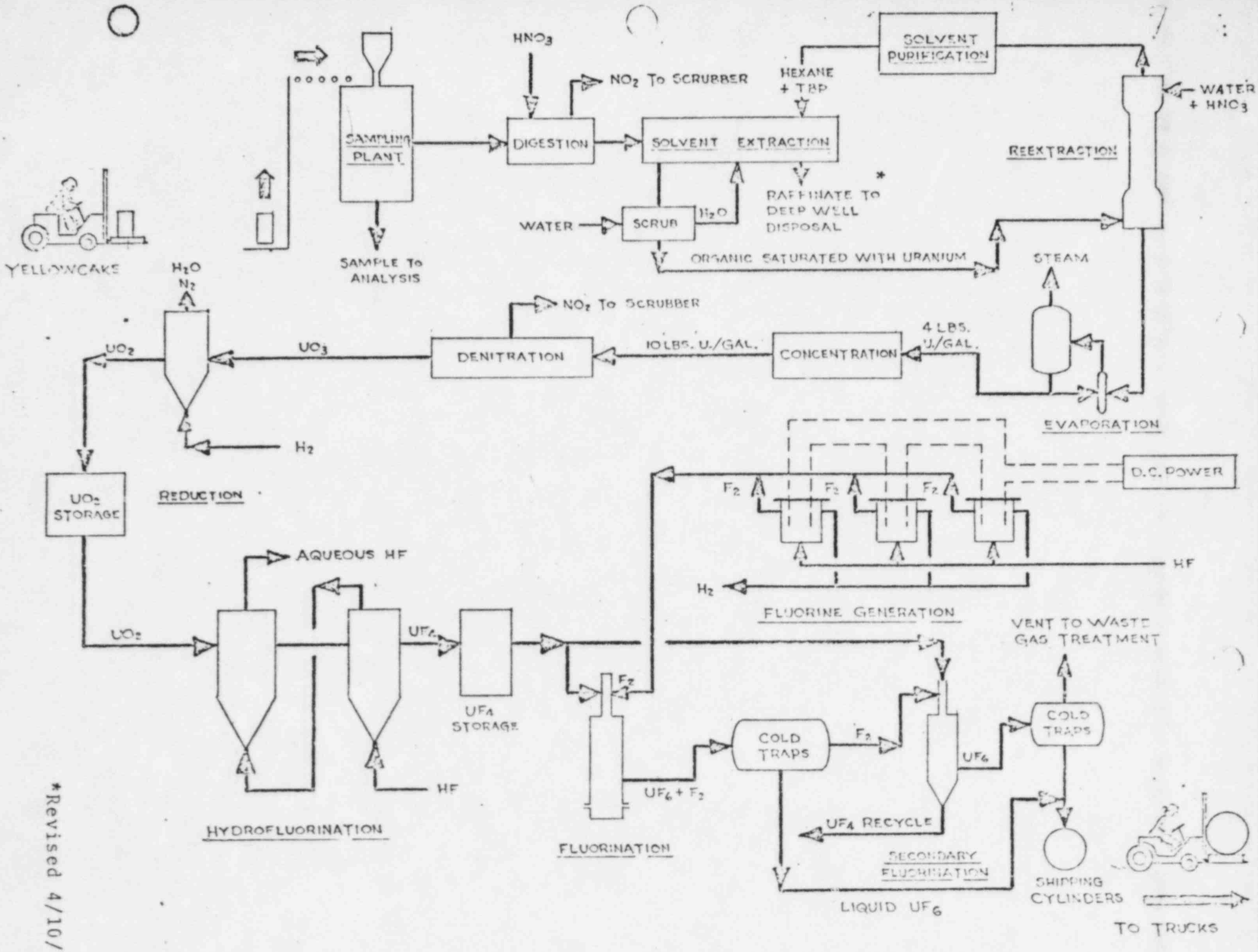
New Pages (4/10/70)	Revision Reason	Replaces Pages (2/3/70)
I-3	Added specific approval request to exceed 10CFR20 limits for well disposal.	I-3
Fig. III-2	Raffinate to well disposal	Fig. III-2
III-3	Raffinate to well disposal	III-3
IV-1 to IV-6.1 and Fig. IV-1 (7 pages)	Partial revision of Section IV - Waste Disposal to reflect waste well disposal	IV-1 to IV-6.1 (Figs. IV-1 and IV-2) (9 pages)
IV-7	Liquid waste releases	IV-7
Total 11 new pages plus Appendix B		Total 13 pages to be removed

a. Exemption is requested from the specific posting requirement of Section 20.203(e)(2) of 10CFR20 for areas and rooms within the plant. All entrances to the plant will be conspicuously posted in accordance with Section 20.203(e)(2) and with the words, "Any area or room within this plant may contain radioactive material."

