CHAPTER 5
PRE-OPERATIONAL ASSESSMENT OF WELLFIELDS AND ENVIRONMENTAL MONITORING

The primary objectives for an in situ leaching project monitoring program are protection of existing groundwater supplies, keeping employee and public exposure to ALARA, and preventing and/or mitigating the impact of any surface contamination that could result due to a leak or spill of process solutions. The program to keep employee and public exposure to ALARA is discussed in Chapter 9. The remaining pre-operation and operational monitoring programs are discussed in this chapter.

5.1 PRE-OPERATIONAL ASSESSMENT OF WELLFIELDS

5.1.1 General

Appendix D5 and Appendix D6 contain general baseline geologic and hydrologic information pertaining to the overall project area. Prior to wellfield development it is necessary to collect and assemble very detailed information on geologic and hydrologic conditions in order that ore zones can be defined, geologic and hydrologic parameters quantified, wellfields planned, hydrologic monitoring programs developed, and baseline ground water quality sufficiently determined. To accomplish the above, the operator must conduct a very capital intensive multi-step program which includes interaction with the WDEQ.

Sections 5.1.2 through 5.16 contain a detailed description of the types of geologic and hydrologic data which have been collected for operating wellfields and will be collected for proposed wellfields. Section 5.1.7 contains a description of the baseline gamma surveys that will be conducted at all proposed wellfields.

5.1.2 Monitor Well Spacing

The density and spacing of monitor wells are determined during the detailed geologic and hydrologic assessment of a proposed wellfield. Monitor wells are installed in the mineralized area (production pattern area) at a density of one well per three acres of area under the production patterns. A minimum of five of these wells are installed per mine unit. These wells are used to obtain baseline water quality data to characterize the Production Zone and to determine ground water Restoration Target Values (RTVs).

Monitor wells are installed within the Production Zone, outside the mineralized portion of the ore zone and production pattern area in a "ring" around the mine area. These wells are used to obtain baseline water quality data and characterize the area outside the production pattern area. Upper Control Limits (UCL's) are determined for these wells from the baseline water quality data (Section 5.1.5). The distance between these monitor wells is typically between 300 and 800 feet. The distance between these monitor wells and the production patterns is typically 250 to 600 feet. The acceptable distance between the monitor wells and the production patterns is determined using a ground water flow model and estimated hydraulic properties for the proposed production area. The acceptable distance between monitor wells and the production patterns also takes into account the demonstration that if an excursion were to occur, production fluids can be controlled within 60 days, as required by WDEQ requirements.

Monitor wells are installed within the overlying and underlying aquifers at a density of one of each type of well per every three acres of pattern area. These wells are used to obtain baseline water quality data and are used in the development of UCL's for these zones. In the case that no potentially affected overlying and/or underlying aquifer exists, or the confining unit (aquitard) between the production zone and/or the overlying or underlying aquifer is thin (less than 5 feet in thickness), within a part, or entire wellfield, the density and location of such wells will be determined in consultation with the regulatory agencies. In the event that the mineralized area and corresponding production pattern area is very narrow and continuous (i.e. "line drive"), wells monitoring the overlying and underlying aquifers (if present) will not be more than approximately 1,000 ft apart from one another.

5.1.3 Hydrologic Testing Proposal

Once an area has been adequately assessed from a geologic and mineability standpoint and the operator determines that it is both feasible and desirable to ISL the area, the limits of the mine area are determined and it becomes a proposed mine unit. A Hydrologic Testing Proposal is then developed to determine the following:

1. Hydrologic characteristics of the Production Zone aquifer.

2. Presence or absence of hydrologic boundaries within the Production Zone aquifer.

3. The degree of hydrologic communication, if any, between the Production Zone and the overlying and underlying aquifers.

4. The vertical permeability of the overlying and underlying confining units which have not already been tested.

5. The degree of hydrologic communication between the Production Zone and the surrounding monitor well ring.

The Hydrologic Testing Proposal is submitted to the WDEQ for review and comment. PRI has a Standard Operating Procedure (SOP) in place which details the contents of the Hydrologic Testing Proposal.

5.1.4 Mine Unit Hydrologic Test Document

Following completion of the field data collection, the Mine Unit Hydrologic Test Document is assembled and submitted to the WDEQ for review. In accordance with NRC requirements, the Mine Unit Hydrologic Test Document is reviewed by a Safety and Environmental Review Panel (SERP) to ensure that the results of the hydrologic testing and the planned mining activities are consistent with technical requirements and do not conflict with any requirement stated in the NRC license. A written SERP evaluation will evaluate safety and environmental concerns and demonstrate compliance with applicable NRC license requirements. The written SERP evaluation will be maintained at the site.

The Mine Unit Hydrologic Test Document contains the following:

1. A description of the proposed mine unit (location, extent, etc.).

2. A map(s) showing the proposed production patterns and locations of all monitor wells.

3. Geologic cross-sections and cross-section location maps.

4. Isopach maps of the Production Zone sand, overlying confining unit and underlying confining unit.

5. Discussion of how the hydrologic test was performed, including well completion reports.

6. Discussion of the results and conclusions of the hydrologic test including pump test raw data, drawdown match curves, potentiometric surface maps, water level graphs, drawdown maps and when appropriate, directional transmissivity data and graphs.

7. Sufficient information to show that wells in the monitor well ring are in adequate communication with the production patterns.

8. Any other information pertinent to the area tested will be included and discussed.

5.1.5 Baseline Water Quality Determination

5.1.5.1 General

The collection of baseline water quality data and determination of baseline water quality conditions is very important as the Upper Control Limits (UCL's) and ground water restoration objectives are based on this data. PRI has Standard Operating Procedures (SOPs) in place that detail acceptable water quality sampling and handling procedures, as well as the statistical assessment of the data.

5.1.5.2 Data Collection

Water quality samples are obtained and analyzed from the above monitor wells to establish baseline (background) ground water quality conditions in each zone. Sampling, preservation and analysis procedures are performed in accordance with accepted procedures. The number of samples collected and the parameters analyzed are as follows:

1) Mineralized Zone (Production Pattern) MP-Wells - Two separate samples, collected at least two weeks apart, are collected for the parameters listed in Table 5-1 The regulatory authorities are contacted in order that they can, if desired, collect split samples from the second field sampling for comparative purposes.

   Two separate samples, collected at least two weeks apart, are analyzed for the following parameters:

   - Total alkalinity
   - Chloride
   - Conductivity
   - Sulfate
   - TDS
   - Fluoride*
   - pH
   - Selenium
   - Uranium
   - Radium-226
   - Arsenic*

   * Arsenic and fluoride are deleted from the above list of parameters if the previous two analyses (conducted for the list of parameters included in Table 5-1) show that arsenic and fluoride are below detection limits.

2) Ore Zone (Monitor Well Ring), M and Trend (T) Wells (if installed) - One sample for the parameters in Table 5-1 and three samples for the UCL parameters chloride, total alkalinity, and conductivity. All samples are collected at least two weeks apart.

3) Overlying and Underlying Zones, MO and MU Wells - Two samples for the parameters in Table 5-1 and two samples for the UCL parameters chloride, total alkalinity, and conductivity. All samples are collected at least two weeks apart.

5.1.5.3 Statistical Assessment of Baseline Water Quality Data

Baseline water quality is determined by averaging the data collected for each parameter, for each zone that is monitored. The variability of the data is also calculated. Outliers are determined in accordance with methods presented in WDEQ-LQD Guideline 4, or other accepted methods. Values determined to be outliers are not used in the baseline calculations. Where wells are not uniformly distributed, the average may be determined by weighting the data according to the fraction of area, or water volume, represented by the data. Baseline conditions are determined as follows:

Mineralized Zone (Production Pattern) Wells - Data for each parameter are averaged. If the data collected for the entire mine unit indicate that waters of different underground water classes (WDEQ-WQD Rules and Regulations, Chapter VIII) exist together, the data are not averaged together, but treated as sub-zones. Data within specific sub-zones are averaged. Boundaries of sub-zones, where required, are delineated at half-way between the sets of sampled wells which define the sub-zones.

Ore Zone (Monitor Well Ring) Wells - Data for each parameter are averaged. As with the mineralized zone wells, if sub-zones are present which differ in underground water classes, data within the specific sub-zones is averaged separately.

Overlying Aquifer - Data for each parameter are averaged.

Underlying Aquifer - Data for each parameter are averaged.

5.1.5.4 Restoration Target Values

The Restoration Target Values (RTV's) are determined from the baseline water quality data and are used to assess the effectiveness of ground water restoration activities. The average and range of baseline values determined for the wells completed in the Production Zone within the wellfield area (i.e. MP-Wells), constitute the RTV's. If the data indicate that waters of significantly different quality exist within the same mine unit, the data will be divided into sub-zones and averaged to determine the RTV's for each subzone.

5.1.6 Upper Control Limits

5.1.6.1 General

Monitor wells are installed within the Production Zone outside and around the pattern area (i.e. monitor well ring) and within overlying and underlying aquifers to document that the lixiviant and production fluids are not leaving the defined Production Zone. The process bleed (wellfield purge), in combination with production activities (pumping and injection rates), assist in keeping production fluids within the Production Zone.

Should production fluids reach a monitor well and its UCLs are exceeded, an "excursion" occurs. If an excursion is determined to have occurred, operational changes are implemented until such time that production fluids are retrieved to the Production Zone and the affected monitor well(s) is no longer on excursion status. As part of the detailed hydrologic assessment, UCLs are determined based on the baseline water quality data. The UCL parameters are chloride, total alkalinity, and conductivity.

It should be noted that the UCLs for Highland wellfields historically used bicarbonate instead of total alkalinity. Given the pH of the ground water UCLs for bicarbonate and total alkalinity are synonymous, except that total alkalinity is expressed as mg/L $CaCO_3$ equivalent instead of mg/L of bicarbonate. PRI intends to convert all UCLs to total alkalinity with approval of the NRC and WDEQ. Such a conversion is necessary to assist laboratory operations and provide consistent reporting requirements throughout the project.

