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1.5 AUTHORIZED ACTIVITIES

This application for license renewal requests authorization to receive, possess, use, store and ship authorized special nuclear materials pursuant to 10 CFR Parts 19, 20, 21, 70, 71, 73, 74 and 75.

1.5.1 Product Processing Operations

1.5.1.1 UF_6 Conversion - Conversion of uranium hexafluoride to uranium oxides by ADU, GECO, and a steam hydrolysis process.

1.5.1.2 Fuel Manufacture - Fabrication of nuclear reactor fuels containing uranium.

1.5.1.3 Scrap Recovery - Reprocessing of unirradiated scrap from GE-Wilmington and from other sources with nuclear safety characteristics similar to GE-Wilmington in-process materials.

1.5.1.4 Waste Recovery - Recovery of uranium from wet and dry sludges stored in on-site lagoons, pits and basins. The recovered uranium will be returned to the fuel processing facility. *

1.5.2 Process Technology Operations

1.5.2.1 Development and fabrication of reactor fuel, fuel elements and fuel assemblies in small amounts or of advanced design.

1.5.2.2 Development of scrap recovery processes.

1.5.2.3 Determination of interaction between fuel additives and fuel materials.

1.5.2.4 Chemical analysis and material testing, including physical and chemical testing and analysis, metallurgical examination and radiography of uranium compounds, allcys and mixtures.

1.5.2.5 Instrument research and calibration, including development, calibration and functional testing of nuclear instrumentation and measuring devices.

1.5.2.6 Other process technol gy development activities related to, but not limited by, the above.

1.5.2.7 Conversion of UF_6 to UO_2 and other intermediate compounds using wet and dry processes.

1.5.3 <u>Laboratory Operations</u>

Chemical, physical or metallurgical analysis and testing of uranium compounds and mixtures, including but not limited to, preparation of laboratory standards.

1.5.4 <u>General Services Operations</u>

1.5.4.1 Storage of unirradiated fuel assemblies, uranium compounds and mixtures in areas arranged specifically for maintenance of criticality and radiological safety.

1.5.4.2 Design, fabrication and testing of uranium prototype processing equipment.

1.5.4.3 Maintenance and repair of uranium processing equipment and auxiliary systems.

1.5.4.4 Storage and nondestructive testing of fuel rods containing licensed amounts of plutonium.

1.5.5 Waste Treatment and Disposal

1.5.5.1 Treatment, storage and disposal and/or shipment of liquid and solid wastes whose discharges are regulated.

1.5.5.2 Decontamination of non-combustible contaminated wastes to reduce uranium contamination levels, and subsequent shipment of such low-level radioactive wastes to licensed burial sites for disposal or as authorized by the NRC.

1.5.5.3 Treatment or disposal of combustible waste and scrap material pursuant to 10 CFR 20.302(a) and 10 CFR 20 305.

1.5.6 Off-Site Activities

Testing, demonstration, nondestructive modification, and storage of materials and devices containing unirradiated uranium, provided that such materials and devices shall remain under the control of GE-Wilmington.

1.6 EXEMPTIONS AND SPECIAL AUTHORIZATIONS

1.6.1 Requirements for Prior Authorization of Activities by License Amendment

Prior authorization by license amendment shall be required for the following activities:

1.6.1.1 Major changes or major additions to existing processes which may involve a significant increase in potential or actual environmental impact resulting from utilizing such changes or additions.

1.6.1.2 Major process changes or major additions which involve a new process technology for which a criticality safety demonstration has not been previously submitted to the NRC. In determining whether a new process technology requires such prior authorization by license amendment, the following factors will be considered: (1) type of equipment utilized, (2) chemical reactions involved and (3) potential and/or actual environmental impact.

1.6.1.3 Proposed activities for which specific application and prior approval are required by NRC regulations.

1.6.2 <u>Contamination-Free Articles</u>

Authorization to use the guidelines and contamination and exposure rate limits specified in license pages I-1.18 through I-1.21, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," US NRC, August 1987, for decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use.

1.6.3 <u>Disposal of Contamination-Free Liquids</u>

1.6.3.1 Hydrogen Fluoride Solutions

Authorization, pursuant to 10 CFR 70.42(b)(3), to transfer liquid hydrofluoric acid to Brush Wellman, Elmore, Ohio, through the chemical supplier, Consolidated Chemical Company, Kansas City, Missouri, without either company possessing an NRC or Agreement State license for special nuclear material, provided that the concentration of uranium does not exceed three parts per million by weight of the liquid and the enrichment is less than 6 weight percent U^{235}.

The hydrofluoric acid is transferred and used in such a manner that the minute quantity of uranium does not enter into any food, beverage, cosmetic, drug or other commodity designated for ingestion or inhalation by, or application to, a human being such that the uranium concentration in these items would exceed that which naturally exists. Additionally, the acid is used in a process which will not release the low levels of radioactivity to the atmosphere as airborne material and whose residues will remain in a lagoon system.

Prior to shipment, each transfer is sampled and measured to assure that the concentration does not exceed three parts per million of uranium.

GE-Wilmington shall maintain records under this condition of license including, as a minimum, the date, uranium concentration and quantity of all hydrofluoric acid transferred.

1.6.3.2 Nitrate-Bearing Liquids

Authorization, pursuant to 10 CFR 20.302(a), to dispose of nitrate-bearing liquids, provided that the uranium concentration does not exceed a 30-day average of 5 parts per million by weight of the liquids and the enrichment is less than 6 weight percent U^{235}, by transport to an off-site liquid treatment system located at Federal Paper Board Corporation, Riegelwood, North Carolina, in which decomposition of the nitrates will occur and from which the denitrified liquids will be discharged in the effluent from the system.

The environmental monitoring program as described in Table 5.1 is used to control these activities.

1.6.4 Use of Materials at Off-Site Locations

1.6.4.1 Authorization to use up to 15 grams of U^{235} at other sites within the limits of the United States and at temporary job sites of the licensee anywhere in the United States where the Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.

The manager of the radiation safety function shall establish the safety criteria for material being used at off-site locations and shall designate the individual who will be responsible for carrying out these criteria.

1.6.4.2 Authorization to store at nuclear reactor sites, uranium fully packaged as for transport in any Fissile Class I package, in accordance with the conditions of a license authorizing delivery of such containers to a carrier for Fissile Class I transport, at locations in the United States providing such locations minimize the severity of potential accident conditions to be no greater than those in the design bases for the containers during transportation.

Provisions for compliance with applicable 10 CFR 73 requirements are described in the NRC-approved GE-Wilmington Physical Security Plan dated June 6, 1986, as currently revised in accordance with regulatory provisions.

Storage at nuclear reactor sites is subject to the financial protection and indemnity provision of 10 CFR 140.

1.6.4.3 Authorization to store at nuclear reactor sites, arrays of finished reactor fuel rods and/or assemblies in any of the inner metal containers of the RA-series shipping package described in NRC Certificate of Compliance Number 4986 at locations in the United States providing such locations minimize the severity of potential accident conditions to be no greater than those in the design bases for the containers during transportation.

Arrays may be constructed without limit to the number of containers so stored, except that each array shall be stacked to the smaller of 4 containers high or the height demonstrated to comply with criticality safety requirements. Each container must be separated by nominal 2-inch wooden studs, with the width and length for each array and separation between arrays determined only by container handling requirements.

Provisions for compliance with applicable 10 CFR 73 requirements are described in the NRC-approved GE-Wilmington Physical Security Plan dated June 6, 1986, as currently revised in accordance with regulatory provisions.

Storage at nuclear reactor sites is subject to the financial protection and indemnity provision of 10 CFR 140.

1.6.4.4 Authorization to transfer, possess, use and store unirradiated reactor fuel of GE-Wilmington manufacture or procured to GE specification at nuclear reactor sites, for purposes of inspection, fuel bundle disassembly and assembly, including fuel rod replacement, provided that the following conditions are met.

1.6.4.4.1 A valid NRC license has been issued to the reactor licensee, which authorizes receipt, possession and storage of the fuel at the reactor site, and that GE-Wilmington possesses the fuel only within the indemnified location.

1.6.4.4.2 Not more than one fuel assembly plus unassembled rods so that the total number of rods, including the assembly, possessed by GE-Wilmington at any one reactor site at any one time does not exceed 99 except when the fuel has been packaged for transport or as described in Section 1.6.4.3. The fuel rods must be of the types described in NRC Certificate of Compliance Number 4986.

1.6.4.4.3 All operations involving the fuel are conducted by or under the direct supervision of a member of the GE-

Wilmington staff who shall be responsible for all work on the fuel element assembly. The person shall be knowledgeable of and shall have access to all applicable procedures and license conditions at the reactor site and appropriate actions that are to be taken in the event of emergencies at the site.

1.6.4.4.4 All operations involving the fuel are so conducted that neither mechanical damage nor flooding is credible.

1.6.4.4.5 Loose rods are stored in RA-series inner metal containers.

1.6.4.4.6 Fuel is handled in accordance with pertinent provisions of the reactor license and in accordance with written procedures which are jointly approved by GE-Wilmington and the reactor licensee.

