3.0 DESCRIPTION OF THE FACILITIES

The Nichols Ranch In-Situ Recovery (ISR) Project is divided into **three** units, the Nichols Ranch Unit, the Hank Unit, **and the Jane Dough Unit**. The Nichols Ranch Unit encompasses approximately 1,120 acres of land, the Hank Unit area encompasses approximately 2,250 acres of land, and the Jane Dough Unit encompasses approximately 3,680 acres. The project units will contain all of the proposed operations. The major surface facilities in the **Nichols Ranch and Hank Units** include the central processing plant, satellite plant, wellfields, and deep disposal wells. The injection and production proposed wellfield and disturbance area for Nichols Ranch Unit will contain approximately 113 acres, and Hank Unit will contain approximately 155 acres. The deep disposal wells will be designed such that there will be adequate disposal capacity for the various phases of operation (i.e. Production, Production and Resotration, and Restoration. For this application a disposal estimate of 100 gpm flow rate for each has been used and each disposal well will have a maximum injection pressure less than the fracture pressure of the formation. **The Jane Dough Unit only includes wellfields.**

3.1 IN SITU RECOVERY PROCESS AND EQUIPMENT

Uranerz plans to mine the Nichols Ranch Unit (Township 43N, Range 76 West, Sections 7, 8, 17, 18, and 20), Hank Unit (Township 44N, Range 75 West, Sections 30 and 31; Township 43N, Range 75 West, Sections 5, 6, 7 and 8) **and the Jane Dough Unit (Township 43 North, Range 76 West, portions of Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, and 34)** ore zones using the in-situ recovery (ISR) extraction method. This is the same method that is used by Power Resources Inc. (PRI) at the Smith-Highland mine in the southern Powder River Basin and is the same method used by COGEMA (AREVA) at the nearby Christensen Ranch site.

The ore zones at the Nichols Ranch Unit, the Hank Unit, and **Jane Dough** Unit will be divided into individual production areas where injection and recovery wells will be installed. As typical with the above mentioned commercial operations, the wells will be arranged in 4-spot, 5-spot or 7-spot patterns. In some situations, a line-drive pattern or staggered line-drive pattern may be employed. Horizontal and vertical excursion monitor wells will be installed at each wellfield as dictated by geologic and hydro-geologic parameters, and as approved by the Wyoming Department of Environmental Quality - Land Quality Division and the United States Nuclear Regulatory Commission. The facilities will be constructed according to acceptable engineering practices.

3.2 SITE FACILITIES LAYOUT

The Nichols Ranch Unit will consist of a complete processing plant including auxiliary facilities such as office, change room, laboratory, maintenance, and deep disposal well. The processing plant will have the capability of concentrating the wellfield recovery solution obtained from wells installed in the Nichols Ranch Unit ore zone. Figure 3-1 (see map pocket) is a site facility diagram of the Nichols Ranch Unit This figure shows the location of the major surface facilities. **The Jane Dough Unit will only contain wellfields as the uranium will be processed at the Central Processing Plant located in the Nichols Ranch Unit.**

In addition, the Nichols Ranch Unit processing facility will have excess installed capacity to process uranium loaded resin or yellowcake slurry from the Hank Unit Satellite plant. The accumulated uranium values from both ore zones will then be processed into a dry yellowcake concentrate, packaged in approved 55 gallon steel drums, and trucked off site for conveyance to the licensed uranium conversion facility of choice. At the Hank Unit there will be a plant building, maintenance building, and deep disposal well. A site facility diagram showing the major surface buildings for the Hank Unit is presented in Figure 3-2 (see map pocket).

3.2.1 Nichols Ranch Unit – Central Processing Plant

At the Nichols Ranch Unit processing facility, most of the process equipment will be housed in an approximate 150 x 250 ft metal building with eave heights less than 50 ft. The major process equipment is shown in Figure 3-3 (see map pocket), with some of the bulk chemical storage tanks located outside of the process building. The major equipment inside the process building will be the ion exchange circuit, the lixiviant make-up circuit, the elution/ precipitation circuit, and the yellowcake drying facility. During restoration, the water treatment system for aquifer restoration will also be located in the process building.

The yellowcake drying and drumming facilities will be located at one end of the process building. Due to the height of the dust abatement equipment, the building's eave height is approximately 40 ft at this end. A yellowcake storage area will be located adjacent to the yellowcake drying and packaging area. This will be an enclosed, heated area approximately

60 x 60 ft. By storing the drummed yellowcake within an enclosed area, employee safety will be improved (no snow or ice to work around) and the packaged product will be secured under locked conditions.

An office building, now planned to be approximately 150 x 60 ft, will be located adjacent to the process building. The office will be near the process building to allow use of a centralized lunch room and restroom facilities. In addition to office spaces for professional staff; a central security monitoring room, computer server room and the on-site laboratory will be located in the office building.

A second auxiliary building (maintenance building) will house the vehicle, electrical, and rotating equipment maintenance area, as well as provide an area for additional office spaces for field and operating personnel. The first aid area may be located in the maintenance building.

3.2.2 Hank Unit – Satellite Facility

The Hank Unit Satellite facility will consist of an ion exchange circuit and lixiviant make-up circuit, bleed treatment and disposal well. Most of the process equipment will be housed in an approximate 80 x 160 ft metal building with eave heights less than 40 ft. The process equipment layout is shown in Figure 3-4 (see map pocket) with some of the bulk chemical storage tanks located outside of the process building. Carbon dioxide will be added to the lixiviant as the fluid exits the Hank Unit satellite facility and returns to the header houses where oxygen and/or sodium bicarbonate could be added prior to injection into the wellfield.

3.2.3 Process Description

3.2.3.1 Uranium Recovery

The proposed uranium in-situ recovery (ISR) process has been successfully tested at the Ruth R & D project and at a commercial scale at other uranium ISR extraction properties in Wyoming including the nearby Christensen Ranch Mine. This process, involving the dissolution of the

water soluble uranium compound from the mineralized host rock at neutral pH ranges, consists of two steps. First, the uranium is oxidized from the tetravalent to the hexavalent state with an oxidant such as oxygen or hydrogen peroxide. Second, a chemical compound such as a baking soda ($NaHCO_3$) is used to complex the uranium in the solution if needed. The uranium rich solution (typically 20 mg/l to 250 mg/l, but may be higher or lower) is transferred from the production wells to the processing facility nearby for uranium concentration with ion exchange resin. Figure 3-5 (see map pocket) shows a general flow process schematic.

3.2.3.2 Lixiviant Composition

The lixiviant for the in-situ uranium recovery process is a dilute carbonate/ bicarbonate aqueous solution that is fortified with an oxidizing agent. During the injection of lixiviant, oxygen or hydrogen peroxide will be added to oxidize the uranium underground. A small amount of chlorine or sodium hypochlorite, approximately 3 mg/l as chlorine, may be added to the injection solution to prevent bacterial plugging of the injection wells. Carbon dioxide is provided to lower the pH to about neutral. Additionally, carbon dioxide dissolved in water provides another source of the carbonate/ bicarbonate ions. Finally, sodium carbonate/ bicarbonate may be used to adjust the carbonate/ bicarbonate concentration.