b. Specific approval pursuant to 10CFR20.305 for incineration of contaminated combustible waste materials is requested. Incineration of radioactive contaminated waste will be conducted as described subsequently under the Waste Disposal section.

c. Specific approval pursuant to 10CFR20.302 is requested for disposal of radioactivity in liquid waste in excess of the limits of Appendix B, Table II of 10CFR20. Liquid waste releases to the unrestricted area will be made by deep well disposal as described subsequently in the Waste Disposal section.

*Revised 4/10/70



*Revised 4/10/70

After the uranium has been removed from the solvent, it is treated with ammonium sulfate-caustic to remove the residual uranium and TBP degradation products.

The raffinate from the extraction step (pumper-decanters) contains about 0.002 lb. U per gallon and the impurities associated with the yellowcake. *This waste is diluted with other waste liquids and pumpe down a waste disposal well.*

Preparation of Uranium Trioxide

The aqueous uranyl nitrate prepared in the solvent extraction step is converted to dry uranium trioxide by a two-step procedure. The solution is first concentrated by evaporation to form uranyl nitrate hexahydrate (UNH) which is then heated to yield uranium trioxide. Continuous processes utilize stirred trough and/or fluid-bed denitrators.

Evaporation and Denitration

The purified uranyl nitrate is concentrated by evaporation in a singl effect evaporator followed by batch boildown tanks and converted to UO_3 by heating in agitated trough denitrators.

The boildown tanks are heated by steam. The boiling temperature is controlled at levels ranging from 250 to 290°F. Solution freezing points range from 140 to 240°F., thus requiring heating on all transfer lines and storage tanks. In general, nitric acid is recovered from the denitrator off-gas, and condensed streams containing uraniur are recycled.

The concentrated uranyl nitrate hexahydrate (UNH) may be denitrated to UO_3 by a horizontal heated and agitated trough, or in an externall heated fluidized bed reactor.

The process uses a heated trough, 26 inches in width, with a rounded bottom. The 12-foot long trough with a reaction length of about 6 feet is heated electrically and contains a horizontal agitator whic rotates at 60 rpm. The agitator consists of an 8-inch diameter shaf with twelve arms each in the form of a T-bar. The clearance between the shaft and the arms is 1/8-inch. The agitator is driven by a 150 hp. motor and generally draws about 90 hp.

Uranyl nitrate hexahydrate is introduced through three feed pipes extending vertically from the top of the trough to within about 3 inches of the bottom. The uranium trioxide product overflows throug an adjustable weir into a collection bin below the reactor. The uranyl nitrate hexahydrate feed rate is regulated to control the bed temperature at a set value, usually about 570°F.

*Revised 4/10/70

*IV. WASTE DISPOSAL

The various waste products which evolve from operation of the Sequoyah Facility are treated and disposed of in a manner to avoid surface water or potable underground water pollution.

Liquid Waste Treatment and Disposal Systems

The liquid waste disposal scheme at the Sequoyah Facility is divided into three separate systems, namely:

1. Solvent extraction raffinate treatment facilities which prepare the raffinate for injection into a deep well disposal system. This includes raffinate decanter, raffinate holding tanks and and associated pumps and lines.

2. Waste well system including surge tank and associated liquid collection systems, pumps and lines.

3. Liquid effluent handling and storage system including settling basins, sanitary waste lagoon and associated equipment and lines. This system processes all the liquids which normally do not go to the disposal well.

A simplified sketch of the liquid waste system is shown on Figure IV-1. The Oklahoma Water Resources Board has approved the overall waste treatment plan within their jurisdiction.

The quality of the various waste streams can be divided into two areas: 1) effluent to the disposal well, and 2) surface effluent.