5.1.6.2 Determination of Upper Control Limits

The UCLs are based on the baseline water quality data and determined as follows:

- Chloride UCL - baseline mean plus five standard deviations, or the baseline mean plus 15 mg/L, whichever is greater. Expressed as mg/L chloride.

- Total Alkalinity UCL - baseline mean plus five standard deviations. Expressed as mg/L as $CaCO_3$.

- Conductivity UCL - baseline mean plus five standard deviations. Expressed in µmhos/cm at 25°C.

5.1.7 Baseline Gamma Survey

Prior to beginning solution mining in a wellfield, a gamma survey of the wellfield production area will be conducted. The survey design will be based on a grid system using a 100 meter spacing between grid lines. Pre-mining gamma readings will be taken near the intersections of all grid lines within the projected mining area. The data is typically plotted on a map of the wellfield. This information is retained on site for comparison with similar information during wellfield decommissioning.

5.2 OPERATIONAL HYDROLOGIC MONITORING PROGRAM

5.2.1 General

During operation, the primary purpose of the wellfield monitoring program is to detect and correct any condition which could lead to an excursion of leaching solution or detect such an excursion should one occur. To achieve this objective, flow rates and operating pressures are monitored at individual operating wells and along the main pipelines to and from the recovery plant. Water quality and water levels in the wellfield monitor wells are tested to ensure compliance.

5.2.2 Monitoring Frequency and Reporting

The Production Zone, overlying aquifer, and underlying aquifer monitor wells are sampled semi-monthly at approximately two week intervals (but not less than 10 days apart) and the samples are analyzed for and compared against the excursion parameter UCL values. The excursion parameters shall be chloride, conductivity and total alkalinity. In addition, the water level in each monitor well is measured and recorded prior to each sampling event. Water levels are not used as an excursion indicator. Water level and analytical monitoring data for the UCL parameters are reported to the WDEQ-LQD on a quarterly basis. This data is retained on site for review by the NRC.

5.2.3 Water Quality Sampling and Analysis Procedures

Water quality samples are obtained by pumping the monitor wells with permanently installed submersible pumps. To assure that water within the well casing has been adequately displaced and formation water is sampled, wells are pumped a certain amount of time, based on the particular well's performance. A minimum of one (1) casing volume of water is removed from the well prior to sampling. Prior to sampling, the electrical conductivity and pH are measured at periodic intervals and recorded on field data sheets to demonstrate that water quality conditions have stabilized and ensure that formation water is sampled. All data for each well are periodically reviewed to ensure that both sampling and analytical procedures are adequate.

Water quality samples from monitor wells are analyzed for chloride, total alkalinity, and conductivity usually within 48 hours of sampling, at the on-site laboratory. All analyses are performed in accordance with accepted methods. PRI has Standard Operating Procedures (SOPs) in place that detail water sampling and laboratory analysis procedures.

5.2.4 Excursions

An excursion is considered to have occurred at a well if any two of the three UCL parameters (chloride, alkalinity, and conductivity) are exceeded. A verification sample is taken within 24 hours of the determination that a sample has exceeded two of the three UCL values. The verification sample is split and analyzed in duplicate to assess analytical error. During an excursion all monitoring wells on excursion status are sampled at least every seven days for the UCL parameters and uranium.

Upon verification of an excursion, the WDEQ-LQD will be verbally notified within 24 hours and the NRC Project Manager will be verbally notified within 48 hours. The WDEQ will be notified in writing within seven days. The NRC Project Manager will be notified in writing within 30 days. Corrective actions, such as changes in pumping or injection rates are implemented as soon as possible. Corrective actions continue until the excursion is mitigated.

If the concentration of the UCL parameters detected in the monitor well(s) does not begin to decline within 60 days after the excursion is verified, injection into the production zone adjacent to the excursion will be suspended to further increase the net water withdrawals. Injection will be suspended until a declining trend in the concentration of the UCL parameters is established. Additional measures will be implemented if a declining trend does not occur in a reasonable time period. After a significant declining trend is established, normal operations will be resumed with the injection and/or production rates regulated such that net withdrawals from the area will continue. The declining trend will be maintained until the concentrations of excursion parameters in the monitor well(s) have returned to concentrations less than respective UCLs.

5.3 EFFLUENT AND ENVIRONMENTAL MONITORING

5.3.1 General

PRI maintains a detailed environmental and radiological program to monitor any releases from the SR-HUP operations to the environment. The program scope encompasses monitoring of air, groundwater, surface water, and direct radiation. Soils and vegetation are also monitored at the irrigation facilities. The program is designed to meet the requirements of NRC's 10 CFR 40.65. Monitoring results are reported semi-annually to the NRC in the 40.65 Semi-Annual Reports. PRI has SOPs in place that detail the various monitoring programs. Many years of monitoring data collected at both the Smith Ranch and HUP operations have shown no significant adverse impacts to the environment or any increased health risks to the public.

5.3.2 Continuous Air Particulate Monitoring

To ensure compliance with 10 CFR 20.1301, 20.1302 and 20.1501, PRI maintains a continuous air monitoring program at five separate locations. These monitoring locations contain high flow air pumps which continuously collect particulate matter on paper filters. The filters are exchanged weekly, composited for analysis on a quarterly basis, and are analyzed for uranium, radium-226, and thorium-230 and lead-210. Results of the analyses are reported to the NRC in the Semi-Annual Report. The locations of the Air Monitoring Stations are shown on Plate 1 and are as follows:

1. Air Station No. 1 (Dave's Water Well): This station monitors background conditions, upwind of both the Smith Ranch and HUP wellfields and yellowcake processing facilities. The site is located adjacent to Dave's Water Well in the SW¼ NW¼ Section 8, T35N, R74W.

2. Air Station No. 2 (Smith Ranch Restricted Area): This station monitors conditions downwind of the Smith Ranch CPP Restricted Area boundary. The site is located 500 feet northeast of the Smith Ranch CPP in the NW¼ NE¼ Section 36 T36N, R74W.

3. Air Station No. 3 (Vollman Ranch): This station monitors the nearest downwind resident to the Smith Ranch CPP Restricted Area as well as background conditions for the Highland Central Plant Restricted Area. The site is located adjacent to the ranch house in the NW¼ NE¼ Section 27, T36N, R73W.

4. Air Station No. 4 (Overlook): This station monitors conditions downwind of the Highland Central Plant at the Restricted Area boundary. The site is located approximately 400 feet northeast of the Central Plant Facility in the NE¼ NE¼ Section 29, T36N, R72W. This monitoring station is only

operated when yellowcake processing operations are active at the Highland Central Plant.

5. Air Station No. 5 (Fowler Ranch): This station monitors conditions at the nearest downwind residence to the Highland Central Plant. The site is located approximately 1200 feet west of the Fowler Ranch house in the SE¼ SE¼ Section 9, T36N, R72W. The ranch house is only occupied for a few months each year. This station is only operated when yellowcake processing operations are active at the Highland Central Plant.

Table 5-2 summarizes the U-Nat, Th-230, and Ra-226 monitoring data collected at the Smith Ranch Air Monitoring Stations for the period 1996 through 2002. Review of the air particulate data shows that all radionuclide concentrations have averaged less than 5% of the respective Effluent Concentration Limits. The data also shows that no significant difference has been determined between background radionuclide concentrations and those determined at the Restricted Area Boundary of the Smith Ranch CPP, or the nearest downwind residence (Vollman Ranch).

Table 5-3 summarizes the U-Nat, Th-230, and Ra-226 monitoring data collected at the Air Monitoring Stations used to monitor the impact of the Highland Central Plant, for the period 1995 through 1999. Review of this data shows that all radionuclide concentrations have averaged less than 5% of the respective Effluent Concentration Limit. A review of this data also shows that no significant difference has been determined between background radionuclide concentrations and those determined at the Restricted Area Boundary at the HUP Central Plant, or the nearest downwind residence (Fowler Ranch). Comparison of historic radionuclide particulate data from the Smith Ranch and Highland Air Monitoring Stations shows no significant variations.

5.3.3 Passive Radon Gas Monitoring

Passive radon gas (radon-222) is monitored at the site to assess background conditions and releases from the facilities to the environment. Radon is monitored using Track-Etch type radon cups (detectors) provided by a contractor specializing in radon detection. The radon cups were historically exchanged on a quarterly basis. The frequency of exchange of the cups has been changed to semi-annually (every 6 months) in order that the 0.2 pCi/L sensitivity level recommended in NRC Regulatory Guide 4.14 can be potentially met. Results of the monitoring are reported to the NRC in the Semi-Annual Report. Radon is monitored at the five Air Monitoring Stations described above. Radon is monitored at Air Station Nos. 4 and 5 only when the stations are active in response to yellowcake processing at the Highland Central Plant.

Radon-222 monitoring data collected at the Smith Ranch Air Monitoring Stations for the period 1996 through 2002 is summarized in Table 5-2. Table 5-4 summarizes the radon-222 monitoring data collected at the Highland Air Monitoring Stations and the three Passive Air Stations. A review of these data shows that radon-222 at all sites has averaged less than 20% of the Effluent Concentration Limit. Review of this data also shows that no significant difference has been determined between background radon-222 concentrations and those determined at the Restricted Area Boundary or nearest downwind residence sites. The data from the Highland Passive Air Stations also show that increases in radon-222 adjacent to Satellite No. 2, where radon is routinely vented during operations, has had a minimal impact on ambient air quality. As the monitoring data shows, any increases in radon-222 have been minimal and well below the Effluent Concentration Limit.

5.3.4 Passive Gamma Radiation Monitoring

Passive gamma radiation is monitored at the five Air Monitoring Stations described above. Passive gamma radiation is monitored using spherical TLD's which are exchanged on a quarterly basis. Results of the monitoring are reported to the NRC in the Semi-Annual Report. Gamma radiation is monitored at Air Station Nos. 4 and 5 only when the stations are active in response to yellowcake processing at the Highland Central Plant.