The barren solution that leaves the uranium ion exchange system will be refortified with chemicals prior to the re-injection into the ore zone aquifer. The process continues until the economics become unfavorable.

3.2.3.3 Process Plant Circuits

The proposed Nichols Ranch Unit processing plant will have three major solution circuits: 1) the recovery/ extraction circuit, 2) the elution circuit, and typically 3) a yellowcake slurry production circuit. The system is designed to recycle and reuse most of the solutions inside each circuit. A small bleed will be taken from each circuit to prevent buildup of undesirable ions. This bleed solution will be routed to the deep disposal well.

The recovery/extraction circuit includes the flow of lixiviant from the wellfield to the sand filters, or directly to the ion exchange columns and back to the wellfield. The uranium, that is liberated underground, is extracted in the ion exchange system of the process plant. The bleed from the circuit is permanently removed from the lixiviant flow to create a "cone of depression" in the wellfield's static water level and ensure that the lixiviant is contained by the inward movement of groundwater within the designated recovery area. The bleed is disposed of by means of injection into Class I – Non Hazardous approved deep disposal wells. The volume of the concentrated bleed is approximately 0.5% to 1.5% of the circulating lixiviant flow for the Nichols Ranch Unit and 2.5% to 3.5% for the Hank Unit.

The Nichols Ranch Unit elution circuit is designed to release the uranium from the loaded ion exchange resin by applying an aqueous solution of salt and sodium carbonate or sodium bicarbonate to the loaded ion exchange resin. The uranium concentration in the eluate will be built up at a controlled concentration range of between 20 to 40 grams per liter. This uranium rich eluate is ready for the de-carbonation process that occurs in the uranium precipitation circuit.

The yellowcake production circuit starts when the eluate is treated with acid to destroy the carbonate portion of the dissolved uranium complex. In addition to adding the acid slowly, a common defoamer may be used to reduce the foaming activity. The precipitation reagents, hydrogen peroxide and sodium hydroxide, or ammonia are added to the eluate to precipitate uranium yellowcake. The yellowcake slurry is then filtered, washed, dried, and drummed.

A bleed from the elution and the yellowcake precipitation circuits is used to control the concentration of undesirable ions such as sulfates. The chemical strength is refortified during each cycle.

3.2.4 Chemical Reactions

3.2.4.1 Underground Recovery

Oxidation of tetravalent uranium is achieved by using oxygen or hydrogen peroxide. For economic reasons, oxygen is widely used in commercial applications. Uranerz will utilize oxygen as the primary oxidant; however, hydrogen peroxide may be used if needed to increase the oxidation potential in the lixiviant.

The end product of the carbonate/bicarbonate complexing process can be identified as uranyl-dicarbonate, $[UO_2(CO_3)_2]^{2-}$ (UDC), at neutral pH ranges and as uranyl-tricabonate, $[UO_2(CO_3)_3]^{4-}$ (UTC), at more alkaline pH ranges.

The chemical reactions for the alkaline recovery process are listed as follows:

Oxidation:
$$UO_2 + ½ O_2 = UO_3$$
$$UO_2 + H_2O_2 = UO_3 + H_2O$$

Complexing:
$$UO_3 + 2HCO_3- = [UO_2(CO_3)_2]^{2-} + H_2O$$
$$UO_3 + 2HCO_3- + CO_3- = [UO_2(CO_3)_3]^{4-} + H_2O$$

3.2.4.2 Ion Exchange

A strong base resin will be used for the ion exchange of either the uranyl-dicarbonate complex, $[UO_2(CO_3)_2]^{2-}$ (UDC), or the uranyl-tricarbonate complex, $[UO_2(CO_3)_3]^{4-}$ (UTC), in the process plant.

The chemical reactions are listed as follows:

$$[UO_2(CO_3)_2]^{2-} + R^{2+} = R[UO_2(CO_3)_2]$$
$$[UO_2(CO_3)_3]^{4-} + 2R^{2+} = R_2[UO_2(CO_3)_3]$$

R denotes the active site on the ion exchange resin.

The barren lixiviant will be reconstituted to the proper bicarbonate strength if needed prior to wellfield injection. Sesqui-carbonate, soda ash, and/or carbon dioxide will be used, if needed, to maintain proper sodium bicarbonate strength. Carbon dioxide may also be used to adjust the pH.

3.2.4.3 Elution Process and Resin Handling

The resin is ready for elution when it is fully loaded with uranium. The elution process reverses the loading reactions for the ion exchange resin and strips the uranium from the resin. The eluant will be an aqueous solution containing salt and sodium carbonate and/or sodium bicarbonate.

The chemical reactions are listed as follows:

$$R\,[UO_2(CO_3)_2] = [UO_2(CO_3)_2]^{2-} + R^{2+}$$
$$R_2[UO_2(CO_3)_3] = [UO_2(CO_3)_3]^{4-} + 2R^{2+}$$

The elution circuit at the Nichols Ranch Unit facility will be designed to also accept and elute uranium loaded resin from other satellite operations. A DOT approved trailer will be used to transport the resin to and from satellite facilities. The resin will be hydraulically removed from the trailer and screened to remove formation sand and other debris. Once screened, the resin will flow by gravity into a dedicated elution vessel where the resin will be contacted with eluant.

3.2.4.4 Yellowcake Production

Yellowcake will be produced from the rich eluates that are processed at the Nichols Ranch Unit. The eluate from the elution circuit will be de-carbonated by lowering the pH below 2 with acid. The yellowcake product will be precipitated with hydrogen peroxide and a base such as sodium hydroxide or ammonia.

De-carbonation:

$$[UO_2(CO_3)_2]^{2-} + 4H^+ = UO_2^{2+} + 2CO_2 + 2H_2O$$
$$[UO_2(CO_3)_3]^{4-} + 6H^+ = UO_2^{2+} + 3CO_2 + 3H_2O$$

Precipitation:

$$UO_2^{2+} + H_2O_2 + 4H_2O = UO_4 \cdot 4H_2O + 2H^+$$

The precipitated yellowcake slurry will be transferred to a filter where excess liquid will be removed. Following a fresh water wash step that will flush the dissolved chlorides, the resulting product cake will be transferred to the yellowcake dryer which further reduces the moisture content, yielding the final dried free flowing product.

The yellowcake drier will operate under a vacuum. The use of vacuum conditions lowers the temperature at which the yellowcake solids are dried (typically 165 F to 190 F). At these temperatures, water soluble uranium oxides and other compounds are not formed. In addition, the vacuum draws solids and water vapor toward the system's interior preventing unwanted dust releases. This type of dryer is the same design that has been successfully used by Power Resources Inc. (PRI) at the Smith-Highland mine in the southern Powder River Basin.

3.2.5 Flow and Material Balance

The ion exchange system for the Nichols Ranch Unit is designed to accommodate flow rates up to 3,500 GPM. In order to contain the lixiviant within the designated wellfield recovery area, a small portion of the barren solution is withdrawn from the ion exchange circuit. The amount of bleed is estimated to be in the average range of 1% of the overall flow rate or equivalent to about 35 GPM.