The composition of the well effluent varies because it is made up of a mixture of eleven separate plant streams of widely varying compositions, many of which will flow only intermittently. The normal effluent to the disposal well is primarily metallic nitrate solution containing about one molar free nitric acid, up to 2% HF, up to 0.5 lb/gal suspended solids, and traces of natural uranium, other metals, tributyl phosphate, hexane, potassium carbonate and sodium hydroxides.

The only surface effluents which are released from the plant site are the sanitary lagoon effluent, cooling tower blowdown, boiler blowdown, once-through cooling water and brine solution from the water treatment regeneration system. All of these streams are dilluted with excess raw water from Lake Tenkiller before entering the Illinois River. The only release of radioactivity in this liquid effluent is from the laundry and ample dilution of the stream assures compliance with the regulatory limits. Grab samples of the combined outfall from the sanitary lagoon and the settling basin will be collected weekly and analyzed radiometrically to demonstrate compliance to the release limits of 10CFR20. The surface effluent stream ultimately discharges to the Illinois River at 3,140 feet north and 3,700 feet west of southwest corner of Section 21, range 21 E., and Township 12 N., Sequoyah County, Oklahoma.

SEQUOYAH FACILITY
WASTE SYSTEM-SIMPLIFIED FLOW SHEET

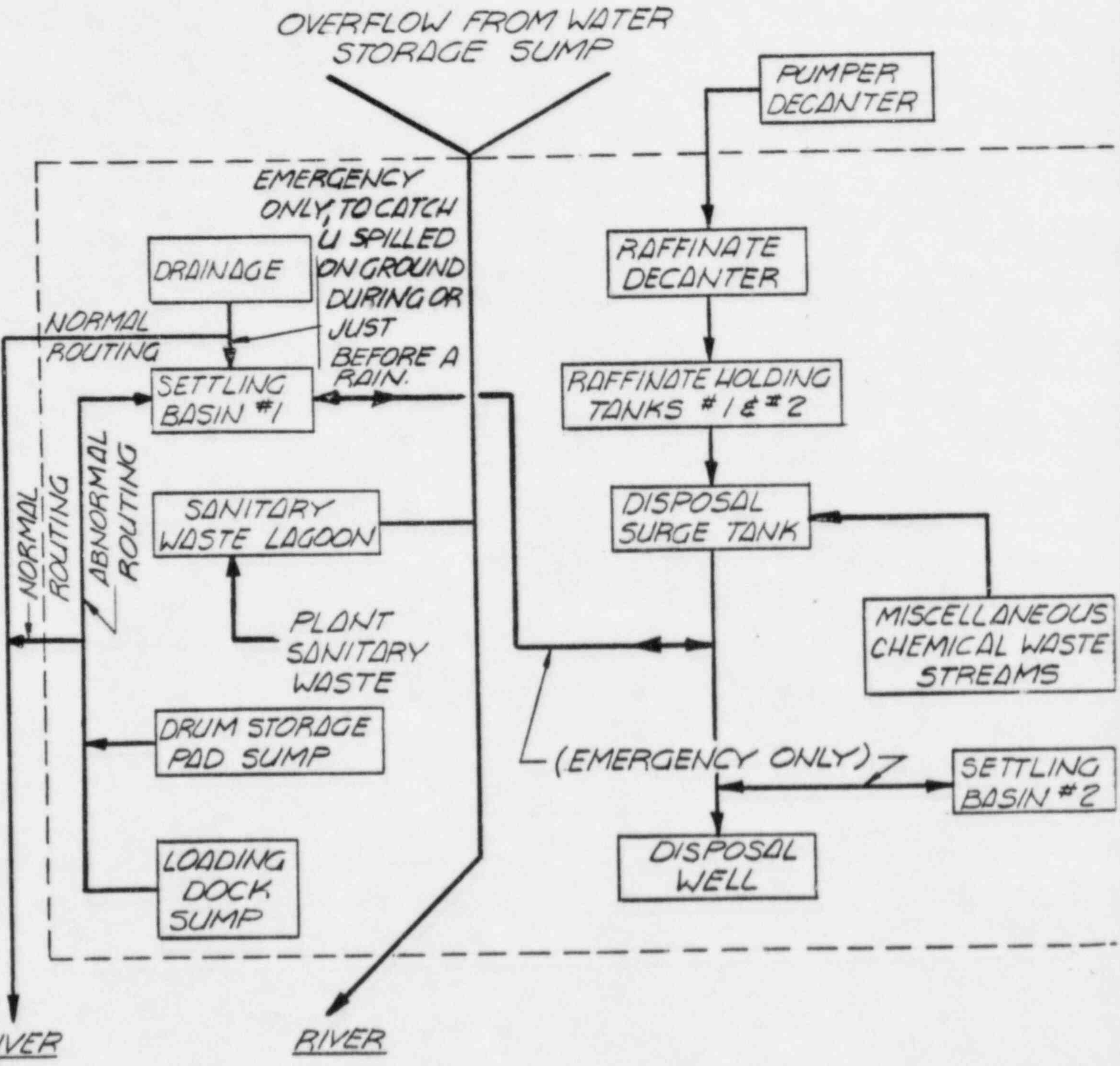


FIGURE IV-1
Revision 4/10/70

Impounding and settling provisions are available in case of disposal well malfunction. Included are provisions for a manual diversion and piping of the discharge stream from the well pumps to one of two settling ponds of 5.5 million gallon capacity. This separate impermeable surface storage is provided for temporary storage during periods that the well disposal system may be inoperative and the construction of the ponds is in accordance with the AEC licensing guide for Embankment Retention Systems. The standby raffinate pit or settling pond is loaded with limestone for neutralization of a temporary discharge of raffinate.

A flow totalizer measures the quantity of liquid pumped either to the disposal well or the settling ponds.

All raffinate is thus impounded and there is no release to the river. Monitoring of ground waters in the area is periodically conducted to assure that ground seepage is not excessive.

The raffinates and chemical wastes are disposed of via deep well into the Arbuckle limestone formation at a depth of approximately 1,600 to 3,100 feet. Monitor wells are utilized to assure that no contamination of upper potable aquifers occurs.

Raffinate Treatment