Passive gamma radiation monitoring data collected at the Smith Ranch Air Monitoring Stations for the period 1996 through 2002 is summarized in Table 5-2. Table 5-5 summarizes the passive gamma radiation monitoring at the Higland Air Stations and the three Passive Air Stations. Review of these data show that background gamma radiation levels at the respective upwind and downwind sites for each project range from 33 to 36 mRem per quarter. It should be noted that the downwind sites also represent background due to their distance from any processing areas or gamma radiation sources. In comparison to the background sites, data obtained at the Restricted Area Boundaries of the Smith Ranch CPP and Highland CPF show apparent minimal increases in gamma radiation of only 2 to 5 mRem per quarter.

5.3.5 Environmental Ground Water Monitoring Program

The project wide environmental ground water monitoring program includes the quarterly monitoring of operating domestic and stock wells located within 1 km of operating wellfields. Water samples are obtained from these wells for the analysis of uranium and radium-226. The ground water monitoring stations for current (March 2003) operating wellfields are described in Table 5-6 and shown on Plate 1. Plate 1 also shows the locations of other potential ground water monitoring sites near proposed wellfields that will be added to the monitoring program once wellfield operations commence in those areas.

5.3.6 Environmental Surface Water Monitoring Program

The project wide environmental surface water monitoring program includes the quarterly monitoring of Sage Creek when stream flow is present as well as numerous stock ponds that are located down stream of operating wellfields. The surface water monitoring sites are described in Table 5-7 and shown on Plate 1. Water samples are obtained from these sites for the analysis of uranium and radium-226 when adequate water exists to permit sampling.

5.3.7 Wastewater Land Application Facilities Monitoring Program

5.3.7.1 General

To assist in assessing impacts of irrigating treated wastewater at the Satellite No. 1 and Satellite No. 2 Wastewater Land Application Facilities (Irrigation Areas) the irrigation water, soil, and vegetation are monitored for various constituents including natural uranium and radium-226. This monitoring program has been in place since the start of each facility. Results of the monitoring program are reported to the NRC in the Semi-Annual Report and to the WDEQ-LQD in the Annual Report. The monitoring programs for the Satellite No. 1 and Satellite No. 2 Wastewater Land Application Facilities are shown in Tables 5-8 and 5-9, respectively.

5.3.7.2 Radium Treatment Sampling

Monthly Grab samples are collected from the radium treatment system at each Satellite to assure that the barium chloride treatment system is reducing radium-226 to acceptable concentrations (less than the Effluent Concentration Limit of 60 pCi/L (6.0E-8µCi/mL)). Monitoring data collected throughout the life of the project shows that the treatment system is very effective in reducing radium-226 concentrations to levels below the Effluent Concentration Limit (ECL).

The result of monitoring data for the radium treatment system at Satellite No. 1 for the period 1995 through 1999 shows a mean radium-226 concentration of 9.25 E-9 µCi/mL which is 15% of the ECL. The results of monitoring data for the radium treatment system at Satellite No. 2 for the period 1995 through 1999 shows a mean radium-226 concentration of 2.51 E-8 µCi/mL, which is 42% of the ECL. Monitoring data for the Satellite No. 3 treatment system, which has only been operational since January 1999, shows a mean radium-226 concentration of 2.12 E-8 µCi/mL (35% of the ECL) for the period January 1999 through December 1999.

5.3.7.3 Irrigation Fluid Sampling

The irrigation fluid quality has been monitored at both irrigation facilities since irrigation operations started. Review of the irrigation fluid monitoring results at the Satellite No. 1 facility, for the period 1989 through 1999, shows the following mean concentrations of natural uranium and radium-226 (weighted by volume of water applied):

U-Nat 1.32 mg/L or 9.0 E-7 µCi/mL
Radium-226 5.59 pCi/L or 5.6 E-9 µCi/mL

Results of this monitoring program at the Satellite No. 2 facility for the period 1995 through 1999 show the following mean concentrations of natural uranium and radium-226 (weighted by volume of water applied):

U-Nat 0.79 mg/L or 5.3 E-7 μCi/mL
Radium-226 7.33 pCi/L or 7.3 E-9 μCi/mL

The concentrations of uranium and radium-226 within the treated wastewater applied at both irrigation facilities are within the range of concentrations predicted in the information submitted to the NRC for use of these facilities.

5.3.7.4 Soil Sampling

The monitoring programs for the Satellite No. 1 and Satellite No. 2 Wastewater Land Application Facilities also require that soil samples be collected annually in August at depths of 0-6 inches and 6-12 inches to assess impacts of irrigation on the irrigated soil. Results of the soil monitoring for natural uranium and radium-226 at the Satellite No. 1 and Satellite No. 2 facilities are summarized in Tables 5-10 and 5-11, respectively.

A review of the soils data for the Satellite No. 1 facility shows an increasing trend in natural uranium concentrations within the 0-6 inch soil depth, compared to a background range of 4.4 E-7 to 1.7 E-6 μCi/g (0.7 to 2.5 mg/kg). The most recent data obtained in August 1999 shows a mean natural uranium concentration of 1.1 E-5 μCi/g (16.5 mg/kg) for the 0-6 inch soil depth. Since no discernable increase in radium-226 concentrations have been observed at this same depth, no problems are anticipated in meeting soil radionuclide release criteria.

A review of the natural uranium concentration data for the 6-12 inch soil depth at the Satellite No. 1 facility shows only a minimal increase above background. Since no discernable increase in radium-226 concentrations have been observed at this same depth, no problems are anticipated in meeting soil radionuclide release criteria.

The higher concentrations of uranium in the near surface soil (0-6 inch depth) is attributed to the uranium attaching to soil particles and being more concentrated due to evaporation of soil water towards the surface. If deemed necessary at decommissioning, it would be possible to reduce the near surface concentrations by deep plowing and mixing the soil.

A review of the data for the Satellite No. 2 facility, which has not been in operation as long as the Satellite No. 1 facility, shows that uranium is also increasing slightly in the near surface soil (0-6 inch depth). The most recent data obtained in August 1999 shows a natural uranium concentration of 4.6 E-6 μCi/g (6.9 mg/kg) which is minimally above the background range of 1.8 E-6 to 3.4 E-6 μCi/g (2.7 to 5.0 mg/kg). Data for the

6-12 inch depth shows that soil uranium concentrations are still within the background range.

A review of the radium-226 data for both soil depths at the Satellite No. 2 facility shows that concentrations have not exceeded the background range of radium-226 concentrations. Because no discernable increase in radium-226 has been determined, or is it expected, no problems are anticipated in meeting soil radionuclide release limits.

5.3.7.5 Vegetation Sampling

The vegetation (grass) at both irrigation facilities is also monitored on an annual basis, in August of each year, to determine the potential accumulation of radionuclides in the vegetation. Monitoring of the vegetation started at the Satellite No. 1 facility in 1991 while monitoring of the Satellite No. 2 facility commenced in 1996. The mean natural uranium and radium-226 concentrations in vegetation for the Satellite No. 1 and Satellite No. 2 irrigation facilities are included in Tables 5-12 and 5-13, respectively.

A review of the data for the Satellite No. 1 irrigation facility shows a relatively small increase in uranium concentrations within the vegetation during the period 1991 through 1997. The apparent abrupt increase in uranium in the vegetation in 1998 and 1999 is attributed to a change in sample analysis procedures. At the request of the WDEQ-LQD, starting in 1998, the radionuclide and other parameters were analyzed on a dry weight basis, instead of a wet weight basis. The highest uranium concentrations in the vegetation, which were observed in the 1999 data, are also suspect as the "background" sample also showed anomalously higher uranium concentrations. Monitoring data obtained in August 2000 should help explain this apparent anomaly.

A review of the radium-226 data obtained for the vegetation at the Satellite No. 1 facility shows that radium-226 concentrations remain very close to the range of background concentrations.

A review of the data for the Satellite No. 2 irrigation facility shows only minor increases in uranium concentrations within the vegetation. The mean concentration determined for the samples collected in August 1999 was 6.8 E-4 mg/kg (1.00 mg/kg). Radium-226 concentrations in the vegetation showed no discernable increase compared to background concentrations.

5.3.8 <u>Waste Disposal Well Monitoring</u>

The SR-HUP currently (March 2003) utilizes three Class I Non-Hazardous Waste Disposal Wells to dispose of waste water generated by wellfield and yellowcake processing operations. Wells WDW #1 and WDW #2 are associated with the Smith Ranch facilities and Well Morton 1-20 is associated with the Highland facility (see Plate 1). In accordance with the UIC permits issued by the WDEQ-WQD for the disposal wells at each facility, the quality of the injected water is monitored on a quarterly basis. Samples are composited from the waste stream each quarter and analyzed for total dissolved solids, total alkalinity, ammonia, natural uranium, radium-226, and pH.

The quality of waste water injected into the Smith Ranch waste disposal wells and Highland Morton 1-20 Well for the period 1997 through 2002 is summarized in Tables 5-14 and 5-15. The permit limit for uranium is 65 mg/L while pH must be maintained between 2 and 11. Permit limits have not been established for any of the other sample parameters. Review of the data in Tables 5-14 and 5-15 shows that the permit limit for uranium was exceeded at Smith Ranch during the 3rd Quarter 2002 report period and at Highland during the 4th Quarter 2002 report period. The permit limits for uranium and pH were not exceeded during any other report period.

The elevated uranium concentration in the Smith Ranch 3rd Quarter 2002 sample resulted from an upset condition in the CPP Precipitation Circuit during the period August 13 to 26, 2002. Since the 3rd Quarter 2002 composite sample was also collected during this two week period, the sample contained an elevated concentration of uranium. Samples of the waste water obtained on a daily basis and analyzed at the CPP Process Lab showed an average uranium concentration for the three month period of 43.9 mg/L, which is less than the permit limit of 65 mg/L. As evidenced by the results of the 4th Quarter 2002 sample, corrective actions have been implemented to ensure that an upset condition such as that which occurred in August 2002 does not happen again.

For the Highland Morton 1-20 Well, the elevated uranium concentration in the 4th Quarter 2002 sample was a result of tank cleanout procedures that did not allow for normal operation of the uranium removal circuit during preparation of the Highland Central Plant for standby status. Currently (March 2003), the Morton 1-20 well is also on standby status.