1.6.4.4.7 Records of the operation, including the procedures used, are maintained at the GE-Wilmington facility.

1.6.5 <u>Disposal of Industrial Waste Treatment Products</u>

Notwithstanding any requirements for state or local government agency disposal permits, GE-Wilmington is authorized to dispose of industrial waste treatment products without continuing NRC controls provided that either of the two following conditions are met.

1.6.5.1 All free-standing liquid shall be removed prior to shipment.

The uranium concentration in the material shipped for disposal shall not exceed 30 pCi per gram after all free-standing liquid has been removed.

The licensee shall possess authorization from appropriate state officials prior to disposing of the waste material. The authorization shall be available for inspection at the GE-Wilmington facility.

1.6.5.2 The uranium concentration in the material shipped for disposal only at the RCRA hazardous waste burial facility in Pinewood, South Carolina (licensed by the State of South Carolina), shall not exceed 250 pCi per gram of uranium activity, of which no more than 100 pCi per gram shall be soluble. The minimum burial depth shall be at least four feet below the surface.

1.6.6 Dilution Factor for Airborne Effluents

Authorization to utilize a dilution factor to the measured stack discharges for the purpose of evaluating the airborne radioactivity at the closest site boundary of stack discharges from the uranium processing facilities. For purposes of control, this dilution factor shall be no greater than 100. For other purposes, specific dilution factors, which consider dispersion model parameters, may be calculated and used.

1.6.7 Monitor System Exemption

Authorization for exemption from the criticality accident monitoring system requirements of 10 CFR 70.24 for each area in which there is not more than:

- A quantity of finished reactor fuel rods equal to or less than 45% of a minimum critical number under conditions in which double batching is credible, or equal to or less than 75% of a minimum critical number under conditions in which double batching is not credible, or

- The number and type of finished reactor fuel rods and/or assemblies authorized for delivery to a carrier for transport as a Fissile Class I shipment in the model RA-series shipping package described in NRC Certificate of Compliance Number 4986, without limit on the number of such stored containers, provided the storage locations preclude mechanical damage and flooding, or

- The quantity of uranium authorized for delivery to a carrier for transport as a Fissile Class I package when fully packaged as for transport according to a valid NRC authorization for such packages without limit on the number of such packages, provided storage locations preclude mechanical damage and flooding, or

- Arrays of finished reactor fuel rods and/or assemblies in any of the inner metal containers of the RA-series shipping package described in NRC Certificate of Compliance Number 4986, under storage conditions described in Section 1.6.4.3.

1.6.8 Waste Oxidation-Reduction Facility

Authorization, pursuant to 10 CFR 20.302(a) and 10 CFR 20.305, to treat or dispose of waste and scrap material containing special nuclear material by oxidation-reduction.

1.6.9 Posting

For those areas within the Controlled Access Area in which radioactive materials are processed, used, or stored, where it is deemed impractical to label individual containers pursuant to 10 CFR 20.203(f), a sign stating "Every container in this area may contain radioactive material" shall be posted.

1.6.10 Uranium Recovery Enrichment Control

Some parts of the uranium recovery process have been analyzed and demonstrated to be safe for a maximum enrichment of up to 5%, while other parts have been analyzed and demonstrated to be safe for a lower maximum enrichment. The maximum enrichment allowed in uranium recovery at any time shall not exceed the lowest maximum enrichment for which any part of the system has been analyzed and demonstrated to be safe. This will allow processing of higher enrichments when criticality safety has been demonstrated.

1.6.11 Sanitary Sludge Accumulation

Authorization to accumulate treated sanitary sludge containing trace amounts of uranium, in the sanitary sludge land application area pending final disposal.

1.6.12 Transfer of Calcium Fluoride Test Quantities

Authorization to transfer test quantities of calcium fluoride (CaF_2) to potential buyers for the purpose of their examination and evaluation as described in GE-Wilmington's letter dated March 21, 1988, to the NRC.

Test quantities may not contain more than 30 pCi per gram on a dry weight basis and are limited to 1 gram U^{235} at each off-site location.

Test activities and end uses of the material will be limited to those that do not allow chemical separation of the uranium or entry of the product into the food chain.

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT

PRIOR TO RELEASE FOR UNRESTRICTED USE

OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE,

OR SPECIAL NUCLEAR MATERIAL

U.S. Nuclear Regulatory Commission
Division of Industrial and
Medical Nuclear Safety
Washington, DC 20555

August 1987

15.21 OUTSIDE PRODUCT CAN STORAGE

15.21.1 Process Description

West of the fuel manufacturing building are fenced pads utilized for temporary storage of 5-gallon cans of uranium compounds. Each can is separated 12 inches from adjacent cans in a row by physical barriers with 3-foot aisleways between adjacent rows. Only closed containers which are free of surface contamination are stored in these outside storage areas.

15.21.2 Criticality Safety

The criticality safety of the outside can storage areas has been demonstrated by an analysis performed with the KENO IV Monte Carlo code and using JRK Modified Hansen-Roach 16 group cross section sets. Calculations were performed for an infinite planar array of containers with a minimum separation between containers of 12 inches with each container limited to 35 kgs of 4.0% U^{235} enriched UO_2, with optimum moderation by water of the UO_2, and with full reflection on the top and bottom of the array by 12 inches of water.

The KENO IV result demonstrates compliance with the multiplication requirements of Section 4.2.2.3. Stored containers are protected against rearrangement under severe wind conditions.

15.22 URANIUM RECOVERY FROM LAGOON SLUDGE FACILITY

15.22.1 Introduction

The purpose of the URLS facility is to recover uranium from the various sludges that have accumulated in storage lagoons, basins and pits from the treatment of the waste streams generated at our fuel manufacturing facility in Wilmington, N.C.

These sludges will be removed from their storage locations and processed to remove the uranium. The solid waste generated will be disposed off-site in accordance with the provisions of Section 1.6.5 of the license. The liquids generated will be transferred to the lagoons. The resulting uranium will be sent to the existing uranium purification facility for further purification.

Concentration is the criticality control mechanism utilized throughout the URLS facility with the exception of the precipitation system where geometry is the primary control and mass is the secondary control mechanism. To date, the highest enrichment processed through the conversion plant is 4.025% U-235 which is used as a basis for process evaluation. According to the Criticality Handbook ARH-600, this results in a minimum critical concentration value of 360 g U/L for UO_2 and water. A control limit of 180 g U/L, which is half the minimum critical concentration, forms the basis of all concentration limits.

Process chemicals used in the URLS facility will be checked for chemical makeup (e.g. molarity, purity, etc.) by the URLS laboratory.

Although this discussion addresses the West Nitrate lagoon sludges, the chemical composition of the sludges from other lagoons, basins and pits are essentially the same.

15.22.2 Facility Description

As shown in Figure 1, the facility is located on the east side of the existing boiler building at the site's waste treatment area. This single-level structural extension (Figure 2) has a roofed area of about 2,000 square feet. The entire poured concrete area is curbed for containment of spills. The building has a self-contained HVAC system, including stack sampling. The outside tanks for chemical and sludge storage are curbed or diked to contain spills. All major utilities and support services are supplied by the existing waste treatment facility. The generalized URLS processing system is shown in Figure 3.

15.22.3 Process Description & Criticality Safety Analysis

15.22.3.1 Dredge and Feed System

15.22.3.1.1 Process Description

The purpose of this system is to dredge, settle, and queue sludge for eventual processing. The feed sludge is dredged out of the lagoon and transferred to the Nitrate Settling Tank T-1010 located in a diked area