The primary purpose of the solvent extraction raffinate treatment system is to prepare the raffinate for injection into the waste disposal well. The raw raffinate contains a considerable volume of the organic solvent tributyl phosphate (TBP) and may contain more than a desirable amount of uranium. The TBP is removed since it is detrimental to the lining material on the well tubing. The excess uranium is removed primarily for economic reasons and to control radioactive releases.

To remove the TBP, the raffinate is scrubbed with hexane in a decanter and the raffinate flows to one of two 5,000 gallon hold tanks until released to the well surge tank for disposal. If the uranium content is high, the raffinate is recycled to solvent extraction.

The raffinate stream consists of the liquid volume from digestion, after solvent extraction, plus about 30% for scrub and other streams. It is about one molar in free nitric acid. The disposal system can handle a combined stream of raffinate and chemical waste at about 125 gpm.

Automatic samples are taken while filling a raffinate hold tank and analyzed prior to disposal. The hold tanks are used alternately but not at the same time. Provisions exist for recycling raffinate to a pumper decanter in case raffinate is high in uranium content. The raffinate hold tanks operate five days a week and are emptied after a weekend shutdown of the solvent extraction system. One of the raffinate disposal pumps is operating continuously. Additional automatic sampling of the combined raffinate and chemical waste stream is done at the disposal pump and analyzed for final verification of the disposed contaminants.

Waste Well System

The waste well system includes the collection systems for all of the chemical wastes (except raffinate) that flow to the well, a surge tank, the well pumps and the well itself. The surge tank insures maximum dilution of the chemical stream and maintains a positive suction head on the disposal pumps. One pump is in operation and one in standby. Each pump is rated for 125 gpm at 350-400 psig.

Raffinate acceptable for disposal is drained from the hold tanks to a 2,500 gallon feed tank for two waste disposal well injection pumps operating at 400 psig and 125 gpm. The hold tanks are controlled so that when draining they cannot be filled. The 2,500 gallon feed tank also receives the chemical waste from various sources and scrubbers.

Liquid Effluent Handling and Storage

The liquid effluent handling and storage system processes all of the plant liquid wastes which do not normally go to the well. In addition, it provides emergency facilities for holding well wastes at times when the well is not operable.