5.3.9 Evaporation Ponds

5.3.9.1 Evaporation Pond Sampling

The evaporation ponds are sampled on a semi-annual basis. Each pond sample is analyzed for bicarbonate, calcium, chloride, sodium, sulfate, TDS, uranium, radium-226 and thorium-230. PRI has SOPs in place that detail the monitoring programs for these ponds.

5.3.9.2 Leak Detection Monitoring

Each lined evaporation or treatment pond at the Smith Ranch CPP is constructed with a leak detection system consisting of a network of perforated pipes in a sand layer beneath the liner with the pipes draining to a collection sump. Should a leak in the liner occur, the water will flow through the sand, enter a perforated pipe, then flow to the sump. PRI has SOPs in place that detail the monitoring program for the leak detection system. The monitoring program for the lined ponds includes either a fluid level sensor in each pond sump with an alarm displayed at the CPP or a daily inspection of each sump by an operator. The evaporation ponds are inspected daily for visual indications of leaks or embankment deterioration by an individual instructed in proper inspection procedures. The pond inspections are recorded and initialed by the inspector.

If six inches or more of fluid is detected in any leak detection system sump, it will be sampled and analyzed for chloride and conductivity. If analyses indicate a pond leak, and the analyses are confirmed, the appropriate agencies will be notified by telephone within 48 hours after receiving the confirming analyses and the water level in the pond with the indicated leak will be lowered by transferring the contents to another cell. If water continues to flow to the sump, samples will be collected every seven days and analyzed for chloride and conductivity. Once per month a sample will be analyzed for bicarbonate, uranium, and sulfate. A written report will be filed with the appropriate agencies within 30 days after the notification of the suspected leak and every 30 days thereafter until the leak is repaired. The reports will include the available analytical data, the corrective actions taken, and results of the actions.

A freeboard of at least three (3) feet will be maintained in each pond to prevent loss of solutions by wave action and to allow for holding the contents of another pond on a temporary basis in the event of a leak.

5.3.10 Wildlife Monitoring

5.3.10.1 General

In accordance with WDEQ mine permit requirements, the SR-HUP takes various precautions to limit potential adverse impacts to wildlife.

Impacts to wildlife as a result of current and proposed operations are insignificant for the following reasons:

1. No unique or critical habitats are present within the permit area.
2. No important wildlife migration routes are contained within the permit area.
3. ISL activities disturb relatively minor amounts of land surface compared to conventional open pit mining methods.
4. Areas disturbed by wellfield activities are quickly revegetated after wellfield construction and are used by wildlife throughout production activities.
5. Restrictive fencing is limited to isolated areas which do not significantly impede wildlife movements.
6. Vehicular traffic is limited and reduced speed limits are utilized for safety purposes and to decrease the potential for vehicle-wildlife collisions.

7. Power lines are constructed using standard practices to minimize the potential electrocution of raptors.

Observations over the 12+ years of operation show that wildlife are not impacted, and both deer and pronghorn readily utilize the fenced operating areas. It is likely that wildlife are attracted to the fenced wellfield areas due to the lack of livestock and the abundant vegetative growth which offers food and cover.

During the initial permitting of both the Smith Ranch Project and the HUP, commitments were made to the WDEQ-LQD and Wyoming Game & Fish Department to monitor for a 3-year period the effects of ISL mine development and operation activities on Pronghorn Antelope and Mule Deer, the big game species of concern in the area. These 3-year monitoring commitments were complete at both operations and the required reports submitted to the WDEQ-LQD. Based on the results of these monitoring programs it was determined that the ISL operations were having no significant negative impact on Pronghorn or Mule Deer. The regulatory agencies agreed that it was not necessary to prolong this monitoring.

5.3.10.2 Threatened and Endangered Species

The baseline studies of the project site identified the three species that were "Threatened" or "Endangered Species" and could possibly be present at the site. These species included the Blackfooted Ferret (Endangered), the Bald Eagle (Threatened) and the Peregrine Falcon (Threatened). In May 2000 the U.S. Fish and Wildlife Service (USFWS) was contacted to assess the status of these species. It was determined that only the Blackfooted Ferret is still on Endangered Species.

Relative to Blackfooted Ferrets, none have ever been observed on, or near, the project site and the lack of prairie dog colonies anywhere near the site precludes the habitat required by them.

Current (January 2003) information suggests that the Mountain Plover is proposed by the USFWS for listing as a Threatened Species. Although the project site is located in the very broad geographic region where this specie is known to exist, the site does not contain the habitat preferred by them. Field observations throughout the life of the project have resulted in no observations of the Mountain Plover.

In the case that a Threatened or Endangered Species begins to use the license area or adjacent areas, the USFWS Wyoming Field Office, Cheyenne will be notified.

5.3.10.3 Raptor Nest Surveys

It is not anticipated that mining related activities will adversely affect a raptor nest, or disturb a nesting raptor as there is a lack of nesting raptors on and near the permit area due to the lack of trees and other nesting sites. Additionally, mining related activities are limited to relatively small areas for limited periods of time. Known active nest sites are not located within active or proposed wellfield areas.

In accordance with WDEQ-LQD requirements a raptor nest survey is conducted in late April or early May each year to identify any new nests and assess whether known nests are being utilized. The survey covers all areas of planned activity for the life of mine (wellfields, Satellites, CPF, etc.) and a one mile area around the activity. Status and production at known nests will be determined, if possible. This survey program is primarily intended to protect against unforeseen conditions such as the construction of a new nest in an area where operations may take place.

Raptor nest surveys since 1992 has shown that known nest sites are used by Redtailed Hawks, Swainsons Hawks, and great Horned Owls on a seasonal basis. The only Golden Eagles nesting on the project site have nested approximately 2 miles from any project activity.

Activities at the project site have not resulted in the need to disturb or relocate any raptor nest. Due to the location of proposed wellfields, it is very unlikely that any raptor nests will be disturbed in the future. In the very unlikely event that it is necessary to disturb a raptor nest, a permit for a mitigation plan will be acquired from the U.S. Fish and Wildlife Service, Wyoming Field Office, in Cheyenne, Wyoming.

5.3.11 Cultural Resources Mitigation

In accordance with WDEQ-LQD and Wyoming State Historic Preservation Office (WSHPO) requirements, cultural resource surveys have been conducted on lands comprising the project area (see Section 2.4 of Chapter 2). These surveys have been approved by the USBLM, WDEQ-LQD, and WSHPO.

In the Smith Ranch area, it was determined that only two sites of significant historical or archaeological value could be potentially affected by the project. These sites included 48C01289 and 48C0352, both of which were considered eligible for the National Register of Historic Places (NRHP) at the time of the initial surveys. Due to the potential for impacts to site 48C01289 during future wellfield operations, additional evaluative testing was conducted in July 1999. As a result of this additional testing, the cultural resource evaluation of 48C01289 has been changed to “ineligible”. Currently (March 2003), no additional evaluative testing has been conducted on site 48C0352. However, no surface disturbing activities will take place within 100 feet of the boundaries of this site until the adverse effects of such disturbance have been mitigated under a plan approved by the USBLM, WDEQ-LQD, and WSHPO.

In the Highland area, it has been concluded in all previous cultural resource surveys that the sites mapped are of no significant historical or archaeological value. If any significant cultural materials are discovered during the development and construction of new mining areas, they will be protected and the appropriate federal (USBLM) or state (WSHPO) office notified.

5.3.12 Spill Reporting Requirements

Any liquid spill which enters a water of the state, any liquid spill in excess of 420 gallons or any spill that threatens to enter a water of the state, comprised of lixiviant, pregnant liquor, acid, solvent, process waste water or any similar stream, must be reported to the WDEQ/LQD within 24 hours of the incident. A written report is required to be submitted within 7 days. For purposes of this document, a water of the state includes dry draws, playas, and wetlands, as well as streams, rivers and lakes.

All reportable spills are recorded in a spill log or file located at the facility. The NRC Project Manager will be notified within 48 hours for any spill that may have a radiological impact on the environment or is required to be reported to any other State or Federal agency.

This notification will be followed within 30 days by a written report to the NRC Project Manager.

TABLE 5-1

BASELINE WATER QUALITY PARAMETERS

Parameter	Lower Detection Limit *
Alkalinity	0.1
Ammonium	0.05
Arsenic	0.001
Barium	0.1
Bicarbonate	0.1
Boron	0.1
Cadmium	0.01
Calcium	0.05
Carbonate	0.1
Chloride	0.1
Chromium	0.05
Copper	0.01
Electrical Conductivity @ 25 degrees C	1 micromho/cm
Fluoride	0.1
Iron	0.05
Lead	0.05
Magnesium	0.01
Manganese	0.01
Mercury	0.0005
Molybdenum	0.05
Nickel	0.05
Nitrate	0.01
pH	0-14 s.u.
Potassium	0.1
Radium-226	0.1 pCi/L
Selenium	0.001
Sodium	0.05
Sulfate	0.5
Total Dissolved Solids	1
Uranium	0.001
Vanadium	0.1

* mg/L unless specified otherwise

Table 5-2

Mean Concentrations of U-nat, Thorium-230, Radium-226, Radon-222, and Gamma Radiation Air Monitoring Data at the Smith Ranch Air Monitoring Stations for the Period 1996 through 2002

Parameter	Air Station No. 1 Dave's Water Well (Upwind)	Air Station No. 2 CPP Fence Line (Restricted Area Boundary)	Air Station No. 3 Vollman Ranch (Downwind)
Air Particulate Monitoring			
U-nat (µCi/mL)	1.60E-15	1.85E-14	1.40E-15
ECL (µCi/mL)	3.00E-12	3.00E-12	3.00E-12
% ECL	0.05%	0.6%	0.05%
Th-230 (µCi/mL)	5.40E-16	6.30E-16	4.90E-16
ECL (µCi/mL)	2.00E-14	2.00E-14	2.00E-14
% ECL	3%	3%	2%
Ra-226 (µCi/mL)	5.30E-16	1.90E-15	6.00E-16
ECL (µCi/mL)	9.00E-13	9.00E-13	9.00E-13
% ECL	0.06%	0.2%	0.07%
Radon-222 Monitoring			
Radon-222 (µCi/mL)	1.30E-09	1.10E-09	1.10E-09
ECL (µCi/mL)	1.00E-08	1.00E-08	1.00E-08
% ECL	13%	11%	11%
Gamma Radiation			
Gamma (mRem/Qtr)	33	38	34