The ion exchange system for the Hank Unit is designed for flow rates up to 2,500 GPM. The average bleed rate for Hank Unit is estimated to be 3% or equivalent to about 75 GPM. The bleed rate estimates are discussed in detail in Section 3.4.8 of this Chapter. **The bleed rate for the Jane Dough Unit is 1% and the production rate is 3,500 gpm.**

The bleed solution is to be used to rinse and clean-up freshly eluted resin, make-up fresh eluant in the elution circuit, back wash sand filters, and wash yellowcake if necessary. A flow and material balance for the two Units is presented nominally in Figure 3-6 (see map pocket). The flow shown is an example capacity for the facilities and does not represent any design or regulatory limits. A water balance is shown in Figure 3-7 (see map pocket).

3.2.6 Sources of Plant Liquid Effluents and Disposal Methods

Liquid effluents are expected to be generated from well development water, pumping test water, process bleed, process solutions, wash-down water, and restoration water. The water generated during well development and pumping tests is expected to satisfy WDEQ-WDQ Class IV (Livestock) standards at a minimum and has minimal potential radiological impact on soils or surface water. No alternate handling or disposal method is required allowing water to be pumped onto the ground.

The process bleed and wash down water will be transferred to a deep disposal well. This deep disposal well will be equivalent in design and depth to existing deep disposal wells at similar *in situ* uranium recovery sites. This deep disposal well will be permitted through the WDEQ and operated according to permit requirements. Uranerz will demonstrate UIC approval from WDEQ for the deep disposal wells prior to injection.

The restoration water will be treated by reverse osmosis or other purification technology. The treated restoration water will be re-injected into the process with the restoration water bleed transferred to the deep disposal well.

Uranerz plans to use at least two Type I – Non Hazardous deep disposal wells. As required, the disposal wells will be completed in approved formations. A typical deep disposal well is depicted in Figure 3-8 (see map pocket).

To ensure that Uranerz can maintain acceptable bleed rates if a problem arises with a deep disposal well, a number of items were considered. Uranerz commits to having two deep disposal wells drilled prior to starting up Nichols Ranch. Uranerz also commits to having critical spare parts on site for the deep disposal well injection system. Uranerz investigated timing for deep disposal well emergency maintenance. The work over is estimated to be an average of 5 days. Frac tank availability and tank rental information was obtained. Frac tanks are readily available in Wyoming from the petroleum industry, and can be mobilized quickly. The tanks are capable of holding 16,800 gallons of water each.

Uranerz also conducted an analysis regarding shutting in the wellfield and not having a bleed during the time the deep disposal well is down. A cone of depression is in place, and Uranerz wanted to determine the amount of time the groundwater would migrate without a bleed.

A depression in the piezometric surface will exist during operation of the wellfields. If the wellfield operation had to be shut-in for a short period of time the water levels would gradually recover with flow inward to the wellfield on the down gradient side initially, then becoming a very flat gradient with very little flow and finally recovery to a outward gradient that is flatter than the natural gradient for the aquifer. The use of the natural gradient to estimate the movement of the ground water outward during a shut-in period is therefore very conservative. The use of the natural gradient in the ground-water movement rate should account for the variability in the ground-water velocity due to variability in aquifer properties.

The natural ground-water velocity for the A Sand aquifer at Nichols Ranch Unit is 12 ft/yr. This ground-water velocity was used to estimate the movement of ground-water at Nichols Ranch Unit for 45 days of non-operation which indicates that the ground-water would move less than two feet from its position prior to the shut-off period. This analysis demonstrates adequate containment of the ISR solution during a significant shut-in period of 45 days at the Nichols Ranch Unit.

The natural ground-water velocity for the F Sand aquifer at Hank Unit is 8 ft/yr. The use of this ground-water velocity to estimate the travel distance of the ISR solution during a 45 day shut-in period indicates that the solution would move roughly one foot during the non-operation period. This indicates that the Hank Unit solution should adequately be contained during a significant shut-in period of 45 days.

For the Nichols Ranch Unit there are three types of liquid effluent that will constitute the bleed that can be up to 35 GPM: 1) the wellfield bleed, 2) the elution circuit bleed, and 3) the general plant waste (resin wash, filter backwash, etc). A small quantity of water, about 1 to 2 GPM, may be introduced from a permitted water well for plant wash down and yellowcake wash.

Nichols Ranch Unit 1% Bleed

Production Only

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)40	GPM
Other	(-)1-2	GPM
Remaining Balance	+58	GPM

Production and Restoration

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)40	GPM
Restoration Flow to DDW	(-)57	GPM
Other	(-)1-2	GPM
Remaining Balance	+1	GPM

Restoration Only

Deep Disposal Well (DDW) Flow	+100	GPM
Restoration Flow to DDW	(-)90	GPM
Other	(-)1-2	GPM
Remaining Balance	+8	GPM

Jane Dough Unit 1% Bleed

Jane Dough production occurs after the Nichols Ranch Unit production is over. Therefore production and restoration water balance usage will not increase with Jane Dough Unit but will only extend the same usage for a longer period of time.

Hank Unit 3% Bleed

Production Only

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)75	GPM
Other	(-)1-2	GPM
Remaining Balance	+23	GPM

Production and Restoration

Deep Disposal Well (DDW) Flow	+100	GPM
Production Flow to DDW	(-)75	GPM
Restoration Flow to DDW	(-)22	GPM
Other	(-)1-2	GPM
Remaining Balance	+1	GPM

Restoration Only

Deep Disposal Well (DDW) Flow	+100	GPM
Restoration Flow to DDW	(-)90	GPM
Other	(-)1-2	GPM
Remaining Balance	**+8**	**GPM**

It should be noted that the previous numbers are estimates only. Uranerz plans to permit four (4) disposal wells at each site. If the flow estimates for one disposal well prove to be inadequate, additional wells will be added to accommodate the disposal requirements.

For the restoration operation, reverse osmosis or other purification technologies will be used to treat the recovery solution from the spent production areas. The ground-water restoration plan is discussed in detail in Chapter 6.0. For a typical restoration schedule, the anticipated liquid effluent flow rates are:

Pore Volume	Gross Water Withdrawn	Net Water Consumption
1st	50 GPM	50 GPM
2nd to 5th	200 GPM	50 GPM
6th	50 GPM	50 GPM

The average annual net water consumption from the ore zone aquifer during restoration activities is anticipated to be approximately 50 GPM.

The potential effluents that will need to be controlled for the Nichols Ranch ISR Project include radon, radioactive particulates in air, and radionuclides in liquid streams. The effluent control for gaseous and airborn particulates and liquid and solid wastes are discussed in detail in Chapter 4.0. For solid waste Uranerz will obtain an agreement with a licensed and approved 11e.(2) by product disposal facility. Uranerz will notify the NRC in writing within 7 days if the agreement expires or is terminated, and Uranerz will submit a new agreement for NRC approval within 90 days of the expiration of the termination. Uranerz commits to provide the NRC with the details of the waste disposal agreement for 11e(2) byproduct disposal at an NRC or Agreement State licensed facility. Uranerz plans to have readily available the most current safety equipment and personal protective equipment at the Nichols Ranch Unit and Hank Unit.