The following specific facilities comprise this system:

Settling Basin No. 1 - Receives drainage from loading dock sump and drum storage pad sump when radioactive contamination of this drainage is expected. Flow to well may be diverted to the basin when the well is not operating. Provision is made for pumping the chemical wastes back to the well system.

Settling Basin No. 2 - Flow to the well may be diverted to this basin when well is not operating and back to the well for disposal.

Sanitary Waste Lagoon - All plant sewage including laundry effluent flows to this oxidation type lagoon. The lagoon meets the design requirements of the Oklahoma State Health Department.

Excess Water Line - Lake Tenkiller water, which is surplus to the plant's requirement, is used to dilute the sanitary lagoon effluent and other streams before discharge to the Illinois River.

Loading Dock Sump and Drum Storage Pad Sump - These sumps may be drained to Settling Basin No. 1 in abnormal circumstances to limit the spread of any spilled uranium concentrate and/or chemicals.

*Waste Disposal Well

(See Appendix B -- Feasibility Report - Kerr-McGee Sequoyah Disposal Well prepared by T. M. West, Geologist of Exploration Research, Kerr-McGee Corporation.)

Radiological Aspects of Well Disposal

The radioactivity in the liquid wastes is due to that of the natural uranium lost in the solvent extraction step plus that of the decay products of natural uranium which are purposely extracted; namely, thorium-234, thorium-230 and radium-226. Most of the radioactivity in the liquid chemical wastes is attributed to the daughter products of natural uranium.

For the initial plant capacity, the release of natural uranium is expected to be within the limits of 10CFR20 for release to the unrestricted area. The natural uranium in the effluent to the well is expected to average about 25 pounds per operating day (about 1.2 curie per year assuming 85% on-stream factor), for initial plant capacity of 5,000 tons annually, of which about 50% is soluble and 50% insoluble. This uranium is diluted with an average of about 100 gallons per minute of liquids before it is injected into the well. The resulting activity from the natural uranium is thus about 0.7×10^{-5} µCi/ml as compared to the allowable release concentration of 10CFR20 of 2×10^{-5} µCi/ml.

Because of its short half-life, the Th-234 reaches its equilibrium concentration in the feed material. The recovery of Th-234 in the solvent extraction process and subsequent disposal to the well results in the release of essentially the equilibrium quantity of Th-23· associated with the total uranium processed. This release will normally be about 0.015 μCi/ml for initial plant capacity which is about 750 times MPC for the allowable release limit of 2×10^{-5} μCi/ml. This release does not constitute a health hazard in the disposal scheme and furthermore,

1. After 235 days in the ground, the Th-234 decays to the allowable radioactivity limit due to its relatively short half-life.

2. The radius of water travel after a five-year period is estimated to be only 460 feet from the well bore. And, after 20 years, this increases to only 930 feet. Therefore, the radioactive waste is under land on which Kerr-McGee controls underground development for many years past the time when the Th-234 has decayed to acceptable unrestricted area release limits.

3. Experimental data from a similar well indicates that about 99% of the thorium will precipitate at the interface between the waste water and the disposal formation because of neutralization of the acid waste water. This also decreases the likelihood that radioactive thorium will migrate very far from the well bore. (Reference: Lynn, R. D., Arlin, Z. E., "Anaconda Successfully Disposes of Uranium Mill Waste Water by Deep Well Injection." Mining Engineering, July 1962, Page 49).

At an initial processing rate of 5,000 tons per year, the liquid waste could exceed MPC for soluble material by a factor of 100 for Th-230 and by a factor of 233 for Ra-226. The primary assumptions are:

1. The yellowcake as produced at the mill will contain 1% of the thorium 230 and 0.035% of the radium 226 originally present in the uranium ore (at radioactive equilibrium). These are average figures contained in the literature for acid leach type mills. Information sources are:

    a. "Waste Guide for Uranium Milling Industry," U. S. Department of Health, Education and Welfare, Public Health Service. Technical Report W62-12.

    b. "The Control of Radium and Thorium in the Uranium Milling Industry," Report WIN-112.

    Data related to acid leach type mills was assumed to be typical for the Sequoyah operation because (1) it is expected that in the long run at least 50% of the yellowcake processed will come from Kerr-McGee's acid circuit mills and (2) about 80% of the remaining uranium milling capacity in this country is based on an acid circiut. Present sales

indicate that more than 50% of the business involves Kerr-McGee yellowcake and that the balance ~~of the yellow~~cake is (to the extent known) from acid circuit mills.