FIGURE 1

LOCATION OF SLUDGES AT THE WILMINGTON SITE

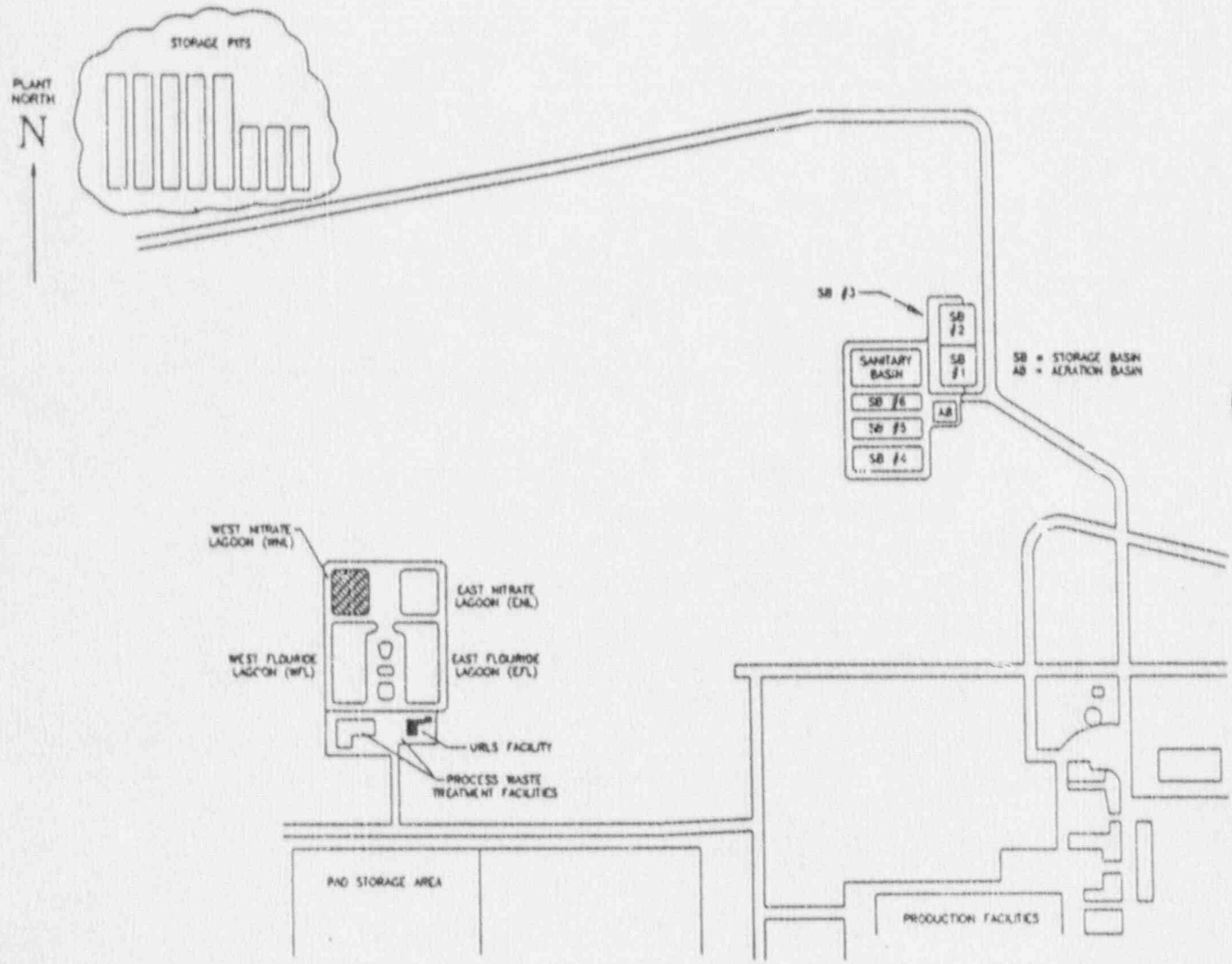


FIGURE 2

URLS PLANT PLAN VIEW

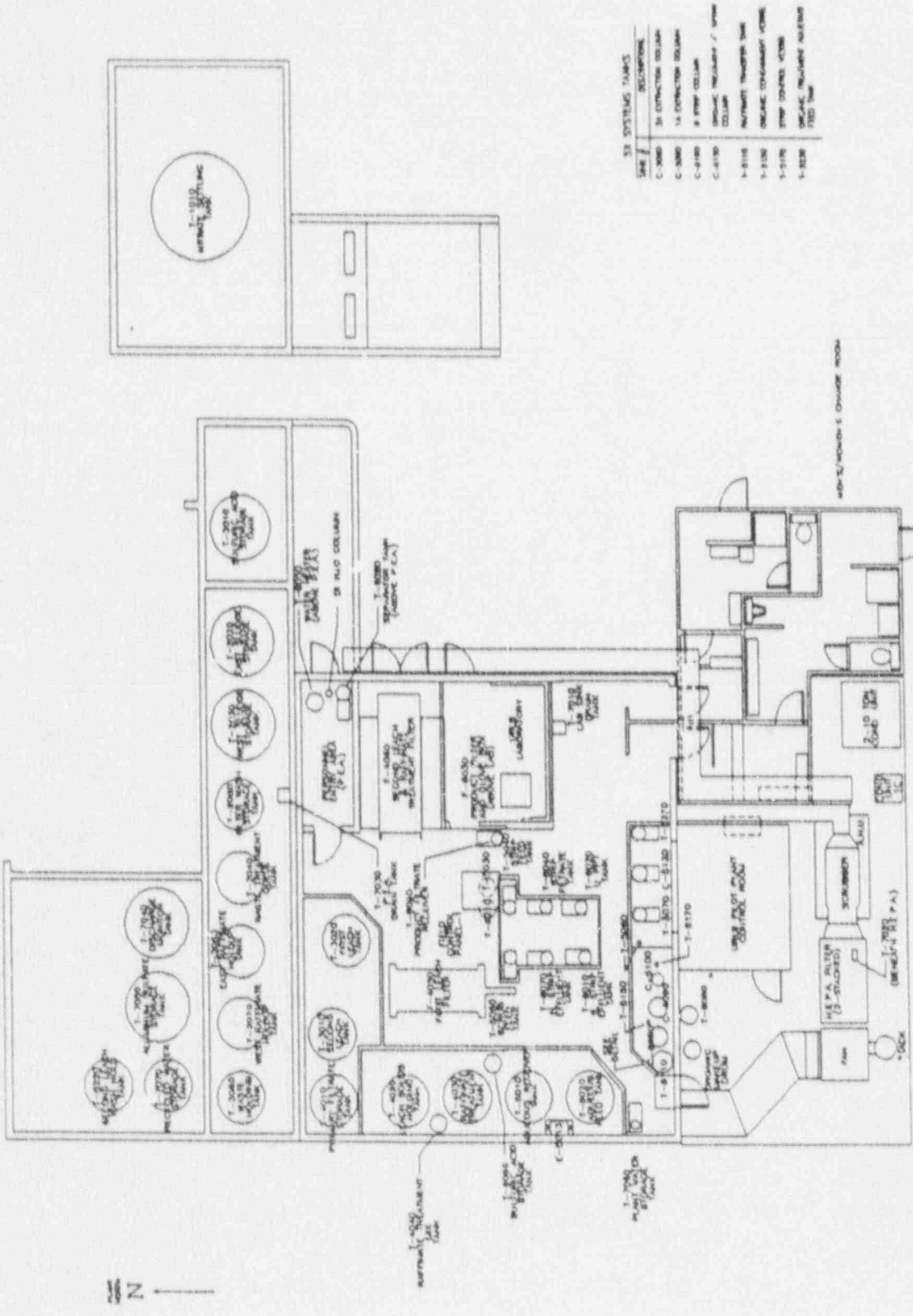
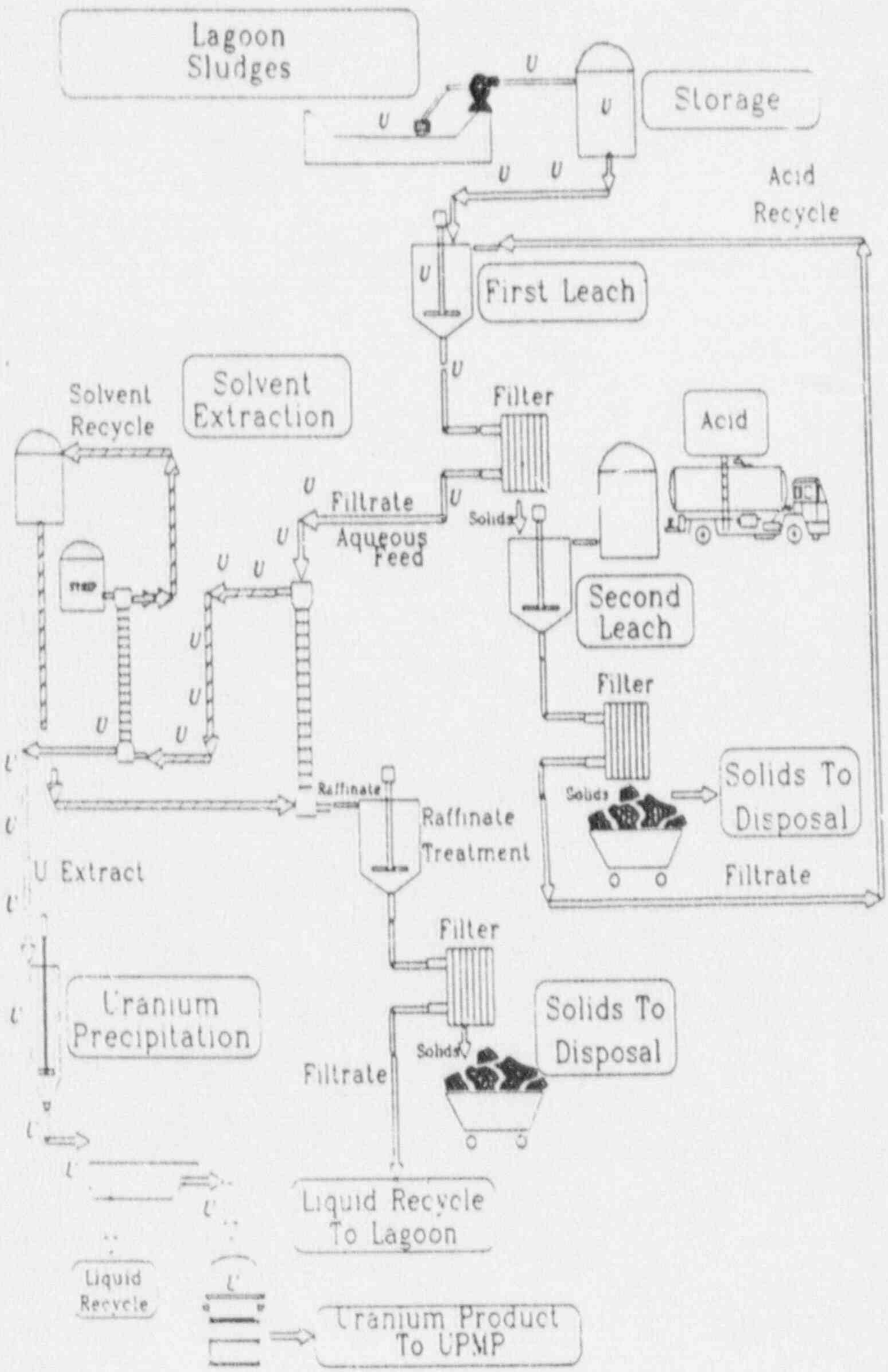


FIGURE 3

GENERALIZED URLS PROCESS FLOW SHEET



northeast of the Uranium Recovery of Lagoon Sludge (URLS) facility. Sludge is allowed to settle in this tank, while supernate is decanted back to the lagoon. From T-1010, the sludge is pumped to the Sludge Storage Tank T-2020 or T-2030. A diagram of this system is shown in Figure 4.