The storage of contaminated equipment, including wastes, will be in the fenced-plant boundary for the Nichols Ranch and the Hank Units. The amount of 11e(2) byproduct material stored at the Nichols Ranch Unit and Hank Units will be kept to a minimum. The byproduct material

from the plants will be placed into drums such as 55-gallon drums with drum liners, or placed in watertight packages such as super sacks. The packages will be located in restricted areas until placed inside an 11e(2) disposal container. After a package is full it will be moved to the plant's 11e(2) byproduct storage area, and the contents placed in a strong tight container such as a roll-off container. If material such a pipe is too large to fit in the package, the large material will be placed in a lined container inside th 11e(2) disposal area. The storage areas are shown on the revised diagrams: Figure 3-1 Site Facility Diagram Nichols Ranch Unit and Figure 3-2 Site Facility Diagram Hank Unit. The areas will have concrete pads and or gravel pads and appropriate signage. The strong tight containers will follow DOT regulations, and typically be covered containers with an estimated capacity of 20 cubic yards. After a container is filled, it will be transported to an approved 11e(2) byproduct storage facility.

In the wellfields outside the plant areas there will be some temporary storage of equipment and supplies that are needed for wellfield construction. Equipment and materials that are not releasable for unrestricted use and are not amenable to placement in a container will be stored to prevent dispersion and migration of contamination; e.g. decontamination of removable or covering to prevent weathering. The wellfield sites will be minimized, have appropriate signage, and will be within the wellfield fenced boundary.

3.3 CHEMICAL STORAGE FACILITIES

Uranerz plans to use chemicals to extract uranium, process waste water, and restore groundwater. The Nichols Ranch Unit and the Hank Unit will store chemicals that are both hazardous and nonhazardous. The different types of chemicals will be stored in separate locations **in accordance with regulatory agency requirements.** A list of possible chemicals to be used at the facilities include: hydrochloric acid, hydrogen peroxide, sodium chloride, sodium hydroxide, sodium hypochlorite, anhydrous ammonia, oxygen, carbon dioxide, sodium carbonate, and sodium bicarbonate. **Chemicals that could be located at the Hank Unit include oxygen, carbon dioxide, and sodium bicarbonate. During operations and especially during groundwater restoration activities, hydrochloric acid may be located at the Hank Unit. Sodium carbonate and/or sodium bicarbonate could be located at the Hank Unit for leaching.** Material Safety Data Sheets (MSDS) for each of the chemicals will be reviewed for facility safety The sheets will be located at the Nichols Ranch Unit and the Hank Unit.

No chemicals will be stored in the Jane Dough Unit.

3.3.1 Process Related Chemicals

Chemicals that are considered hazardous and have the potential to effect radiological safety are anhydrous ammonia (pH adjustment), hydrogen peroxide (uranium precipitation and oxidant in lixiviant), and hydrochloric acid (pH adjustment). These chemicals will be located outside of the main processing building, **unless small quantities (e.g. totes, drums etc.) are delivered and may be stored within the plant or satellite.** The outside storage locations will have a concrete curbed secondary containment basin for tanks **containing liquids (e.g. hydrochloric acid) unless tanks are designed with internal secondary containment (e.g. gas and diesel fuels)**.

Oxygen (oxidant in lixiviant), sodium hydroxide (pH adjustment), sodium hypochlorite, carbon dioxide (carbonate complexing), sodium carbonate/bicarbonate (carbonate complexing and resin regeneration), and sodium chloride (resin regeneration) are the other bulk chemicals used for processing uranium. The carbon dioxide is typically stored outside and is added to the lixiviant before the flow leaves the ion exchange facilities. Oxygen can also be stored centrally so that it can be added to the injection stream in each header house or if necessary the oxygen can be added down hole with individual spargers. A down hole sparger is typically constructed of approximately two feet of three quarter inch diameter weighted PVC pipe capped on the lower end. One sixteenth inch diameter holes are drilled throughout the two feet of pipe. The perforated pipe acts as a sparger and diffuses the oxygen for dissolution into the injection fluid.

Due to the possibility of gas locking problems in the ore bearing formation, Uranerz commits to not using hydrogen peroxide at the Hank Unit. In addition, Uranerz will monitor the recovery solution to insure excess oxygen does not become evident so no possibility of gas locking can occur. Periodic testing of the oxygen levels will be performed on the recovery solution to insure the solubility limit is not exceeded. Special care will also be taken to control the amount of oxygen added to the injection solution in areas of low hydrostatic pressure to insure off gassing of oxygen does not present a problem. An additional corrective action that may be taken is to cycle wells from injection to extraction duty during the mining sequence. Pressure gauges and oxygen flow meters on the injection solution will be used during oxygen addition to insure no excess of oxidant

occurs. If necessary, a limited number of ore body wells will be installed with completion of the wells being just below the upper aquitard to relieve any build up of gas in that area.

The sodium hydroxide, sodium carbonate/bicarbonate, and sodium chloride will be stored inside the main processing plant near the point of addition.

Standards for transporting, handling, storing, and managing hazardous chemicals have been developed by regulatory agencies. Uranerz conducted detailed design work for chemical usage and chemical storage areas. The detailed design calculations were based upon using sodium hydroxide and not ammonia, and then hydrochloric acid and not sulfuric acid. Uranerz confirms compliance with NUREG-6733, Chapter 4 for Chemical Hazard Consequence Analysis. The list belowsummarizes the specific regulations for the proposed chemicals.

3.3.2 Nonprocess Related Chemicals

Chemicals that are nonprocess related materials are stored at the Nichols Ranch Unit and the Hank Unit. The materials include gasoline, diesel and propane. Since these materials are considered flammable and/or combustible, the bulk quantities are stored outside of the main buildings. The storage tanks are located above ground and within secondary containment unless tanks are designed with internal secondary containment (e.g. gas and diesel fuels).

Chemical	Name	Regulation	Minimum Reporting
NH_3	Ammonia	Threshold Quantity(TQ) from Clean Air Act for 40 CFR part 68 RMP	10,000 lb
		TQ for OHSA 29 CFR part 1910.119 Process Safety Management	10,000 lb
		TPQ (planning) for 40 CFR part 355 Emergency Response (ERP)	500 lb
		Reportable for CERCLA from 40 CFR 302.4	100 lb
H_2SO_4	Sulfuric Acid	TPQ for 40 CFR 355 ERP	1,000 lb
H_2O_2	Hydrogen Peroxide	TPQ for 40 CFR 355 ERP (conc > 52%)	1,000 lb
		TQ for OSHA 29 CFR 1910.119 PSM (conc > 52%)	7,500 lb
O_2	Oxygen	Not listed in any of the 4 regulations	NA
CO_2	Carbon Dioxide	Not listed in any of the 4 regulations	NA
Na_2CO_3	Sodium Carbonate	Not listed in any of the 4 regulations	NA
NaCl	Sodium Chloride	Not listed in any of the 4 regulations	NA
HCl	Hydrochloric Acid	TQ from CAA for 40 CFR Part 68 RMP (conc >37%)	15,000 lb
		TQ from OSHA for 29 CFR 1910.119 PSM (anhydrous HCl)	5,000 lb
		RQ for CERCLA from 40 CRF 302.4	5,000 lb
NaOH	Sodium Hydroxide	RQ for CERCLA from 40 CRF 302.4	1,000 lb