Notes: ECL, Effluent Concentration Limit

Table 5-3

Summary of U-Nat, Thorium-230 and Radium-226 Air Monitoring Data at the Highland Air Monitoring Stations for The Period 1995 through 1999

Yr/Qtr	U-Nat (µCi/mL)			Th-230 (µCi/mL)			Ra-226 (µCi/mL)		
	Air Station No. 1 Vollman Ranch (Upwind)	Air Station No. 2 CPF Overlook (Restricted Area Boundary)	Air Station No. 3 Fowler Ranch (Downwind)	Air Station No. 1 Vollman Ranch (Upwind)	Air Station No. 2 CPF Overlook (Restricted Area Boundary)	Air Station No. 3 Fowler Ranch (Downwind)	Air Station No. 1 Vollman Ranch (Upwind)	Air Station No. 2 CPF Overlook (Restricted Area Boundary)	Air Station No. 3 Fowler Ranch (Downwind)
1995-1st	3.85E-16	7.46E-15	3.46E-15	<1.00E-16	<1.00E-16	<1.00E-16	2.10E-16	9.50E-16	2.24E-15
2nd	5.43E-16	2.55E-15	3.31E-16	<1.00E-16	<1.00E-16	3.31E-16	<1.00E-16	<1.00E-16	2.65E-16
3rd	3.77E-16	5.71E-15	3.59E-15	<1.00E-16	<1.00E-16	6.76E-16	<1.00E-16	1.56E-16	1.18E-15
4th	2.68E-16	3.12E-15	3.42E-15	1.10E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	1.22E-16
1996-1st	3.40E-16	1.60E-14	2.34E-15	<1.00E-16	1.42E-16	1.13E-16	<1.00E-16	<1.00E-16	<1.00E-16
2nd	3.03E-16	1.10E-14	2.77E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16
3rd	4.35E-16	6.28E-15	1.35E-15	<1.00E-16	<1.00E-16	<1.00E-16	1.32E-16	3.17E-16	<1.00E-16
4th	9.01E-16	5.19E-15	2.57E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16
1997-1st	1.22E-15	2.29E-15	1.47E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16
2nd	1.14E-15	2.11E-15	1.56E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	1.94E-16
3rd	5.61E-16	2.85E-15	4.68E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16
4th	7.71E-15	6.50E-15	1.56E-15	<1.00E-16	<1.00E-16	1.67E-16	<1.00E-16	<1.00E-16	<1.00E-16
1998-1st	1.60E-14	2.39E-15	1.36E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	1.70E-16	<1.00E-16
2nd	2.17E-15	2.57E-15	3.57E-15	<1.00E-16	<1.00E-16	3.23E-16	2.08E-16	2.50E-16	4.77E-16
3rd	6.43E-16	1.93E-15	1.21E-15	<1.00E-16	<1.00E-16	<1.00E-16	1.06E-16	<1.00E-16	<1.00E-16
4th	1.02E-14	4.09E-15	2.50E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	1.36E-16	<1.00E-16
1999-1st	2.62E-15	7.06E-16	5.26E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	2.51E-16
2nd	9.33E-15	1.70E-15	1.25E-15	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16
3rd	7.17E-15	2.73E-15	6.75E-16	1.86E-16	1.05E-16	1.58E-16	<1.00E-16	5.25E-16	<1.00E-16
4th	4.38E-15	7.66E-16	8.04E-16	1.58E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16	<1.00E-16
Minimum	**2.68E-16**	**7.06E-16**	**3.31E-16**	**<1.00E-16**	**<1.00E-16**	**<1.00E-16**	**<1.00E-16**	**<1.00E-16**	**<1.00E-16**
% ECL	**0.3**	**0.8**	**0.4**	**0.5**	**0.5**	**0.5**	**0.01**	**0.01**	**0.01**
Maximum	**1.60E-14**	**1.60E-14**	**4.68E-15**	**1.86E-16**	**1.42E-16**	**6.76E-16**	**2.10E-16**	**9.50E-16**	**2.24E-15**
% ECL	**17.8**	**17.8**	**5.2**	**0.9**	**0.7**	**3.4**	**0.02**	**0.11**	**0.25**
Mean	**3.33E-15**	**4.40E-15**	**2.05E-15**	**1.08E-16**	**1.02E-16**	**1.58E-16**	**1.13E-16**	**1.90E-16**	**3.01E-16**
% ECL	**3.7**	**4.9**	**2.3**	**0.5**	**0.5**	**0.8**	**0.01**	**0.02**	**0.03**

Notes:
1. Lower limit of detection used to determine mean values.
2. % Effluent Concentration Limit (ECL) based on the following ECL's:
   U-Nat = 9.00 E-14 µCi/mL Th-230 = 2.00 E-14 µCi/mL
   Ra-226 = 9.00 E-13 µCi/mL

Table 5-4

Summary of Radon-222 Monitoring Data at the Highland Air Monitoring Stations for the Period 1995 through 1999

Yr/Qtr	Air Station No. 1	Air Station No. 2	Air Station No. 3	Passive Air Station No. 1	Passive Air Station No. 2	Passive Air Station No. 3
	Vollman Ranch (Upwind)	CPF Overlook (Restricted Area Boundary)	Fowler Ranch (Downwind)	SAT20-SW	SAT2-NE	SAT3 (Background)
1995-1st	6.0E-10	1.5E-09	9.0E-10	1.1E-09	1.1E-09	NA
2nd	8.0E-10	7.0E-10	1.1E-09	1.7E-09	1.7E-09	NA
3rd	1.2E-09	1.3E-09	1 8E-09	3 7E-09	2.5E-09	NA
4th	1 0E-09	1.7E-09	1.1E-09	1.7E-09	1.9E-09	NA
1996-1st	<3 0E-10	9.0E-10	5.0E-10	1.0E-09	1.1E-09	NA
2nd	9 0E-10	8 0E-10	9.0E-10	1.7E-09	1.2E-09	1.0E-09
3rd	1.9E-09	1.7E-09	1.9E-09	3.8E-09	2.4E-09	1.9E-09
4th	9.0E-10	1.3E-09	9.0E-10	1.6E-09	1.4E-09	7.0E-10
1997-1st	1.5E-09	1.3E-09	1.1E-09	1.4E-09	1.2E-09	1.0E-09
2nd	9 0E-10	1.9E-09	NA	1.4E-09	1.3E-09	1.1E-09
3rd	1.1E-09	1 2E-09	1.2E-09	2.4E-09	1.9E-09	1.7E-09
4th	1.7E-09	9.0E-10	1.8E-09	2.4E-09	1.8E-09	9.0E-10
1998-1st	<3.0E-10	<3 0E-10	3.0E-10	5.0E-10	<3.0E-10	3.0E-10
2nd	7.0E-10	7.0E-10	9.0E-10	1.7E-09	1.5E-09	1.3E-09
3rd	1.0E-09	5 0E-10	9.0E-10	2.7E-09	1.3E-09	1.0E-09
4th	7.0E-10	7.0E-10	9 0E-10	1.4E-09	1.5E-09	8.0E-10
1999-1st	8.0E-10	1.3E-09	1.6E-09	1.8E-09	1.7E-09	9.0E-10
2nd	<3 0E-10	8.0E-10	9.0E-10	1.6E-09	5.0E-10	8.0E-10
3rd	1.0E-09	1.4E-09	1.1E-09	2.5E-09	1.5E-09	3.3E-09
4th	1.2E-09	1.2E-09	1.4E-09	2.6E-09	2.1E-09	1.2E-09
Minimum	**<3.00E-10**	**<3.00E-10**	**3.00E-10**	**<5.00E-10**	**<3.00E-10**	**3.00E-10**
% ECL	**3.0**	**3.0**	**3.0**	**5.0**	**3.0**	**3.0**
Maximum	**1.90E-09**	**1.90E-09**	**1.90E-09**	**3.80E-09**	**2.50E-09**	**3.30E-09**
% ECL	**19.0**	**19.0**	**19.0**	**38.0**	**25.0**	**33.0**
Mean	**9.40E-10**	**1.11E-09**	**1.12E-09**	**1.89E-09**	**1.50E-09**	**1.19E-09**
% ECL	**9.4**	**11.1**	**11.2**	**18.9**	**15.0**	**11.9**

Notes:
1. NA, data not available
2. Lower Limit of Detection used to determine mean values.
3. Concentrations expressed in µCi/mL.
4. % Effluent Concentration Limit (ECL) based on ECL of 1.00 E-8 µCi/mL.

Table 5-5

Summary of Gamma Radiation Monitoring Data
At the Highland Air Monitoring Stations
for the Period 1995 through 1999

Yr/Qtr	Air Station No. 1	Air Station No. 2	Air Station No. 3	Passive Air Station No. 1	Passive Air Station No. 2	Passive Air Station No. 3
	Vollman Ranch (Upwind)	CPF Overlook (Restricted Area Boundary)	Fowler Ranch (Downwind)	SAT2-SW	SAT2-NE	SAT3 (Background)
1995-1st	34.8	40.0	35.4	46 8	30.6	NA
2nd	24.6	31.0	26.4	22.8	32.0	NA
3rd	27.8	42.0	33.8	40.8	39.2	NA
4th	24.6	23.4	31.6	34.6	24.6	NA
1996-1st	37.4	45 4	41.0	52.6	38.8	NA
2nd	28.6	34.6	32.0	42.2	33.4	35.2
3rd	41.8	45.0	38.4	38.0	48.8	41.0
4th	37.4	44.0	43.2	41.2	41.4	37.4
1997-1st	29.0	33 4	30.8	35.8	33.0	31.8
2nd	29 4	34.6	30.4	34.4	29.8	29.0
3rd	32.0	33.8	33.4	35.2	30.0	30.4
4th	30.6	36.8	30.8	39.2	30.2	34.6
1998-1st	32.0	37.0	36.0	35.8	31.8	35.6
2nd	30.6	37.4	32.2	37.6	30.4	33.6
3rd	43 4	49.8	42.8	57.4	48.0	46.6
4th	36 4	40 6	41.0	46 6	42.8	40.4
1999-1st	35.2	32.0	44.0	38.8	32.4	33 4
2nd	37.4	42.8	40 2	53.4	36.4	40.6
3rd	36.0	39.6	35.2	42.8	33.8	NA
4th	38.4	NA	40.4	43.8	37.4	41.6
Minimum	**24.6**	**23.4**	**26.4**	**22.8**	**24.6**	**29.0**
Maximum	**43.4**	**49.8**	**44.0**	**57.4**	**48.8**	**46.6**
Mean	**33.4**	**38.1**	**36.0**	**41.0**	**35.2**	**36.5**

Notes: 1. NA, Data not available.
2. Gamma radiation levels expressed in mRem/Quarter.