15.22.3.1.2 Concentration Analysis

Samples taken of lagoon sludge that has settled for years indicate that the solids settle to form a sludge normally containing no more than 20% solids. However, past studies and analysis of these sludges indicate that they can be as high as 30% solids with 8.4% uranium on a dry weight basis. Assuming this sludge can be physically transferred at this concentration, a maximum of 30% solids is used for this evaluation. The density of this sludge is 1.3 g/cc which results in a maximum concentration of 33 g U/L. Values based on the expected operating conditions would be a sludge density of 1.12 and 15% solids. This would result in a uranium concentration of 14 g U/L.

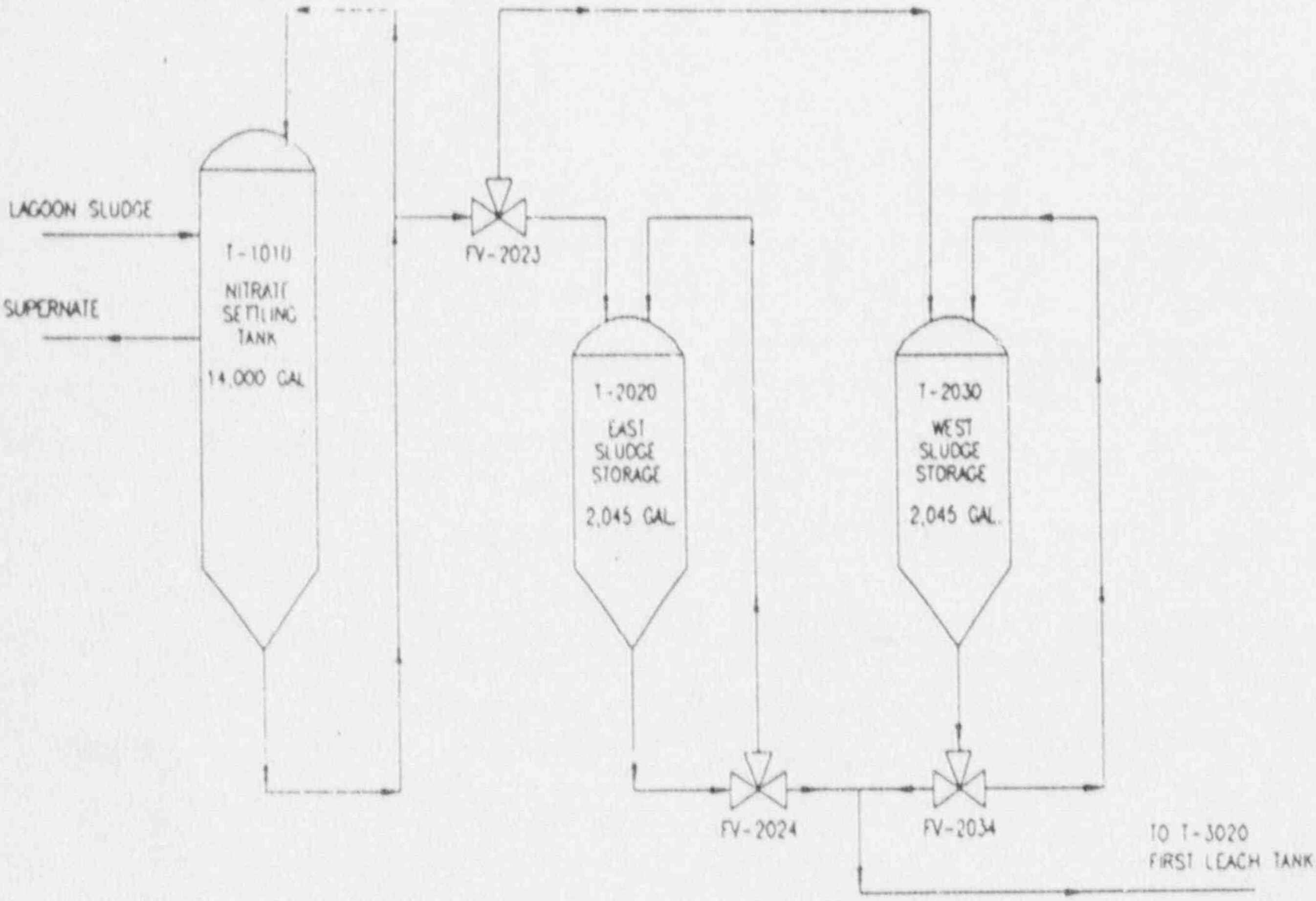
15.22.3.1.3 Safety Features

To ensure that the maximum uranium concentration for this system of 33 g U/L is not exceeded, the following controls have been established.

Use of a closed, dedicated sludge transfer line restricts the addition of any material to the sludge transfer system. The only material that will be added to this system is lagoon liquid and water during the

FIGURE 4

DREDGE AND FEED SYSTEM



dredging operations to create a slurry suitable for transfer to T-1010.

The only plant system that is interconnected with this system is the leaching system.

Backflow into this system and within this system is prevented by introducing all feed streams into the tops of the tanks, above the overflow, to provide an air break. In addition, a level sensing system monitors the levels in T-1010, T-2020 and T-2030. This system is interlocked through the digital control system and automatically terminates feed at a preset level below the overflow.

15.22.3.1.4 Safety Analysis

By virtue of the nature of the material and the controls described above, adequate protection against precipitation or other circumstances which may increase concentration has been provided and the maximum uranium concentration attainable in this system is 33 g U/L.