3.4 WELLFIELDS

3.4.1 Ore Zone

The ore zones for the Nichols Ranch Unit **and Jane Dough Unit** are 300-700 ft below the surface and occur in two long narrow trends meeting at the nose. The nose is the northwest corner of the ore zone where the two narrow trends meet to form the tip of the geochemical front. **Ore zones for the Jane Dough Unit is approximately 400 to 600 feet below the surface and occur in two production units.** The Hank Unit's ore zones are approximately 200-600 ft below the surface. The depths of the three units depend on the topography, the changes in the levels of the formation and the stratigraphic horizon. The host sand for the Nichols Ranch Unit is

designated as the A Sand and the Hank Unit host sand is designated as the F Sand. The average grade of the two units is above 0.1%, the average thickness is above seven feet, and the combined areal distribution is near 100 acres.

3.4.2 Wellfield Areas

Wellfields are designated areas above the ore zone that are sized to reach the desired production goals. The ore zone is the geological sandstone unit where the leaching solutions are injected and recovered in an in situ recovery wellfield and it is bounded between impermeable aquatards. Production areas are the individual areas that will be mined in the wellfield. The injection and recovery wells are completed in the ore zone intervals of the production sand. Horizontal monitor wells are located in a ring around the wellfields. Vertical monitor wells for overlaying and underlying aquifers are installed accordingly for one monitor well for every 4 acres of wellfield area. The distance between the monitor wells in the same aquifer shall not exceed 1,000 ft, and all monitor wells are installed within the production area unit. The final locations of the horizontal and vertical monitor wells will be submitted in the Production Area Pump Test Document as described in Section 5.7.8. This is because the actual locations might need to be changed because of topography, access, etc. The screened intervals for the excursion monitor wells are across the entire production zone.

3.4.3 Wellfield Injection and Recovery Patterns

The patterns for the injection and recovery wells follow the conventional 5-spot pattern. Depending on the ore zone shape, 7-spot or line drive patterns may be used. A typical 5-spot pattern is shown in Figure 3-9 (see map pocket) and contains 4 injection wells and 1 recovery well. The dimensions of the pattern vary depending on the ore zone, but the injection wells will likely be between 50 and 150 ft apart. In order to effectively recover the uranium and also to complete the groundwater restoration, the wells will be completed so that they can be used as either injection or recovery wells. The leaching solution will be injected into the injection wells, and the solution will be recovered through the recovery wells. To create a cone of depression in the wellfield, a greater volume of water is recovered than injected. The excess water or wellfield

bleed will be disposed of in a Class I deep disposal well. With the cone of depression being created, the natural groundwater movement from the surrounding areas is toward the wellfield providing an additional control of the leaching solution.

Wellfield bleed is defined as the difference between the amount of solution injected and produced. The bleed rate is anticipated to average 1% of the total production rate for the Nichols Ranch Unit and up to 3% for the Hank Unit. Over- production can be adjusted to guarantee the horizontal ore zone monitor wells are influenced by the cone of depression from the wellfield bleed.

Depending on the oxidation requirement of the formation, the injection wells may be equipped with down-hole oxygen spargers with oxygen being metered through individual rotometers so that each well can be controlled as to the amount of oxygen concentration it receives, or a header house oxygen manifold distributor will be installed. Header houses are small buildings that contain the manifolds with valves, piping, and instrumentation for injection and recovery wells. Each header house will contain up to 60 well accommodations. There are two possible designs for a typical header house, and they are shown in Figures 3-9A Header House Details (see map pocket) and 3-9B Header House Details Ground Level (see map pocket), and the details of the piping and instrumentation for the header house is shown in Figure 3-9C Header House Piping and Instrumentation (see map pocket).

The header houses will be metal buildings. There are two possible designs for the buildings and foundations. Depending on the terrain and logistics in the wellfield, one of the two designs will be used. Design A will have the metal building set on top of a foundation built of materials such as concrete or steel. The foundation will have grating which will allow access to the sub floor containing valves and hose runs. The maximum dimensions for the header houses will be up to **40 feet by 20 feet with a six inch concrete pad floor. The floor will slope to a sump with an automatic level control pump. The sump will pipe to the recovery line and will include check valves. Design B will have the metal building set on a pad.** The inside of the building will be designed so that the main connection valves and hose runs are behind one of two walls that run

the length of the header house. The walls will be three to four feet from the building edges, and thus allow for maintenance and operators to conduct their inspections and work on the ground level, and not in the sub floor area.

There are two separate solution trunk lines connecting the header houses. One of the trunk lines will take the recovery solutions from the header houses back to the processing plants, and the other trunk line will take injection fluid from the plants out to the header houses for injection into the wellfields. The actual number of header houses will depend on field placement of wells.

At each header house the individual injection and recovery flow and pressure readings can be monitored. Individual well flow readings will be recorded on a shift basis, and the overall wellfield flowrates will be balanced at least once per day. Alternately, flow and totallizer data will be transferred to the main or satellite plant and checked automatically. The recovery and injection trunk lines will have electronic pressure gauges and the information will be monitored from the Unit's control room. The control system will have high and low alarms for pressure and flow. If the pressure and/or flow is out of range the alarms will alert personnel to make adjustments, and certain ranges will signal automatic shutoffs or shutdowns.

The pipelines transport the wellfield solutions to and from the ion exchange columns. The flow rates and pressures are monitored to the individual lines. Automatic valves are installed for control of the flow. High density polyethylene (HDPE), Polyvinyl chloride (PVC), and/or stainless steel piping are used in the wellfield. The piping will be designed for operating pressure of 150 psig. However, the equipment will be operated at pressures less than or equal to the designed piping and other equipment ratings. If higher operating pressures are needed, the overall system will be evaluated and materials of construction with appropriate pressure ratings will be used.

Some of the lines from the ion exchanges facilities, header houses, and individual well lines may be buried to prevent freezing. Other ISR sites in Wyoming have successfully buried pipelines to protect them from freezing.

3.4.4 Wellfield Operations – Production Areas

To plan production, develop extraction schedules, establish baseline data, comply with monitoring requirements and complete restoration, the Nichols Ranch Unit will be divided into two production areas. The Nichols Ranch Unit contains the central processing plant with two production areas, NR Production Area #1 and NR Production Area #2. As the productivity or head grade of some patterns for the NR Production Area #1 decrease below the economic limit, replacement patterns for the NR Production Area #2 will be placed into operation in order to maintain the desired flow rate and head grade to the processing plant. Eventually, all the patterns in NR Production Area #1 will reach their economic limit and all production flow in that area will cease. At that time, all production flow will be coming from NR Production Area #2, and restoration activities will commence at NR Production Area #1. Figure 3-10 (see map pocket) shows the two Production Areas for Nichols Ranch. A characteristic flow rate for each of the two Nichols Ranch Unit Production Areas will range from 1,000-3,500 gallons per minute (GPM).