Table 5-6

Ground Water Monitoring Program

Site	Location	Source	Use	Analyses
GW-1	NW¼, NW¼, SEC 1, T35N, R74W	Windmill	Livestock	Uranium, Radium-226
GW-2	NE¼, NW¼, SEC 35, T36N, R74W	Water Well	Livestock	Uranium, Radium-226
GW-3	SE¼, NW¼, SEC 27, T36N, R74W	Windmill	Livestock	Uranium, Radium-226
GW-4	SE¼, SW¼, SEC 23, T36N, R74W	Windmill	Livestock	Uranium, Radium-226
GW-5	NE¼, NE¼, SEC 30, T36N, R73W	Windmill	Livestock	Uranium, Radium-226
GW-6	SW¼, SE¼, SEC 21, T36N, R73W	Windmill	Livestock	Uranium, Radium-226
GW-7	NE¼, NW¼, SEC 27, T36N, R73W	Water Well	Domestic	Uranium, Radium-226
GW-8	SW¼, NW¼, SEC 23, T36N, R73W	Windmill	Livestock	Uranium, Radium-226
GW-9	SE¼, SE¼, SEC 14, T36N, R73W	Windmill	Livestock	Uranium, Radium-226
GW-10	SE¼, NE¼, SEC 14, T36N, R73W	Water Well	Livestock	Uranium, Radium-226
GW-11	NE¼, SE¼, SEC 11, T36N, R73W	Water Well	Livestock	Uranium, Radium-226
GW-12	SE¼, SW¼, SEC 7, T36N, R72W	Water Well	Livestock	Uranium, Radium-226

Table 5-7

Surface Water Monitoring Program

Site	Location	Source	Analyses
SW-1	NW¼, NW¼, SEC 3, T35N, R74W	Stock Pond	Uranium, Radium-226
SW-2	NE¼, SE¼, SEC 2, T35N, R74W	Stock Pond	Uranium, Radium-226
SW-3	NE¼, NW¼, SEC 35, T36N, R74W	Stock Pond	Uranium, Radium-226
SW-4	NW¼, SE¼, SEC 36, T36N, R74W	Stock Pond	Uranium, Radium-226
SW-5	SW¼, SE¼, SEC 21, T36N, R73W	Stock Pond	Uranium, Radium-226
SW-6	SE¼, SW¼, SEC 22, T36N, R73W	Stock Pond	Uranium, Radium-226
SW-7	SE¼, NW¼, SEC 22, T36N, R73W	Stock Pond	Uranium, Radium-226
SW-8	NE¼, SW¼, SEC 18, T36N, R72W	Stock Pond	Uranium, Radium-226
SW-9	NW¼, NW¼, SEC 18, T36N, R72W	Stock Pond	Uranium, Radium-226
SW-10*	SW¼, SW¼, SEC 19, T36N, R72W	Stock Pond	Uranium, Radium-226

Note: *, Site SW-10 will be monitored once mining commences in drainage area of pond.

TABLE 5-8

Satellite No. 1 Wastewater Land Application Facility Monitoring Program

Sample Type	Location	Frequency	Analyses
Treated Waste Water	At radium settling ponds or discharge from Satellite No. 1 radium treatment system	Monthly; grab	Ra226
Irrigation Fluid	At irrigation pivot during irrigation	Grab sample during each calendar month of operation	Na, Ca, Mg, Cl, SO_4, As, Se, U, Ra226, HCO_3, TDS, K, Ba, B, SAR, pH
Soil Water	24, 48, 72 inch depth	June	pH, Electrical Cond., Cl, SO_4, HCO_3, B, U, Ra226
Irrigated soil thoroughly blended composite 6-12 inch depth	One sample per four (4) irrigated acres	August	Na, Ca, Mg, K, As, Se, B, Ba, Ra226, U, Electrical Cond., SAR, pH
Irrigated Vegetation	One sample at each soil sample location, composited	August; if harvested as hay, one sample per cutting	As, Se, B, Ra226, U, Ba
Visual Inspection	Irrigation Perimeter	Daily during irrigation	Check for runoff

NOTE: Heavy metal analyses in soils will be performed on plant available or ADPTA extractable fraction.

Table 5-9

Satellite No. 2 Wastewater Land Application Facility
Monitoring Program

Sample Type	Location	Frequency	Analyses
Treated Waste Water	At discharge from radium treatment system at Satellite Nos. 2 and 3	Monthly; grab	Ra226
Irrigation Fluid	At Irrigation pivot during irrigation	Grab sample each calendar month of operation	Na, Ca, Mg, Cl, SO_4, As, Se, U, Ra226, HCO_3, TDS, K, Ba, B, SAR, pH
Soil Water	At two 4 ft lysimeters	June	pH, Electrical Cond., Cl, SO_4, HCO_3, Se, B, U, Ra226
Water	At shallow wells 1 and 2 adjacent to reservoir	Water level quarterly, semi-annual grab water quality	pH, Electrical Cond., Cl, SO_4, HCO_3, Se, B, U, Ra226
Irrigated Soil	4 sample sites per quarter of irrigated area, obtained at depths of 0-6 inches, 6-12 inches	August	Na, Ca, Mg, K, As, Se, B, Ba, Ra226, U, Electrical Cond., SAR, pH
Irrigated Vegetation	One sample at each soil sample location, composited by quarter	August	As, Se, B, Ra226, U, Ba
Visual Inspection	Irrigation Perimeter	Daily during irrigation	Check for runoff

NOTE: Heavy metal analyses in soils will be performed on plant available or ADPTA extractable fraction.

Table 5-10

Mean U-Nat and Radium-226 Concentrations in Soil at the Satellite No. 1 Irrigation Area for the Period 1990 through 1999

Year	0-6 Inches				6-12 Inches			
	U-Nat		Ra-226		U-Nat		Ra-226	
	µCi/g	mg/kg	µCi/g	pCi/g	µCi/g	mg/kg	µCi/g	pCi/g
1990	8.8E-7	1.3	1.6E-6	1.6	6.1E-7	0.9	1.6E-6	1.6
1991	2.1E-6	3.1	9.1E-7	0.9	6.8E-7	1.0	1.1E-6	1.1
1992	3.6E-6	5.3	9.2E-7	0.9	1.6E-6	2.4	1.0E-6	1.0
1993	2.5E-6	3.7	2.4E-6	2.4	1.8E-6	2.7	2.6E-6	2.6
1994	2.6E-6	8.3	1.1E-6	1.1	1.8E-6	2.7	1.4E-6	1.4
1995	6.5E-6	9.6	1.3E-6	1.3	1.1E-6	1.6	1.3E-6	1.3
1996	9.1E-6	13.4	1.0E-6	1.0	2.9E-6	4.3	1.0E-6	1.0
1997	8.0E-6	11.8	1.0E-6	1.0	1.8E-6	2.7	1.1E-6	1.1
1998	1.8E-5	26.1	1.3E-6	1.3	3.8E-6	5.6	1.2E-6	1.2
1999	1.1E-5	16.5	1.1E-6	1.1	2.0E-6	2.9	1.1E-6	1.1

Background Range:

U-Nat	0-6 inches	4.4E-7 to 1.7E-6 µCi/g (0.7 to 2.5 mg/kg)
U-Nat	6-12 inches	6.4E-7 to 1.6E-6 µCi/g (0.9 to 2.4 mg/kg)
Ra-226	0-6 inches	9.9E-7 to 1.4E-6 µCi/g (0.5 to 1.4 pCi/g)
U-Nat	6-12 inches	7.0E-7 to 1.3E-6 µCi/g (0.7 to 1.3 pCi/g)

Table 5-11

Mean U-Nat and Radium-226 Concentrations in Soil at the Satellite No. 2 Irrigation Area for the Period 1996 through 1999

Year	0-6 Inches				6-12 Inches			
	U-Nat		Ra-226		U-Nat		Ra-226	
	µCi/g	mg/kg	µCi/g	pCi/g	µCi/g	mg/kg	µCi/g	pCi/g
1996	5.9E-6	8.8	1.1E-6	1.1	2.0E-6	3.0	1.2E-6	1.2
1997	5.0E-6	7.4	1.3E-6	1.3	2.4E-6	3.5	1.4E-6	1.4
1998	8.7E-6	12.9	1.2E-6	1.2	2.3E-6	3.4	1.3E-6	1.3
1999	4.6E-6	6.9	1.4E-6	1.4	2.2E-6	3.3	1.4E-6	1.4

Background Range:

U-Nat	0-6 inches	1.8E-6 to 3.4E-6 µCi/g (2.7 to 5.0 mg/kg)
U-Nat	6-12 inches	8.8E-7 to 3.3E-6 µCi/g (1.3 to 4.9 mg/kg)
Ra-226	0-6 inches	7.0E-7 to 1.9E-6 µCi/g (0.7 to 1.9 pCi/g)
Ra-226	0-12 inches	8.0E-7 to 2.2E-6 µCi/g (0.8 to 2.2 pCi/g)