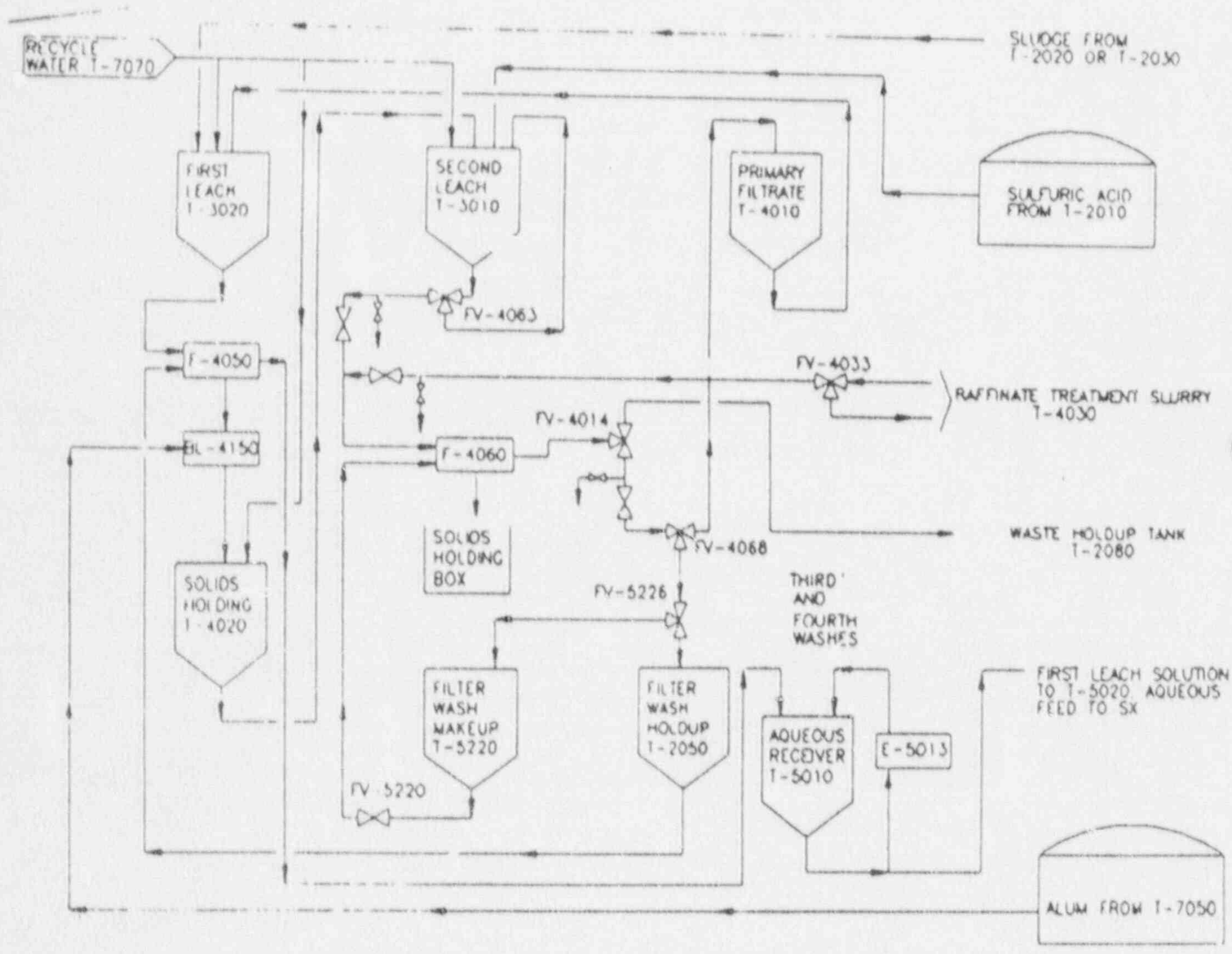
15.22.3.2 Leaching/Filtration

15.22.3.2.1 Process Description

The purpose of the leaching process is to remove the uranium from the sludge. This process is a multi-stage, counter-current acid leaching process. Most of the uranium is removed in the first stage leach; the remaining uranium is removed in the second stage leach. A diagram of this system is shown in Figure 5.

FIGURE 5

LEACH SYSTEM



Sludge stored in either Sludge Storage Tank T-2020/ T-2030 is transferred to the First Stage Leach Tank T-3020, where it is contacted with the acid filtrate from the second leach filter. This mixture is continuously agitated. Heating the slurry in the first leach tank is not expected to be required. For future leaching of other sludges, it may be necessary to heat this system by a heat exchanger or direct injection of steam to improve the efficiency of removing uranium from the sludge.

When the first stage leach cycle is completed, the slurry is pumped to a plate-and-frame Filter F-4050 for solids-liquid separation. Once filtered, the solids may be washed with liquid from the Filter Wash Holdup Tank T-2050, which is the final acid wash water from the second stage filter F-4060. If wash water is not available, a dilute acid is prepared from plant water and concentrated acid. The uranium bearing filtrate and wash water are sent to the Aqueous Receiver Tank T-5010 and becomes the feed to the solvent extraction process.

The solids are discharged from the First Leach Filter F-4050 through a chute, repulped w..h acidic alum solution from the Aluminum Sulfate Storage Tank T-7050, in the Repulp Blender BL-4150, then transferred to the Solids Holding Tank T-4020.

Slurry in the T-4020 tank is pumped to the Second Stage Leach Tank T-3010 where it is contacted with fresh acid from the Sulfuric Acid Tank T-2010. The slurry is continuously agitated and heated either by a heat exchanger or direct steam injection to enhance the leaching efficiency. Following the second leach, the solids contain very low levels of uranium. Uranium recovery in excess of 99% is expected.

After completing the second stage leaching, slurry is pumped to a plate-and-frame Filter F-4060 for solids-liquid separation. Filtrate is transferred to the Primary Filtrate Tank T-4010 to be used as liquid feed to the first stage leaching process. The second stage leach cake is washed with dilute acid from the Filter Wash Makeup Tank T-5220 then air-purged to reduce excess liquid. The filtrate and air purge are discharged into the Filter Wash Holdup Tank T-2050. The solids from the filter are discharged through a chute and into a waste box for future disposal. The cake will be analyzed for pH, % moisture, and radioactivity.

If further removal of uranium from second stage leach solids is necessary, the cake may be returned to the Repulp Blender BL-4150, transferred to the Solids Holding Tank T-4020, and reprocessed in the Second Leach Tank T-3010.

15.22.3.2.2 Concentration Analysis

The URLS leaching system contains numerous large volume tanks and two large filter presses. The chemicals and other materials that may be added to this system are 98% sulfuric acid, alum (aluminum sulfate), water, and calcium hydroxide (Second Stage Filter only).

When sulfuric acid is added to the sludge, the uranium is solubilized as uranyl sulfate. Any uranium present as the highly soluble uranyl ion is immediately solubilized; otherwise, the uranium must be oxidized to the plus six state by the sulfuric acid which is a relatively slow process. The calcium salts are converted to calcium sulfate. Aluminum is utilized to complex the fluoride to enhance the dissolution of the calcium fluoride. The dissolution of the calcium fluoride is necessary because it is assumed that some of the uranium is integrated within the crystalline structure of the calcium fluoride. This structure must be broken in order to solubilize the uranium.

Once solubilized, the only mechanisms known that will precipitate the uranium are changes in either temperature or pH. Since the uranium concentrations of the leach solutions will be well below the maximum solubility for uranyl sulfate solutions, temperature will have no precipitation effect. Also, any precipitation agents will be strictly controlled thus alleviating concern about the pH. In addition, lab analyses have shown that the constituents of the slurry have no reprecipitation effect.

To evaluate possible worst case uranium concentration values in the leaching system, two worst case scenarios are considered. Based on a sludge containing 30% solids and 8.4% uranium by weight, these are:

a) If, because of some failure of the process chemistry, the sludge failed to leach in the first stage but was completely leached in the second stage and this filtrate completely leached the uranium from the fresh sludge in the first stage, the result would be a first stage filtrate containing about 37 g U/L.

b) If the sludge was not leached in either the first or second stage then was filtered. The resultant cake from the second leach filter could be 70% solids. This 70% solids content corresponds to a cake density of 2.0 g/cc. Based on this cake (density = 2.0 g/cc) containing 70% solids of which 8.4% is uranium by weight, the resultant uranium concentration in this cake would be approximately 117 g U/L.

15.22.3.2.3 Safety Features

To provide assurance that the maximum uranium concentrations discussed above are not exceeded, controls have been established to prevent the inadvertant addition of precipitation agents into the system. The following is a description of these controls.

15.22.3.2.3.1 Valving Interlocks/Controls

Since the second leach filter has a dual role (i.e., it is used to filter the second leach slurry and the slurry from the lime treatment of raffinate) a pathway exists for the addition of calcium hydroxide (a precipitant) to the leach system. To prevent cross contamination of calcium hydroxide and uranium bearing solution the following system of valving interlocks/controls has been employed.

- Valve Positioning

  To ensure proper valve positioning the following has been provided:

The feed valve from the Second Leach Tank and the feed valve from the Raffinate Treatment Slurry Tank are interlocked to prevent the simultaneous introduction of these streams to the filter press.

The Second Stage Filter filtrate valve and the feed valve from the Raffinate Treatment Slurry Tank are interlocked to prevent material from being fed to the Primary Filtrate Tank when treated raffinate is fed to the Second Stage Filter.

- Valve Leak

A system of double block and bleed valves are installed on the following process lines in the event of a valve leak:

Feed line from Second Leach Tank to Second Stage Filter. The block valves close and the bleed valve opens when treated raffinate is fed to the filter. This system is interlocked to the feed valve from the Raffinate Treatment Slurry Tank.

Feed line from Raffinate Treatment Slurry Tank to Second Stage Filter. The block valves close and the bleed valve opens when second leach stage slurry is fed to the filter. This system is interlocked to the feed valve from the Second Leach Tank.

Feed line from second Stage Filter to Primary Filtrate Tank. The block valves close and the bleed valve opens when treated raffinate is fed to the filter thus preventing any raffinate filtrate from entering the Primary Filtrate Tank. This system is initiated when the feed valve from the Raffinate Treatment Slurry Tank opens.

All of the above valving systems are fail safe and automatically interlocked through the digital control system.

15.22.3.2.3.2 <u>Backflow Prevention</u>

To ensure adequate process control, any backflow out of or within the system is prevented by the following methods. All feed streams are introduced into the top of the leaching/filtration system tanks, above the overflow to provide an airbreak. In addition, each tank contains a level sensing system device which interlocks through the digital control system, stopping incoming liquid feed prior to the liquid levels reaching the overflow height.

Since steam injection may be used in the leaching process, a vacuum break has been installed on the incoming steam line to prevent solution addition to the steam system. This vacuum break, located between the solution and a steam control valve, opens and bleeds atmospheric air into the line if a vacuum develops. In addition, a block and bleed valving system is installed on the main steam line feeding all injection spargers.

15.22.3.2.3.3 <u>Diluent Control</u>

Since a fundamental assumption in this concentration analysis is that the sludge will contain 70% by weight liquid, the following controls are in place to provide confidence that this liquid content is maintained throughout the leaching process:

- The first and second leach tank slurry will be sampled and analyzed by two independent methods for liquid content to assure that liquid is present prior to acid addition. The analysis will be performed within 24 hours of acid addition. Based on lab studies which demonstrate that it takes greater than one week to reduce from 30% solids to 50% solids, the 24-hour timeframe is an acceptable sampling period.