The Hank Unit is a remote satellite facility with two production areas, Hank Production Area #1 and Hank Production Area #2. The Hank Production Areas will follow a similar developmental, production, and restoration schedule as outlined in the above section for the Nichols Ranch Production Areas. The two Hank Production Areas are shown in Figure 3-11 (see map pocket). A characteristic flow rate for each of the Hank Unit Production Areas will range from 1,000-2,500 (GPM).

The Jane Dough Unit is divided into two production area, Jane Dough Production Area #1 and Jane Dough Production Area #2. The Jane Dough Production Areas will follow a similar developmental, production, and restoration schedule as outlined in the above section for the Nichols Ranch Production Areas. The two Jane Dough Production Areas are shown in Figure 3-11a (see map pocket). A characteristic flow rate for each of the two Jane Dough Unit Production Areas will range from 1,000 - 3,500 gpm.

A Gantt chart showing Nichols Ranch, Hank, **and Jane Dough** Production Areas is shown in Figure 3-12 (see map pocket). The chart shows the proposed plan for production, groundwater restoration, and decommissioning of each production area. However, the plan is subject to change due to extraction schedules, variations with production area recoveries, production plant issues, economic conditions, etc. The exact annual extraction schedules will be updated in the Annual report to the WDEQ. The proposed plan incorporates an adequate water balance calculations so that the deep disposal well can process the proposed production and restoration efforts at any given time.

The amount of time for restoration shown in Figure 3-12 is based on the current estimate of deep disposal well capacity and the restoration methods outlined in Chapter 6.0 of the Technical Report. As stated in Chapter 6.0, Section 6.1, Uranerz will adhere to 10 CFR 40.42. When decommissioning and/or restoration begin, the NRC will be notified and a plan submitted for review or approval. If, at that time, groundwater restoration is estimated to take longer than 24 months based on items such as deep disposal well capacity, Uranerz will request an alternate schedule as allowed under 10 CFR 40.42(i).

After each production area is completed, aquifer restoration will begin as soon as practical. If a completed production area is near a unit that is currently being mined, a portion of the first production area's restoration may be delayed to limit interference with the current extraction production area. The exact production area size and location may change based on the final delineation results of the ore zone and the actual production performance of the particular ore zone.

3.4.5 Well Completion

Pilot holes for monitor, production, and injection wells are drilled through the target completion interval with a small rotary drilling unit using native mud and a small amount of commercial drilling fluid additive for viscosity control. The hole is logged, reamed, casing set, and cemented to isolate the completion interval from all other aquifers. The cement will be placed by pumping it down the casing and forcing it out the bottom of the casing and back up the casing-drill hole annulus. The drill holes will be large enough in diameter for adequate sealing and, at any given depth, at least three inches greater in nominal diameter than the diameter of the outer casing at that depth.

Typical well completion schematics for production wells (recovery and injection wells), and monitor wells are shown on Figures 3-13 (see map pocket) and 3-14 (see map pocket), respectively. Production zone ring monitor wells, overlying monitor wells, and underlying monitor wells are completed with the entire aquifer sand exposed to open hole. Screens are

installed in these wells and open slots are adjacent to the sand for the entire thickness of the aquifer. Production zone monitor wells do not have screens installed in them. Some of these wells have the entire thickness of the production sand exposed. The remainder of this type of well is under reamed for better contact with the mineralization but collectively cover the full thickness of the production aquifer.

The well casing will be fiberglass, PVC, or HDPE. The fiberglass casing has a standard joint length of 30 ft and is rated for at least 950 pounds per square inch operating pressure. PVC well casing is typically 4 to 6 inches in diameter and SDR·17 to SDR·26 (or equivalent). The PVC casing joints normally have a length of approximately 20 ft each. When PVC casing is used, each joint is connected by a water tight o-ring seal. The casing for the well completions will be joined using an O-ring and spline locking system. Screw and glue joints will not be used for well completions. Products that typically are used include CERTA-LOK and SureFIT.

Casing centralizers, located approximately every 40 ft along the casing, are normally placed around the casing to ensure it is centered in the drill hole. Effective sealing materials shall consist of neat cement slurry and/or sand-cement grout meeting Wyoming State requirements described in Section 6, Chapter 11 of the LQD Non Coal Rules and Regulations unless a variance is obtained from the LQD Administrator. The purpose of the cement is to stabilize and strengthen the casing and plug the annulus of the hole to prevent vertical migration of solutions. If needed, the upper portion of the annulus will be cemented from the surface to stabilize the wellhead. This procedure is called "topping off." Tremie pipes can be used to top off a well.

After the well is cemented and the cement has set, the well is under reamed in the mineralized zone and completed either as an open hole or it is fitted with a screen assembly (slotted liner), which may have a sand filter pack installed between the screen and the under reamed formation. The well may then be air lifted for 30 minutes or more to remove any remaining drilling mud and/or cuttings. A submersible pump or small trailer mounted air compressor may be run in the well for final cleanup and/or sampling.

3.4.6 Well Casing Integrity

After an injection or recovery well has been completed, and before it is made operational, a Mechanical Integrity Test (MIT) of the well casing is conducted. For the integrity test, the bottom of the casing adjacent to or below the confining layer above the production zone is sealed with a plug, down hole packer, or other suitable device. The top of the casing is then sealed in a similar manner or with a sealed cap, and a pressure gauge is installed to monitor the pressure inside the casing. The pressure in the sealed casing is then increased to 125% of the maximum operating wellhead casing pressure or to an amount less than the formation fracture pressure (which is less). The well pressure is then monitored for a period of 10 minutes. A well is considered satisfactory with a pressure drop of no more than 10%.

If there are obvious leaks, or the pressure drops by more than 10% during the 10 minute period, the seals and fittings will be reset and/or checked and another test is conducted. If the pressure drops less than or equal to 10% the well casing is considered to have demonstrated acceptable mechanical integrity.

The results of the MITs conducted during a quarter are documented on a quarterly bases to include the well designation, date of the test, method by which the MIT was completed, verification of whether the MIT was or was not established, test duration, beginning and ending pressures, and the signature of the individual responsible for conducting the test. Results of the MITs are maintained on site and are available for inspection by NRC and WDEQ personnel. In accordance with regulatory requirements the results of MITs are reported to the WDEQ on a quarterly basis for those wells that were tested. In accordance with WDEQ and EPA requirements, MITs are repeated once every five (5) years for all wells used for injection of lixiviant, or injection of fluids for restoration operations.

If a well casing does not meet the MIT criteria, the well will be placed out of service and the casing may be repaired and the well re-tested or abandoned. If a repaired well passes the MIT, it will be employed in its intended service. If an acceptable test cannot be obtained after repairs, the

well will be plugged and abandoned. The WDEQ-LQD Administration will be notified in

the quarterly report of wells that fail the MIT. In the quarterly report the following is required: the identification of the failed well, a description of the method of plugging or repair, a status of the corrective actions on defective wells, the results of well plugging or repair, statements that the wells were plugged according to the approved permit and that the volume of material used for plugging equals the volume of material placed in the well.