Table 5-12

Mean U-Nat and Radium-226 Concentrations in Vegetation at the Satellite No. 1 Irrigation Area for the Period 1991 through 1999

Year	U-Nat		Ra-226
	µCi/kg	mg/kg	µCi/kg
1991	1.4E-3	2.03	1.1E-5
1992	7.8E-4	1.16	3.7E-5
1993	9.2E-4	1.36	1.7E-7
1994	3.9E-7	5.70	9.6E-5
1995	1.1E-4	0.16	1.8E-5
1996	5.8E-3	8.60	2.3E-5
1997	5.0E-4	0.73	1.4E-5
1998	3.6E-3	12.75	1.5E-5
1999	2.1E-2	30.82	1.5E-5

Background Range:

U-Nat 3.4E-3 to 5.3E-5 µCi/kg (0.08 to 5.00 mg/kg)
Ra-226 2.6E-5 to 6.4E-6 µCi/kg

Table 5-13

Mean U-Nat and Radium-226 Concentrations in Vegetation at the Satellite No. 2 Irrigation Area for the Period 1996 through 1999

Year	U-Nat		Ra-226
	µCi/kg	mg/kg	µCi/kg
1996	1.3E-4	0.19	4.4E-6
1997	1.5E-4	0.22	2.4E-5
1998	1.1E-3	1.62	1.3E-5
1999	6.8E-4	1.00	1.4E-5

Background Range:

U-Nat 1.7E-5 to 2.8E-5 µCi/kg (0.03 to 0.04 mg/kg)
Ra-226 1.0E-5 to 1.5E-5 µCi/k

Table 5-14

Summary of Injectate Quality at Smith Ranch Waste Disposal Wells WDW #1 and WDW #2 for the Period 1998 through 2002

Yr/Qtr	Total Dissolved Solids (mg/L)	Total Alkalinity (mg/L)	Ammonia (mg/L)	Natural Uranium (mg/L)	Radium-226 (pCi/L)	pH
1998 1st Qtr	18,300	305	323	5.13	994	7.50
1998 2nd Qtr	17,800	373	667	26.7	1,250	7.00
1998 3rd Qtr	19,600	282	568	5.41	1,270	7.23
1998 4th Qtr	20,500	359	832	17.3	1,550	7.51
1999 1st Qtr	34,900	221	1,270	9.4	1,440	7.27
1999 2nd Qtr	21,300	346	798	18.3	1,060	7.33
1999 3rd Qtr	15,500	359	627	20.1	1,050	7.48
1999 4th Qtr	36,500	153	1,300	7.2	2,620	7.16
2000 1st Qtr	15,100	420	365	21.3	1,570	7.51
2000 2nd Qtr	15,200	430	564	29.7	1,900	7.35
2000 3rd Qtr	32,600	117	1,210	10.4	2,910	6.91
2000 4th Qtr	39,200	137	1,330	35.5	2,100	6.93
2001 1st Qtr	10,200	393	403	15.4	2,050	7.17
2001 2nd Qtr	10,700	373	348	7.43	2,450	7.33
2001 3rd Qtr	15,900	332	562	10.8	3,020	7.20
2001 4th Qtr	3,240	487	66	2.74	2,630	7.10
2002 1st Qtr	11,100	467	547	6.4	2,580	7.30
2002 2nd Qtr	6,780	597	261	11.1	2,740	7.13
2002 3rd Qtr	29,700	<1.0	1,380	129	3,710	3.48
2002 4th Qtr	20,600	414	931	42.6	1,750	7.64
Permit Limits	N/A	N/A	N/A	65	N/A	2.0-11.0

Table 5-15

Summary of Injectate Quality at Highland Waste Disposal Well Morton 1-20 for the Period 1998 through 2002

Yr/Qtr	Total Dissolved Solids (mg/L)	Total Alkalinity (mg/L)	Ammonia (mg/L)	Natural Uranium (mg/L)	Radium-226 (pCi/L)	pH
1998 1st Qtr	38,000	85.2	2,560	0.0003	17.2	7.37
1998 2nd Qtr	91,200	57.2	3,660	17.1	124	6.88
1998 3rd Qtr	65,100	118	2,830	9.29	62.2	7.39
1998 4th Qtr	54,800	68	2,000	8.09	41.7	7.18
1999 1st Qtr	54,200	51	2,340	7.16	21.1	7.56
1999 2nd Qtr	56,300	0	2,640	14.9	66.9	4.11
1999 3rd Qtr	55,700	68	2,360	8.01	49.4	7.12
1999 4th Qtr	62,200	70	2,700	14.8	92.3	7.34
2000 1st Qtr	53,900	46	2,300	7.6	23.3	6.96
2000 2nd Qtr	59,100	41	2,510	2.7	26.9	6.76
2000 3rd Qtr	52,700	36	2,790	5.86	13.7	6.99
2000 4th Qtr	57,500	24	2,280	8.24	32.4	6.75
2001 1st Qtr	57,700	<1.0	NA	9.13	44.5	4.08
2001 2nd Qtr	91,600	48	2,020	9.94	18.5	6.77
2001 3rd Qtr	44,600	65	2,720	8.9	120	7.20
2001 4th Qtr	42,700	67	2,350	15.6	72.6	7.20
2002 1st Qtr	47,200	44	2,970	14.8	77.2	6.83
2002 2nd Qtr	52,900	89	2,770	11.6	57.6	7.28
2002 3rd Qtr	36,200	108	2,250	9.05	54.0	7.26
2002 4th Qtr	33,500	4,430	4,420	73.4	128	9.03
Permit Limits	N/A	N/A	N/A	65	N/A	2.0-11.0

CHAPTER 6
RECLAMATION PLAN

The objective of the Reclamation Plan is to return the affected ground water and land surface to conditions such that they are suitable for uses for which they were suitable prior to mining. The methods to achieve this objective for both the affected ground water and the surface are described in the following sections.

6.1 GROUND WATER RESTORATION

6.1.1 Water Quality Criteria

The primary goal of the ground water restoration efforts will be to return the ground water quality of the production zone, on a mine unit average, to the pre-injection baseline condition as defined by the baseline water quality sampling program which is performed for each mine unit. Baseline values will not be changed unless the operational monitoring program indicates that baseline water quality has changed significantly due to accelerated movement of ground water, and that such change justifies redetermination of baseline water quality. Such a change would require resampling of monitor wells and review and approval by the WDEQ. Should baseline conditions not be achieved after diligent application of the best practicable technology (BPT) available, PRI commits, in accordance with the Wyoming Environmental Quality Act and WDEQ regulations, to a secondary goal of returning the ground water to a quality consistent with the use, or uses, for which the water was suitable prior to ISL mining.

For the purposes of this application, the use categories are those established by the WDEQ, Water Quality Division. The final level of water quality attained during restoration is related to criteria based on the pre-mining baseline data from that wellfield, the applicable Use Suitability Category and the available technology and economics. Baseline, as defined for this project, shall be the mean of the pre-mining baseline data, taking into account the variability between sample results (baseline mean plus two standard deviations).

6.1.2 Restoration Criteria

The restoration criteria for the ground water in a mining unit is based on the baseline water quality data collected for each mine unit from the wells completed in the planned Production Zone (i.e., MP-Wells), on a parameter by parameter basis. All parameters are to be returned to as close to baseline as is reasonably achievable. Restoration Target Values (RTVs) are established for the list of baseline water quality parameters. The RTVs for the mining units shall be the mean plus two standard deviations of the pre-mining values. If during restoration, the average concentration of a parameter in the designated production area wells of a mining unit (i.e., MP-Wells) is not reduced to the RTV within a reasonable time, a report describing the restoration method used, predicted results of additional restoration activities, and an evaluation of the impact, if any, that the higher concentration has on the ground water quality and future use of the water will be prepared and submitted to the applicable regulatory agencies.

6.1.3 Restoration Method

The primary restoration technique is a combination of ground water sweep, chemical treatment, and clean water injection. Ground water sweep involves withdrawing water from selected production and injection wells which draws uncontaminated natural ground water through the leached area displacing the leach solutions. Chemical treatment involves addition of approved water treatment chemicals to waters injected into the wellfield to re-stabilize the host formation. Clean water injection involves the injection of a better quality of "clean" water in selected wells within the production area while pumping other production and/or injection wells which again displaces the leach solutions with the better quality water. It is expected that an average of about six pore volumes of water will have to be displaced to achieve restoration of a mining unit.

The source of the clean water may be from an Electro Dialysis Reversal (EDR) or Reverse Osmosis (RO) type unit, water produced from a mining unit that is in a more advanced state of restoration, water being exchanged with a new mining unit, or a combination of these sources. Water withdrawn from the Production Zone during restoration will first be processed through an ion exchange unit to recover the uranium, then will be treated and reused in the project, potentially treated and discharged under an NPDES permit, or routed to a holding pond for future treatment and/or disposal at one of the deep disposal wells, or in the case of HUP wellfields, treated for the further removal of uranium and radium-226, and disposed at the irrigation facilities.

Chemical reductants are beneficial because several of the metals, which are solubilized during the leaching process, are known to form stable insoluble compounds, primarily as sulfides. Primary among such metals is uranium, which occurs at the site because of the naturally occurring reduced state of the ore body. The introduction of a chemical reductant into the mine zone at the end of the mining phase is designed to expedite the return of the zone to its natural conditions and to return as many of the solubilized metals to their original insoluble state as possible. By effecting this partial restoration directly within the formation (in-situ), the external impact of ground water restoration is minimized.

If required to meet ground water restoration goals, the chemical reductant is added above ground to the clean water stream being injected into selected wells before, during, or after the RO/EDR phase of ground water restoration. Based on the historical success reported by other ISL uranium mining companies, and experience at Highland, the reductant will be a sulfur compound such as gaseous hydrogen sulfide (H_2S) or dilute solutions of sodium hydrosulfide (NaHS) or sodium sulfide (Na_2S). If gaseous hydrogen sulfide is chosen for use, a program for its safe handling will be developed to protect workers, the public, and the environment. If PRI should desire to utilize any reductant other than these three sulfur compounds, WDEQ approval will be obtained prior to use.