- The second leach tank is sampled and analyzed for liquid content by two independent methods to assure that boildown does not occur due to sparging in the second leach tank thus increasing uranium concentration. This analysis will only be performed if material is queued in the tank for more than 24 hours after acid addition. Subsequent analysis will be conducted every 24 hours until the material is removed.

15.22.3.2.4 Safety Analysis

Based on the controls/interlocks described above, adequate protection against precipitation or other circumstances which may increase concentration has been provided and the maximum uranium concentration attainable in solution and solid form are 37 g U/L and 117 g U/L respectively.

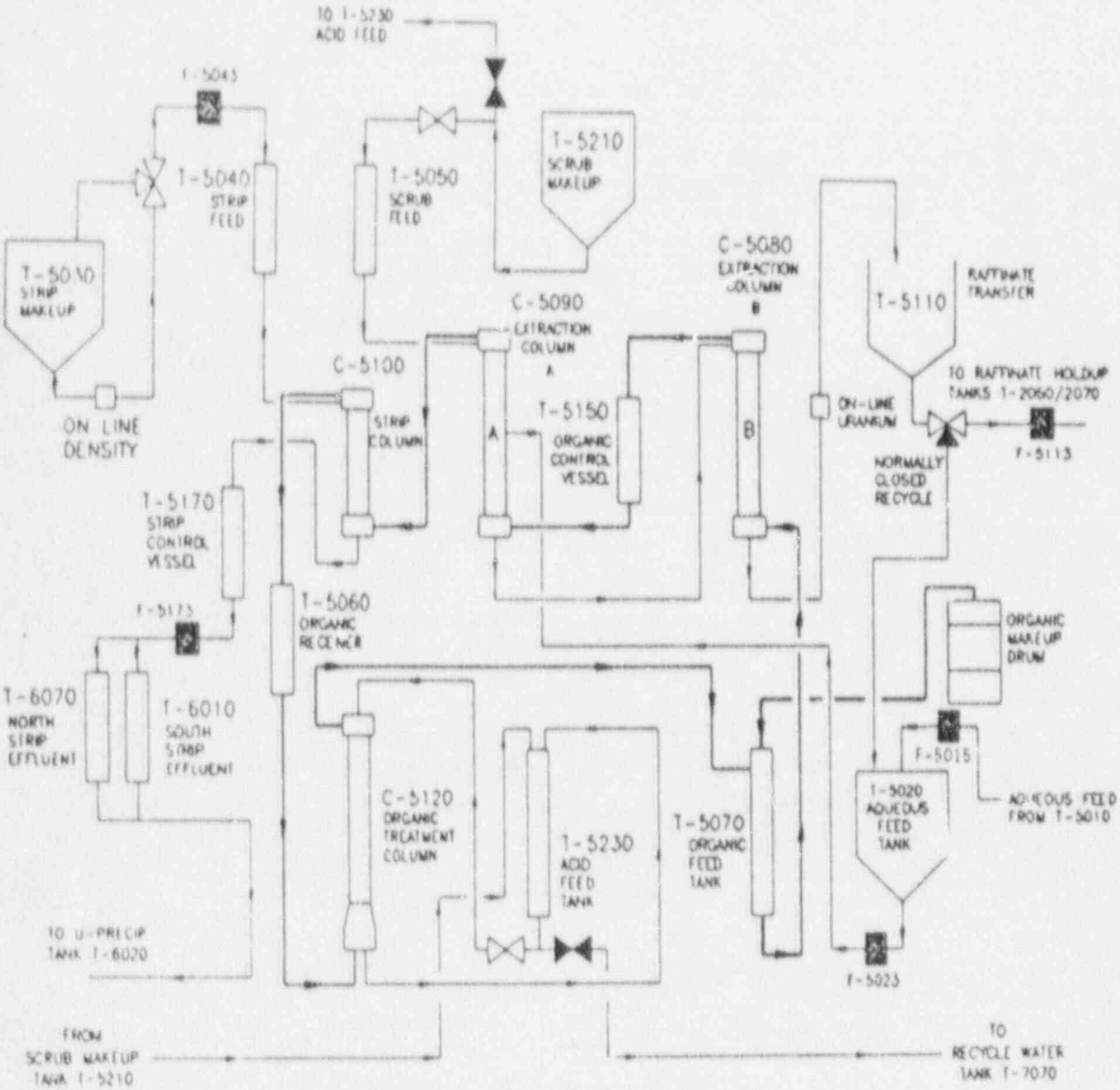
15.22.3.3 Solvent Extraction/Scrubbing/Stripping

15.22.3.3.1 Process Description

The purpose of the solvent extraction system, illustrated in Figure 6, is to selectively recover

FIGURE 6

SOLVENT EXTRACTION SYSTEM



uranium from the leach solution. The two immiscible phases, aqueous and organic, flow counter-current through two pulsed, perforated plate columns. The uranium is transferred from the aqueous phase into the organic phase.

The filtrate from the First Leach Filter is received in the Aqueous Receiver Tank T-5010. The liquid is then transferred through a polishing filter F-5015 into the Aqueous Feed Tank T-5020. Then it is pumped through another polishing filter F-5023 into Extraction Column C-5090.

Organic extractant is made up in a chemical makeup area outside of the main process building. The mixture of solvent is transferred to the Organic Feed Tank T-5070. The barren organic phase is introduced into the bottom section of the Extraction Column C-5080, flowing up through the column and out the top. It is then pumped into the lower section of Extraction Column C-5090, and out the top of the column as pregnant (uranium-bearing) organic.

The aqueous phase is supplied to C-5090 at a midpoint flowing down through the organic phase, exits at the bottom, and then is pumped to the top of C-5080. This aqueous phase exits the bottom of C-5080 as raffinate.

The top section of C-5090 above the feed point functions as a scrub section. This scrub solution from the Scrub Feed Tank T-5050 is made up of very dilute acid, enters the top of the column, contacts the pregnant organic, then mixes with the aqueous phase and exits the bottom of the column with the partially extracted feed.

The uranium is removed from the pregnant organic phase by contact with a stripping solution in Strip Column C-5100. The strip solution is made up in the Strip Makeup Tank T-5030. The organic is pumped into the bottom of the column. It flows up through the strip solution, which is flowing downward, then out the top to the Organic Receiver Tank T-5060. The strip, containing the uranium, flows out the bottom of the column into the Strip Control Vessel T-5170 through the coalescing filter F-5173, to remove any carry over of organic, then into the Strip Effluent Tanks T-6070 and T-6010.

15.22.3.3.2 Concentration Analysis

Following extraction of the uranium from the acidic sulfate leach solutions, the organic is scrubbed with 0.1M dilute sulfuric acid. The scrub combines in Extraction Column C-5090 to form a single aqueous phase process stream to extraction column C-5080. The uranium is then stripped from the organic.

No known precipitation agents exist in this system. Worst case uranium concentrations will be based on the maximum uranium concentrations achievable in the organic phase, aqueous phase, and sodium carbonate strip.

The worst case aqueous phase concentration is the same as the worst case concentration for the leach solutions (i.e., 37 g U/L). The 0.1M dilute sulfuric acid will not back-extract uranium from the organic phase.

The organic phase uranium concentration values are dependent on the extraction capabilities of the chemicals used in the system. Detailed concentration analyses have shown that the worst case uranium concentration present in the organic phase is less than the 180 g U/L limit.

The strip solution uranium concentration is dependent on the ability of the strip solution to extract uranium from the organic phase. Detailed concentration analyses have shown that the worst case uranium concentration present in the strip solution is less than the 180 g U/L limit.

15.22.3.3.3 Safety Features

In order to limit the uranium concentration in the organic and strip streams to less than 180 g U/L, the following controls are in place on the makeup of these streams.

Organic - the organic solutions will be analyzed for content by two independent methods using the following procedure. After the organic is prepared the container will be sampled, sealed, and numbered. The sample will be analyzed by two independent methods. If the analyses provides acceptable results, the container will be tagged indicating acceptance. The results will be recorded in the lab and control room logs. When needed, the container will be transferred to the organic loading station, the seal broken, and attached to the solvent transfer system. The container number will be recorded in the control room log.

Strip - the strip solution will be prepared in the Strip Makeup Tank T-5030. After mixing, the strip solution will be analyzed for content by a density measurement to ensure proper preparation. If the strip makeup is acceptable, it is transferred to Strip Feed Tank T-5040. As a backup, an inline density monitor, placed between T-5030 and T-5040 will be utilized to prevent the transfer of high density strip solution into the process. This instrument operates a block valve if the density is unacceptable.

15.22.3.3.4 Safety Analysis

Based on the chemical makeup controls established above, adequate protection against precipitation or other circumstances which may increase concentration above 180 g U/L has been provided.