2. Yellowcake is likely to be stored for 18 months prior to processing to UF_6. Actually, the buildup of thorium 230 and radium 226 in this period is negligible relative to the amount of these materials left in the yellowcake at the mill. The following table relates to the nuclide buildup.

THORIUM AND RADIUM
PRESENT AFTER 18 MONTHS STORAGE

	μ Curies Per Milliter		
	AEC Limit	Sequoyah Well[1-2]	Times MPC[1-2]
Thorium 230	2×10^{-6}	3.3×10^{-7}	0.17
Radium 226	3×10^{-8}	3.6×10^{-9}	0.12

[1] Excludes original thorium and radium remaining in the yellowcake after milling.
[2] Based on 15,000 TPY uranium throughput. For the initial design throughput of 5,000 TPY uranium one-third of this figure would apply.

Disposal Well Radioactivity Releases

Considering the anticipated expansion of plant capacity, the possibility of increased losses in waste streams over that expected, and a dilution variance, it is requested that specific approval be grant to release radioactivity via the deep well up to the following avera concentrations:

Isotope	Average Conc. (μCi/ml)
U-natural	15×10^{-5}
Th-234	4.5×10^{-2}
Th-230	6.0×10^{-4}
Ra-226	2.1×10^{-5}

Because of limited mobility within the disposal zone and since the beds overlying the Arbuckle disposal formation will effectively inhibit the upward migration of fluids, the radioactivity of the liqui injected into the well will not constitute a health hazard.

Incineration of Contaminated Waste

The incinerator is used to burn all waste materials and trash of a combustible nature only. All materials to be incinerated that may be contaminate with uranium are collected in a designated area and burned at specified times. The incinerator has a capacity of 50 lb/hr and is installed in a suitable location and vented to the plant stack. The ash is removed before and after incineration of potentially contaminated materials and is monitor and/or analyzed for uranium content prior to disposal by authorized methods

Anti-Pollution Criteria

A study was undertaken to enumerate the type and quantity of chemicals and by-product constituents which would represent a potential pollution problem in operation of the Sequoyah Facility if adequate anti-pollution steps were not taken. The plant design includes measures by which the quantities and types of constituents released to the environment are held to a reasonable minimum consistent with the beneficial uses of the air and water in the Sequoyah site area.

Summary of Potential Radioactive Pollutants

UF_6 Gas - Traces of toxic UF_6 are released to the atmosphere. Significant releases will not be allowed to persist for any consequential duration. Th normal amount of UF_6 to escape from the secondary cold trap is only 0.00074 lb-mol/hour. It is released along with 3.3 lb-mol/hour of inert gases, giving a UF_6 concentration of .004 mg/m^3. Further, this quantity of UF_6 is immediately converted to UO_2F_2 upon contact with water and collected in the scrubber used to remove the HF in the effluent. The UO_2F_2 formed would be carried by the scrubber water to the waste disposal well.

Particulate Matter - All gas-solid reaction involves substantial dust evolution. However, these are contained by the use of micron metallic filters which are periodically automatically back flushed in order to assure their proper performance. Most of the effluent gases before release also go to an absorption tower or through scrubbers, which are excellent particulate traps.

Liquids - The liquid waste is a combined stream before release of the raffinates, scrubbing solutions, solvent rework waste and various area sumps which could contain harmful chemicals, and laboratory wastes. These are all forced pumped into a deep well for disposal. The waste stream will contain numerous metallic nitrates, possibly ammonium nitrate, fluorides, from 0.5 to 1.0 molar free nitric acid, and numerous other lesser impurities depending upon the composition of the one concentrate feed being processed.

The only release of radioactivity in liquid effluent (excluding deep well disposal) is from the laundry for which the plant cooling water will supply ample dilution to comply with regulatory limits.

Laundry services for the decontamination of employees' work clothes will result in a process stream averaging less than 1.0 gpm. The waste stream may contain chemical impurities and shall have a radioactivity concentration less than the allowable limits of 10CFR20.303. Laundry effluent

*Revised 4/10/70