The injection pressures for the Class III wells for the Nichols Ranch Unit, the Hank Unit, **and Jane Dough** will be calculated to assure the pressure in the production zones do not generate new fractures or spread existing fractures. Uranerz Energy Corporation will operate the Class III wells in a manner that the injection pressure will be lower than the calculated pressure that could fracture the confining zone, or cause the injection fluid to migrate to unauthorized zones. The injection pressure for the Nichols Ranch Unit, Hank Unit, **and Jane Dough Unit** will be no greater than 60% (range – 38% to 60%) of the formation fracture pressure and will not exceed the pressure rating of the casing.

Search of published fracture gradient information resulted in selecting a conservative fracture gradient of 0.80 psi/ foot of depth, for reservoir rock formations of 2,000 feet in depth or less. The following range for maximum injection pressures are: average depth for Nichols Ranch (600 ft X 0.80 psi/foot = 480 psi) and average depth for Hank (375 ft X 0.80 psi/foot = 300 psi). The range of 480 psi to 300 psi is greater than the maximum injection pressure ratings for PVC casing that Uranerz intends to use. The maximum operating pressure rating for SDR 17 casing is 180 psi and for SDR 21 casing (if used would only be at Hank) is 130 psi. MIT testing will be conducted at the maximum operating pressure of the installed casing. The casing pressure rating; therefore, will be the limiting factor and maximum injection pressure would be 180 psi. At Nichols Ranch 180 psi is 38% of the formation fracture pressure and for Hank it is 60% of the formation fracture pressure.

Injection wells will not be used for injection purposes if they do not demonstrate mechanical integrity. Additionally, a MIT will be conducted on any well to be used for injection purposes after any well repair where a down hole drill bit or under reaming tool is used. Any injection well with evidence of suspected subsurface damage will require a new MIT prior to the well being returned to service.

3.4.7 Monitoring of Wellfield Flow and Pressure

Injection well and recovery well flow rates and pressures are monitored in order that injection and recovery can be balanced for each pattern and the entire production area. Recovery flow rates will always be greater than injection rates. This flow information is also needed for assessing operational conditions and mineral royalties. The volume of fluid for each recovery and injection well is determined by monitoring individual flow meters in each production areas header houses. Recovery well volumes are determined on a daily basis. More details on the instrumentation are given in a following Section 3.5.

3.4.8 Monitor Well Ring Gradient Reversal

3.4.8.1 Analytical Modeling

An analytical simulation of the gradient reversal was conducted with the use of the Theis well flow equation, and a program by Walton (1989), which is called "WELFLO". The program sums the drawdowns from numerous stresses over a grid. The critical location for the gradient reversal at the Nichols Ranch Unit is to the northwest in the down gradient direction. The wellfield orientation extends in this direction; therefore, the drawdowns for the northwestern portion of the wellfield were calculated to evaluate the gradient reversal. Figure 3-15 (see map pocket) shows the location of 73 recovery wells in the northwestern end of the number one wellfield. Additional stresses were lumped together and placed at 15 locations over the remainder with the wellfield, which extends an additional length of 4,800 ft to the southeast of these 73 stresses. This accounts for the entire stress from the wellfield with distribution of the stresses over the area. The bleed rate was applied to each of the recovery wells to simulate the net withdrawal of water from the A Sand aquifer.

An average transmissivity of 350 gal/day/ft and a storage coefficient of 1.8E-4 were used to simulate the drawdowns resulting from the bleed of the Nichols Ranch Unit Production Areas. A stress of 0.155 gpm was applied to each of the 73 recovery wells shown in the northern portion of the production area. The lumped bleed rates for the remaining 15 stresses varied from 0.93 to 2.48 gpm for a total bleed of 23.7 gpm from the additional stresses. The simulation period was one year to allow definition of the gradient reversals after a significant period of operation. The cumulative drawdown was calculated at each of the nodes. The differences

between the 100 ft node drawdowns to the northwest (ground water gradient direction) are shown on Figure 3-15 (see map pocket).

This simulated bleed rate was 1% of the overall flow and the distance between adjacent nodes on the diagonal is 141 ft. In the northwest direction, a simulated head difference between adjacent nodes that is greater than 0.47 ft indicates gradient reversal toward the wellfield. The northwest corner of the model grid is approximately 1,100 ft from the northwest edge of the wellfield, and the simulated head difference between adjacent nodes in the northwest corner of the model grid is much greater than 0.47 ft. Hence, the operation of the Nichols Ranch Unit Production Areas at a bleed of 1% will result in gradient reversal to the wellfield at a distance much greater than 1,100 ft from the northwest edge of the wellfield. A horizontal monitoring ring that is located 500 ft from the perimeter of the Nichols Ranch Unit Production Areas is within the zone of gradient reversal and will be adequate for detection of potential excursions from the Production Areas. These monitoring wells will also be spaced 500 ft from each other.

The magnitude of this simulated gradient reversal shows that the maintenance of a reversal zone in the confined aquifer at the Nichols Ranch Unit is readily achievable, and adjustments in local wellfield balance can be used to quickly induce reversal in the event of excursions.

The groundwater gradient at the Hank Unit site is 0.005 ft/ft to the west. Seventy one wells in the southern end of the Hank Unit Production Area #1 were used to simulate the composite drawdown response for the Hank Units at a rate of 0.426 gpm per well. Aquifer properties used in the simulation were a transmissivity of 400 gal/day/ft and a specific yield of 0.05. A simulation period of 365 days was also used for the Hank Unit Production Areas. The Hank Unit Production Areas are planned for a 2,500 gpm production rate and a 3% bleed was used in this simulation. This resulted in a stress at the seventy one recovery wells of 0.426 gpm. An additional nine stresses were used to simulate the remaining 105 wells in the northern portion of the wellfield with varying stresses from 3.41 to 7.24 gpm for a total additional stress of 44.74 gpm for the northern wells. The total stress rate was 75 gpm.

Figure 3-16 (see map pocket) shows the results of the gradient reversal for the Hank Unit. The head change between the 100 ft nodes is shown on this figure to the left of the 71 recovery stresses. An additional drawdown of 0.5 ft is needed to create gradient reversal toward the wellfield. Horizontal monitoring ring distance for this unconfined aquifer will be adequate at a distance of 500 ft from the wellfield perimeter with a 3% bleed rate for the Hank Unit. A spacing of 500 ft between the monitoring ring wells is also proposed for the Hank Unit.

An additional simulation was conducted on the gradient reversals for the Hank Unit. The second simulation was the same as presented above except that the net extraction from the nine southern recovery wells in the production area were increased by a total of 5 gpm, which increases the overall wellfield bleed from 3% to 3.2%. The individual bleed rate for these nine wells was 0.982 gpm instead of the 0.462 gpm used in the first Hank Unit simulation. This small localized increase in the bleed rate caused the reversal to increase by greater than 60% at a distance of 500 ft from the production area. The second simulation shows that small local adjustments in the bleed rate can be used to expand the local zone of reversal and prevent or retrieve an excursion in a particular area for the Hank Unit.