15.22.3.4 Uranium Precipitation/Filtration

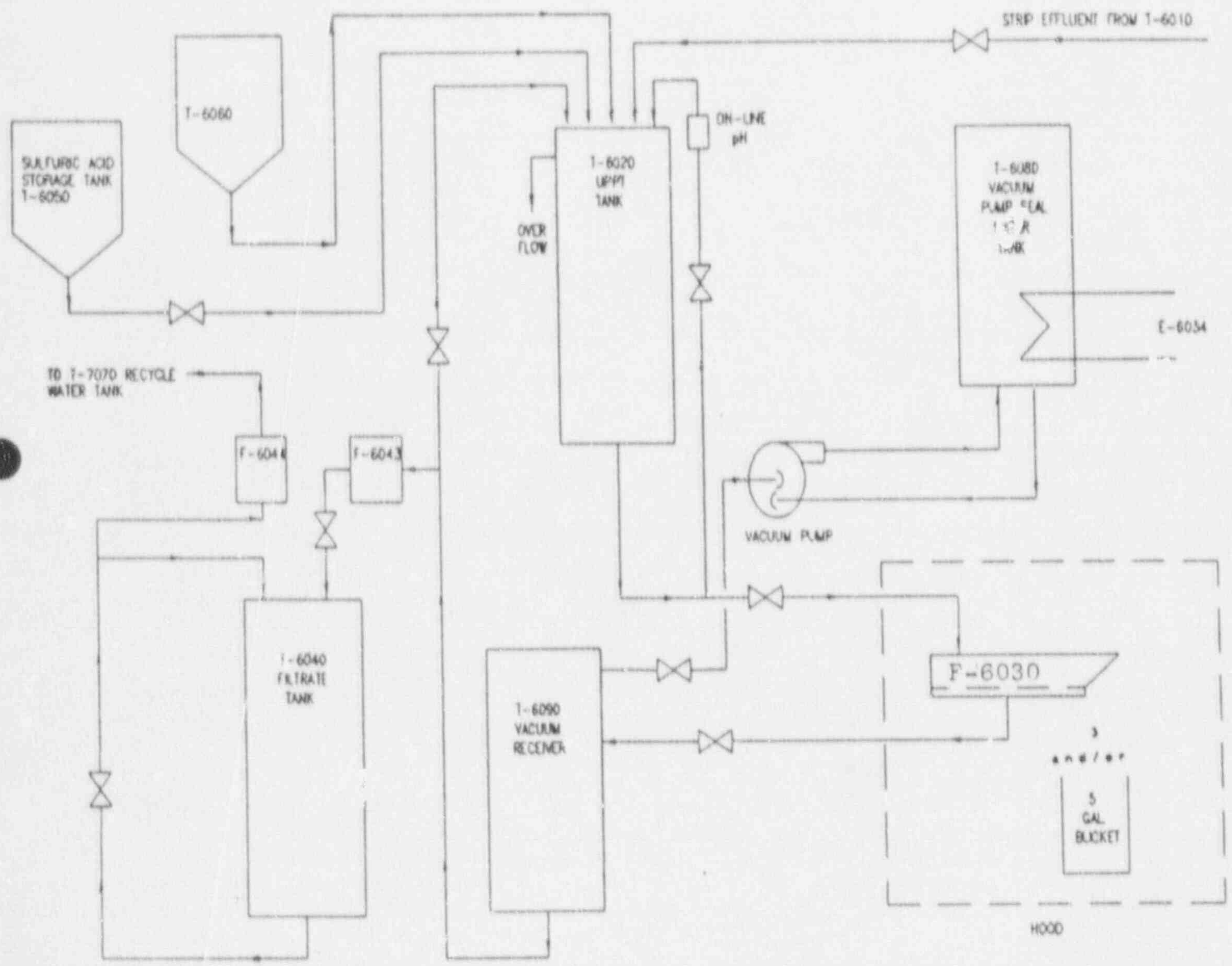
15.22.3.4.1 Process Description

The purpose of the uranium precipitation system is to produce a uranium product. A diagram of the system is shown in Figure 7.

A measured volume of uranium bearing strip solution is transferred to the Uranium Precipitation Tank T-6020. This solution is acidified by lowering the pH with acid from the Acid Tank T-6050. Then a preciptation agent solution from T-6060 is added to precipitate uranium as a diuranate compound. The uranium solids are filtered out by the Product Filter F-6030, washed, air purged, then transferred to 3 or 5-gallon containers. The filtrate is collected in Tank T-6040, and sampled for uranium concentration. If within limits, it is

FIGURE 7

URANIUM PRECIPITATION SYSTEM



transferred to the recycle water tank T-7070. If it is above the limit, it will be retreated in T-6020.

15.22.3.4.2 Safety Features & Analysis

15.22.3.4.2.1 Unload Hood

The Product Filter is 24.5" wide, 37" long, and 6" thick. The product filter has a level-sensing device in place which automatically terminates incoming feed at a preset level below the 6" limit. This provides additional assurance that the geometric safety of the filter pan is not lost.

The discharge chute is pyramid shaped, 11" long and fabricated out of 11 gage SS sheeting. At the end of the chute is a 3" long, 4.5" diameter discharge cylinder. End product material is discharged into a standard 5 gallon carbon steel can. All of these components are inside of a 11 gage, SS hood. The overall hood dimensions are 38" X 38" X 62".

In the event of an upset in the hood, an overflow has been placed at a height of 4" from the bottom of the hood, thus precluding any liquid build-up to an unsafe level. This overflow will be inspected during the preoperational audit to assure that it is free of any obstruction. In addition, a procedural requirement has been implemented which requires the operator, after each batch is processed, to inspect the hood for material accumulations and clean out as appropriate.

Using the GEKENO Monte Carlo Code, it was determined that the maximum effective neutron multiplication factor for accident conditions (i.e., fuel region completely filled with 4.025% enriched UO_2 at optimum moderation and full water reflection) is 0.9442 ± 0.0044. This value is in conformance with the 0.97 limit specified in Section 4.2.2.3 of the license.

15.22.3.4.2.2 Precipitation System Tanks

All tanks in this system, with the exception of T-6090, are 10" Schedule 80 PVC pipe. T-6090 is an 8" Schedule 40 Stainless Steel pipe tank. The length of the tanks are different with the longest being 14' 2.5" long. For purposes of unit analysis it was assumed that all tanks were infinite length 10" SCH 80 PVC. The fuel was assumed to be enriched to 4.025% U^{235}.

Using GEKENO, the highest K-effective value calculated with optimum UO_2 and H_2O mixtures, fully reflected by water, was 0.8472 ± 0.0047. This value is acceptable under the provisions in Section 4.2.2.3 of the license.

15.22.3.4.2.3 Determination of Safe Mass

Calculations have been conducted with 30 kg. of UO_2 serving as the basis to establish this as the mass limit.

GEKENO calculations were conducted using 30 kg. of UO_2 in a spherical shape reflected by 12" of water. Under optimum moderation conditions the maximum effective neutron multiplication factor attained was 0.8821 ± 0.004. This value is acceptable for normal conditions as specified in Section 4.2.2.3 of the license.

15.22.3.4.2.4 Neutron Interaction

Interaction in the precipitation system area has been analyzed by the solid angle technique. This analysis has shown the interaction to be acceptable. The largest subtended solid angle found was 2.17 steradians. This value was for a unit for which 7.7 steradians would have been acceptable.

15.22.3.4.2.5 Backflow Prevention

Backflow from safe geometry equipment to unsafe geometry equipment is prevented by the combination of airbreaks and level sensing devices.

15.22.3.4.2.6 Filtrate Control

All liquids transferred from the Filtrate Tank T-6040 to the Recycle Water Tank T-7070 will be analyzed for uranium concentration. This analysis will be performed using two independent methods. The filtrate is continually recirculated to ensure that the sample is representative of the material in the tank.

15.22.3.4.2.7 Can Handling and Storage

Once a batch has been processed, the can is removed from the hood, weighed, and placed in a one-can elevator for transport to the ground floor. At the ground floor elevation, the can is removed from the elevator and placed in an approved storage location before being removed from the building. All can storage locations have been found to be acceptable utilizing the solid angle method. Movement of cans within the facility is administratively limited to a single can, except when the cans are placed on an approved 3 or 4-can transport cart for removal from the facility. To assure that this single can limit is acceptable, a GEKENO model was placed next to the precipitation tank. Under conditions of optimum UO_2 moderation and full water reflection, this system produced a maximum k-effective of 0.8825 ± .0048. This value is within the requirements set forth in Chapter 4 of the license and therefore single can transport is acceptable.

15.22.3.5 Raffinate Treatment

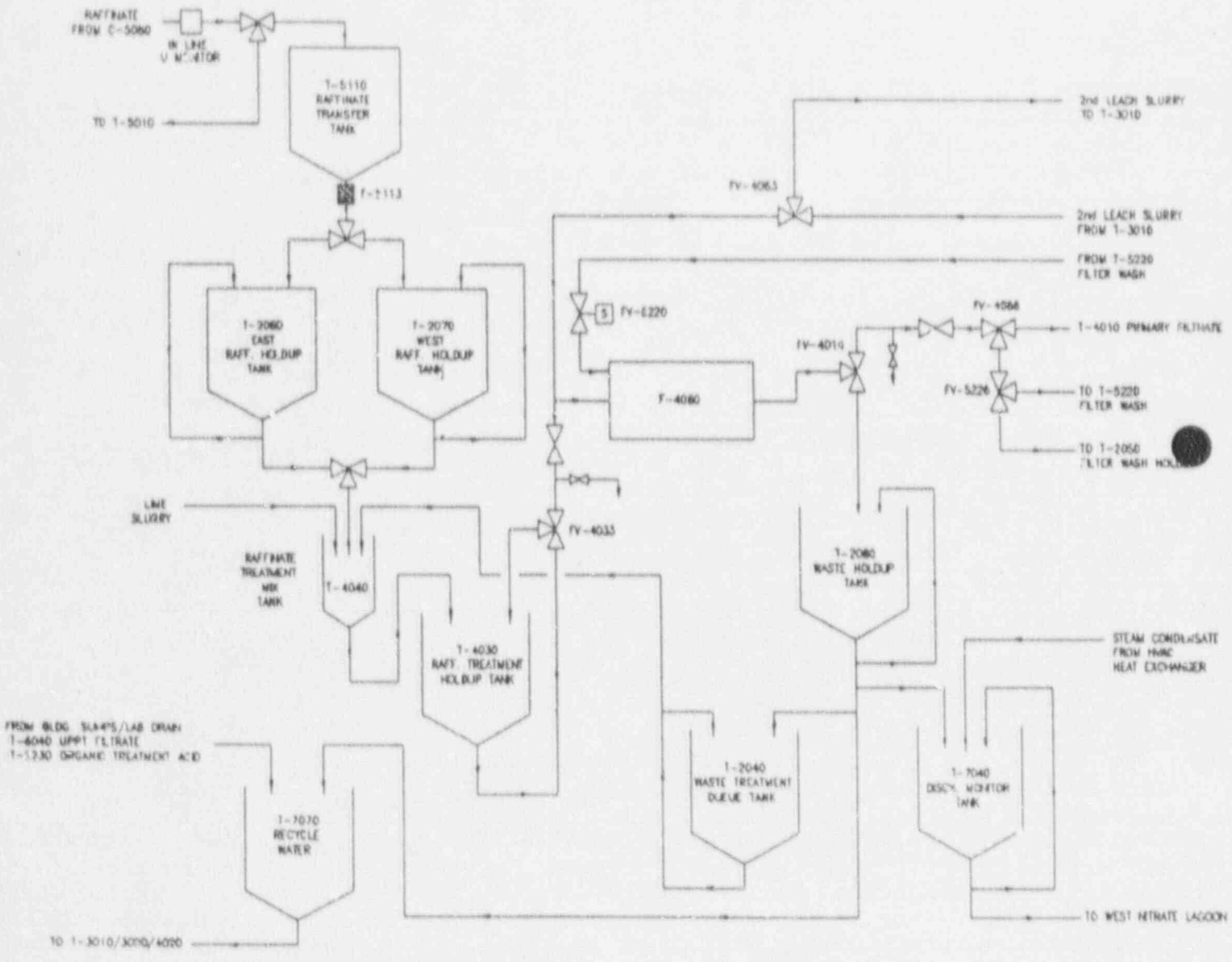
15.22.3.5.1 Process Description

The purpose of the raffinate treatment system is to process waste liquids generated in the plant for release into existing site waste streams (see Figure 8). The raffinate liquids discharged from the solvent extraction process are collected in Raffinate Holdup Tanks T-2060 and T-2070. This solution is pumped into the Raffinate Treatment Mix Tank T-4040 at a controlled rate where it is mixed with lime slurry to control the pH and to precipitate impurities so that it will be compatible with the plants waste stream.

The slurry formed in the treatment tank overflows into the Raffinate Treatment Holdup Tank T-4030. When this tank is full, the slurry is filtered by the Second Leach Filter F-4060. The filtrate is collected in T-2080, then discharged to the lagoon through the Discharge Monitor Tank T-7040. The cake is discharged into a waste box, sampled for uranium and activity, and staged for disposal off-site.

FIGURE 8

WASTE TREATMENT SYSTEM



15.22.3.5.2 Concentration Analysis

Analyses have been conducted to develop a scenario in which the uranium concentration would exceed 180 g U/L. It was concluded that this concentration could be attained only if the feed to the raffinate treatment contained a concentration of 61 g U/L. Normal uranium content in the raffinate leaving the SX system is expected to be less than 100 PPM. This content of 100 ppm uranium has been established as the safety control limit. The maximum credible concentration in the raffinate stream would be the same as that of the incoming aqueous feed to the SX system (37 g U/L).

15.22.3.5.3 Safety Features

To provide adequate assurance that the above established control limit is not exceeded the following controls are provided on the raffinate feed stream:

- The raffinate leaving the solvent extraction system is continuously monitored for uranium. If the above control limit is exceeded, the stream is diverted back to the SX feed receiver.

- The raffinate collected in Raffinate Holdup Tanks T-2060 and T-2070 is sampled and analyzed for uranium content prior to being released for lime treatment. Recirculation is provided to assure sample representativeness.

As previously discussed in the leaching/filtration portion of this analysis, the lime based slurry that is passed through the second leach filter is prevented from entering other parts of the process by a series of valving interlocks controlled by the digital control system.

Backflow within this system and out of this system is prevented by the combination of airbreaks and level sensing devices.

15.22.3.5.4 Safety Analyses

Based on the controls established above, adequate protection against precipitation or other circumstances which may increase concentration above that presented in Section 15.22.3.5.2 has been provided.

15.22.4 Radiological Safety

The facility will be operated according to the radiological control program requirements which exists for the current fuel manufacturing building. This includes exposure controls, personnel monitoring techniques, bioassay programs, area posting and radiation surveys.

Process areas of the facility are designated as airborne controlled areas similar to the controlled process areas of the existing fuel manufacturing building.

Radiation workers will access the controlled areas through a designated changeroom(s), where they will don standard controlled area protective clothing i.e., coveralls, head covering, shoe covers or controlled area shoes, rubber gloves). Persons exiting the controlled area will monitor for contamination following removal of protective clothing.

The facility processes have been designed to offer complete containment to the work areas, thus minimizing the potential for surface and airborne contamination. Process tanks are vented to a scrubber exhaust system. This exhaust system is water scrubbed then filtered through HEPA filters before discharge to the atmosphere.

All process areas are curbed to contain any spills or leaks. The curbed areas have collecting sumps and automatic pumping systems to return the spills to the proper vessel. The recovered uranium-bearing product is transferred out of the process areas in closed three and/or five-gallon pails which are not opened outside of approved hoods.

The existing fuel manufacturing building contamination control plan and action guides will be used for the facility. If contamination in excess of the guideline limits occurs, the necessary decontamination action is taken per existing procedures, based upon knowledge of the particular circumstances and the behavior of the material involved.

The operation of the facility will be conducted according to written instructions prepared by process engineers with inputs from nuclear safety engineering personnel. These documents provide on-the-floor instructions to operations personnel and contain criticality and radiological safety provisions. Each equipment operator is provided adequate training to follow these operating documents.

15.22.5 Plant Safety

15.22.5.1 Fire Protection

The fire protection provided meets or exceeds the plant requirements and the recommendation of the Factory Mutual Insurers.

The organic liquid in the solvent extraction system has a flash point > 160°F which is classified by NFPA as a combustible liquid Class III A, liquids with a flash point > 140°F and < 200°F. Fire safety devices designed into the system include:

- Smoke detectors in the exhaust system
- Sprinkler system in the organic liquid processing areas.
- Secondary liquid containment with a fusible link fire safe valve on the organic makeup lines.
- Strategically located fire extinguishers designed for specific fire control utilization.
- Sprinkler system incorporates an automatic shutdown system for all pumps in the organic processing area.

15.22.5.2 Chemical Safety

Personnel working in the process area containing hot acid are required to wear full face shields in addition to the standard protective clothing required for the controlled area.

Process vessels are vented to a central system which maintains a slight negative pressure in the tanks.

Any spills or overflows are contained within a curbed or diked area.

15.22.5.3 Process Control

The facility is controlled from a central control system located in the URLS building. The control system controls and monitors the uranium recovery operation. An operator in the control room is responsible for monitoring and controlling the process in addition to the operators on the floor.

Instrumentation is installed, operated, and maintained according to plant standards and requirements. All critical systems fail safe if there is an electrical or plant air failure.

15.22.6 Environmental

All effluents, whether gaseous, liquid or solids, are monitored to ensure release criteria are met. The release of radiological and non-radiological particulates, aerosols, fumes, and vapors is controlled to as low a level as reasonably achievable by filtration through high efficiency filters and by scrubbing the air through a packed air-water scrubbing system. Liquids are returned to the lagoons. Solids are analyzed and if within discharge limits, are released for off-site disposal. The uranium product is recycled to the existing fuel processing facility.

The process areas are maintained at a negative pressure with respect to atmosphere and adjacent areas. All exhaust air from the facility will be discharged through a single exhaust stack. Effluent constituents of concern will be continuously sampled or monitored as described in the current facility license information.

Favorable environmental impacts are expected from these activities by the elimination of uranium inventory from fluoride and nitrate waste treatment lagoons. An anticipated longer range benefit of the process, if successful, will be the uranium recovery and decommissioning of all uranium-bearing lagoons on site.