This analysis provides the impacts that in situ recovery operations might have on surrounding groundwater. The surface pathways that might transport extraction solutions offsite include the Cottonwood Drainage and Tex Draw for the Nichols Ranch Unit and the Dry Willow and Willow Creek Drainage for the Hank Unit. The expected post-extraction impacts on geochemical properties and water quality are discussed in the Restoration Chapter, Chapter 6.0. The flood and flood velocities are provided in Appendix D6-1.

The analytical model was not used to simulate the Jane Dough wellfield conditions because a numerical model was developed for the initial analysis of this unit. Average aquifer properties of 330 gal/day/ft and 1.3E-4 were used for the transmissivity and storage coefficient for the Jane Dough unit to simulate the drawdowns resulting from the bleed of the Jane Dough Unit Production Areas. The stress from the Nichols Ranch Unit was initially input to the Jane Dough Unit model to develop cumulative drawdowns from both the Nichols Ranch and Jane Dough Units in the A Sand aquifer. A total of 337 recovery and 591 injection wells were used to simulate the #1 Production Area. Production Area #2 has 195 recovery wells and 356 injection wells. A one percent (1%) wellfield bleed was used in the Jane Dough wellfield simulations.

3.4.8.2 Numerical Modeling

The MODFLOW numerical model was used to simulate the groundwater conditions at the Nichols Ranch Unit **and Jane Dough Unit for the A Sands** and the Hank Unit for the F Sands, respectively. Addendum 3 presents the results of the Nichols Ranch Unit numerical groundwater modeling while Addendum 3C presents the results of the numerical modeling for the Hank Unit. **Addendum 3D present the results of the numerical modeling for the Jane Dough Unit**.

The results for the horizontal flare evaluation for the Nichols Ranch Unit are presented in Addendum 3B in Figures 3B.1-14 and 3B.1-15. The horizontal flare evaluation for the Hank Unit is presented in Addendum 3C and Figures 3C.1-9 through 3C.1-11.

The partially penetrating unconfined groundwater equation was used to evaluate the vertical flare between two wells for the Hank Unit. The vertical flare evaluation for the F Sand is presented in Addendum 3C in Figure 3C.1-12.

The numerical model simulation results for evaluation of excursion retrieval are presented in Figures 3B.1-16 through 3B.1-18 in Addendum 3B for the Nichols Ranch Unit. The results for the retrieval simulation for the Hank Unit are presented in Addendum 3C and Figures 3C.1-13 through 3C.1-17.

The horizontal flare for the Jane Dough Unit should be very similar to the Nichols Ranch Unit flare because the aquifer is the same with similar aquifer properties and the two unit wellfields are similarly aligned with the ground-water flow in the A Sand aquifer. Three ore intervals are planned to be mined at both Nichols Ranch and Jane Dough and the middle ore zone is the primary production interval. In comparing middle ore zone well patterns at the two sites (see Figure MPG.1-4 of Addendum 3B and Figure MPI.1-4 of Addendum 3D), the ore bodies are long, narrow and sinuous. The typical middle ore body width at the Jane Dough Project is slightly greater than that at the Nichols Ranch Project and, in general, an increase in the ratio of width to length of narrow ore bodies will reduce the horizontal flare. Hence, although the ore body width differences are small, the Nichols Ranch horizontal flare estimates should be conservatively large when applied to the Jane Dough production areas.

The estimation of vertical flare is typically based on industry experience and some interpretation of the stratigraphic sequence and corresponding hydrologic properties that may limit vertical fluid movement. The composite flare factor of 1.45 used in the Nichols Ranch Project area included the horizontal flare factor of 1.19 and approximate vertical flare factor of 1.22. This vertical flare factor was estimated for the Hank Project area and is also generally consistent with industry estimates. The composite flare factor of 1.45 which includes vertical flare is considered appropriate for the Jane Dough Project area given the similarities to the Nichols Ranch Project.

3.5 PLANT EQUIPMENT, INSTRUMENTATION, AND CONTROL

The plant equipment at the proposed facilities will consist of standard design, construction, and materials for uranium in-situ recovery extraction. Uranerz plans to install automated devices within the plant circuits to assist the operators with their coverage and reduce the number of operators required for successful coverage. Most of the automated devices will be pre-programmed to control operating parameters and the process information will be recorded. The automated systems will include alarms and shutoffs to prevent overflow and overpressure situations and provide centralized monitoring of the process variables.

The central processing plant, satellite plant, production circuits, wellfields, header houses, lines from the wellfield to the plant, and the deep disposal well will have instrumentation. The control system will have continuous monitoring, and alarms that are set when operating parameters are outside of the specified operating ranges. The alarms signal the operators to proceed with corrective actions until the parameter is back within specific ranges. Extreme tank levels or pressures will activate automatic shutdown of equipment for that area. The header houses, pipelines, and deep disposal wells are the sources of greatest risk for large spills and will have high and low pressure, and flow alarms for automatic shutdown of related equipment.

The total plant flow, total waste flow leaving the plant, and tank levels will be monitored. There will also be a low vacuum alarm for the dyer that will indicate either corrective action or automatic shut down. Manufacture's recommendations for the operating and maintenance of the dryer will be followed and recorded according to 10 CFR Part 40, Appendix A, Criterion 8. The critical systems will be equipped with back up systems that are automatically activated in a power failure or operating failure. The wellfield flows and pressures may be continually recorded, but at a minimum once a day recordings. The pressures will be kept under casing and formation rupture pressures.

The Uranerz Standard Operating Procedures (SOP) will address alarm responses, automatic shutdowns, and start up after automatic shutdowns. The SOP at both the Nichols Ranch Unit and

Hank Unit facilities are designed to minimize the risks of uncontrolled releases of leaching fluids, chemicals, and plant fluids, and provide the maximum safety and protection to the environment and personnel.

In the event that a spill occurs in the wellfield or process plants, measures will be taken to safely and quickly contain the spill and mitigate the impacts of any released material. Proper notification of plant and corporate management will be made along with properly contacting the NRC and State if applicable.

Spills are likely to occur from leaking pipelines and fittings. If a pipeline leak or spill occurs in the plants, the spill or leak will be contained within the building with all spilled material collected in the plant sump. This material will either be pumped backed into the process or sent to the deep disposal well.

Wellfield spills will be contained as soon as possible. The area of the spill will be surveyed to identify any contaminated areas and evaluated to determine prudence of reclamation at the time of the spill or at decommissioning.

If any process vessels or tanks that contain or have contained radioactive materials have to be entered for any reason such as cleaning, inspection, or repairs, a radiation work permit (RWP) will be issued detailing the requirements for special air sampling, protective equipment, and increased exposure surveillance.

To notify operating personnel of potential issues with process and wellfield operations, instrumentation such as flow meters and pressure indicators will be used. If any process condition falls out of the normal operating range, audible and visual alarms will sound notifying employees of potential plant problems. The alarm notification will aid in reducing the severity of any potential spills that might occur.

The NRC will have the opportunity to review and inspect control equipment prior to facility operation to ensure compliance with 10 CFR 40.32(c).