6.1.4 Bioremediation Tests

The use of bioremediation technology has been used fairly extensively in recent years for the restoration of ground water contaminated with organic compounds. Bioremediation is the use of introduced or naturally occurring bacteria and the addition of nutrients such as sugars and alcohols that stimulates the bacterial growth. The bacteria consume the organic compounds and naturally break them down into non-toxic compounds.

It has been previously suggested that bioremediation could be effective at uranium ISL in reducing redox sensitive parameters, such as uranium and selenium. Although some "bench scale" type tests have been conducted in the past, actual field tests at commercial scale ISL operations were very limited. Therefore, PRI conducted laboratory tests during 2001 to assess the potential of using bioremediation as a restoration technology at the Highland Uranium Project. Laboratory tests using ground water from the B-Wellfield leached area showed that native bacteria were present that could potentially effectively reduce uranium and selenium concentrations when nutrients were added to stimulate bacterial growth.

Given the success of the laboratory tests, PRI obtained permission to conduct a field test in the B-16 East area of the B-Wellfield. This area of the B-Wellfield had not yet had any ground water restoration activities conducted at it. Therefore, the test was intended to assess the impact of bioremediation on the reduction of relatively high concentrations of uranium and selenium, as well as determining if bioremediation would cause any operation problems if the ground water was run through an RO unit for further restoration.

The test involved the decarbonation of the ground water at a pattern area consisting of 6 injection wells and 3 production wells, and the addition of nutrients, molasses and methanol. The WDEQ approved the field test as a revision to the Mine Permit. Consistent with guidance from the NRC, the test was authorized by the SERP process (SERP No. 38, dated August 22, 2001). The nutrient injection lasted approximately seven months. Results of the test showed that uranium was reduced from about 25 mg/L to about 15 mg/L and selenium was reduced from about 1.21 mg/L to about 0.005 mg/L.

Based on this success, PRI is intending to expand the test in 2003 to other areas of the B-Wellfield in order that additional nutrients can be tested. Also, PRI desires to test bioremediation at areas where the "starting" ground water quality conditions more closely reflect conditions observed at other wellfield areas (predominantly lower starting uranium concentrations). PRI is hopeful that additional tests will assist in determining the best nutrients to use and the most cost effective methods to introduce them to the mined area. In the case that these expanded tests are successful, PRI expects that bioremediation could replace the reductant phase of ground water restoration and provide a safer means of reducing residual metal concentrations. If the additional tests prove successful, PRI intends to obtain WDEQ approval prior to utilizing bioremediation on a routine "commercial scale" basis.

6.1.5 Ground Water Restoration Schedule

The schedule for mining related activities, including ground water restoration is shown in Figure 3-12 of Chapter 3. Ground water restoration activities are started once the uranium in the particular wellfield is depleted. The duration of restoration activities will vary according to the size of the wellfield, the porosity and permeability of the production zone, and the extent to which the ground water has been affected. Given these factors, it is estimated that restoration activities will take from four to seven years at each wellfield.

At the Highland Uranium Project, ground water restoration activities were begun at the A and B-Wellfields in mid-1991 and at the C-Wellfield in 1997. Currently (March 2003), PRI has completed ground water restoration in the A-Wellfield and is awaiting concurrence from the WDEQ that restoration is acceptable and the wells can be abandoned. Once this approval is received, PRI will request concurrence from the NRC. It is anticipated that active restoration activities will be complete at the B-Wellfield in 2003 or 2004. At the Smith Ranch Project, ground water restoration activities are expected to commence at Wellfield 1 in 2004.

6.1.6 Restoration Monitoring

At the start of restoration, the MP-Wells, which were used to determine baseline, are sampled and analyzed for the parameters in Table 5-1 of Chapter 5 to characterize an "end of injection" water quality average. To track the progress of restoration, the MP-Wells, in areas where active restoration activities are occurring, will be sampled and analyzed for at least conductivity, chloride and uranium once every 60 days during periods of active restoration. In the event that unforeseen conditions (such as snowstorms, flooding, equipment malfunction) occur, the regulatory agencies will be contacted if the well(s) cannot be monitored within 65 days of the last sampling event. Depending on the results of initial sampling at the beginning of restoration, other specific parameters, such as selenium, may also be tracked during restoration to evaluate the need for a chemical reductant, pH control, etc.

During ground water sweep, lixiviant injection is discontinued and the quality of the ground water is constantly being improved back to near baseline quality, thereby greatly diminishing the possibility and relative impact of an excursion. Therefore, the monitor ring wells (M-Wells), overlying aquifer wells (MO or MS-Wells), and underlyng aquifer wells (MU or MD-Wells) are sampled once every 60 days and analyzed for the excursion parameters, chloride, total alkalinity and conductivity. Water levels are also obtained at these wells prior to sampling.

6.1.7 Restoration Stability Monitoring

Following concurrence from the WDEQ that restoration has been achieved in the mining area, a six month stability period is assessed to show that the restoration goal has been adequately maintained. The following restoration stability monitoring program is performed during the stability period:

1. The monitor ring wells (M-Wells) are sampled once every two months and analyzed for the UCL parameters, chloride, total alkalinity and conductivity; and

2. Those MP-Wells designated as restoration stability monitoring wells are sampled once every two months and analyzed for conductivity, chloride, total alkalinity, uranium, TDS and problem parameters identified during active restoration.

In the event that unforeseen conditions (such as snowstorms, flooding, equipment malfunction) occur, the regulatory agencies will be contacted if any of the M-Wells or MP-Wells cannot be monitored within 65 days of the last sampling event.

6.1.8 Well Plugging

Wellfield plugging and surface reclamation will be initiated once the regulatory agencies concur that the ground water has been adequately restored and determined stable. All production, injection and monitor wells and drillholes are abandoned in accordance with WS-35-11-404 and Chapter VIII of the WDEQ-LQD Rules and Regulations to prevent adverse impacts to ground water quality or quantity.

Wells will be plugged and abandoned in accordance with the following program.

1. When practicable, all pumps and tubing are removed from the well.

2. All wells are plugged from total depth to within 5 feet of the collar with a nonorganic well abandonment plugging gel formulated for well abandonment and mixed in the recommended proportion of 10 to 20 lbs per barrel of water, to yield an abandonment fluid with a 10 minute gel strength of at least 20 lbs/100 sq ft and a filtrate volume not to exceed 13.5 cc.

3. The casing is cut off at least two feet below the ground surface. Abandonment fluid is topped off to the top of the cut-off casing.

4. A pre-cast or slurried cement plug is placed at the top of the casing, and the area is backfilled, smoothed, and leveled to blend with the natural terrain.

As an alternative method of well plugging, a dual plug procedure may be used where a cement plug will be set using slurry of a weight of no less than 12 lbs/gallon into the bottom of the well. The plug will extend from the bottom of the well upwards across the first overlying aquitard. The remaining portion of the well will be plugged using a bentonite/water slurry with a mud weight of no less than 9.5 lbs/gallon. A 10-foot cement top plug will be set to seal the well at the surface.

6.2 SURFACE RECLAMATION AND DECOMMISSIONING

6.2.1 Introduction

All lands disturbed by the mining project will be returned to their pre-mining land use of livestock grazing and wildlife habitat unless an alternative use is justified and is approved by the state and the landowner, i.e. the rancher desires to retain roads or buildings. The objectives of the surface reclamation effort is to return the disturbed lands to production capacity of equal to or better than that existing prior to mining. The soils, vegetation and radiological baseline data will be used as a guide in evaluating final reclamation.

Following regulatory approval of ground water restoration in any given wellfield, and at least 12 months prior to the planned commencement of facility decommissioning or surface reclamation in a wellfield area, PRI will submit a final (detailed) decommissioning plan to the NRC for review and approval. This section provides a general description of the proposed facility decommissioning and surface reclamation plans for the SR-HUP.

6.2.2 Surface Disturbance

The primary surface disturbances associated with solution mining are the sites containing the Central Processing Plants, Satellite Facilities, and evaporation ponds. Surface disturbances also occur during the well drilling program, pipeline installations, road construction. These more superficial disturbances, however, involve relatively small areas or have very short-term impacts.

The Smith Ranch Central Processing Plant and Main Office Complex is located within the historic Bill Smith Mine site. Therefore, construction of the facilities for ISL mining did not create any new disturbance areas. Disturbances associated with the evaporation ponds, ion exchange Satellites and field header buildings, will be for the life of those activities and topsoil will be stripped from the areas prior to construction. Disturbance associated with drilling and pipeline installation are limited, and are reclaimed and reseeded as soon as weather conditions permit. Vegetation will normally be reestablished over these areas within two years. Disturbance for access roads is also limited as a network of roads is already in place to most wellfield areas and throughout the project area.

The on-site Smith Ranch solid waste landfill site will be closed in a manner that is consistent with the closure requirements for Construction/Demolition Landfills provided in the WDEQ Solid and Hazardous Waste Rules and Regulations. All current and closed disposal cells located onsite have been, or will be, closed with six inch evenly compacted soil cover and a three foot loose soil cover. Any newly constructed solid waste disposal landfill will be closed in a similar manner as the existing landfill.

6.2.3 Topsoil Handling and Replacement

In accordance with WDEQ-LQD requirements, topsoil is salvaged from building sites (including Satellite buildings), permanent storage areas, main access roads, graveled wellfield access roads and chemical storage sites. Conventional rubber-tired, scraper-type earth moving equipment is typically used to accomplish such topsoil salvage operations. The exact location of topsoil salvage operations is determined by wellfield pattern emplacement and designated wellfield access roads within the wellfields, which are determined during final wellfield construction activities. It is estimated that a maximum of 200 acres of topsoil will be salvaged, stockpiled, and reapplied throughout the life of the project.

As described in Appendix D-7 SOILS, topsoil thickness varies within the permit area from non-existent to several feet in depth. Topsoil thickness is usually greatest in, and along drainages where material has been deposited and deep soils have developed. Therefore, topsoil stripping depths may vary from 0 to up to several feet in depth, depending on location and the type of structure being constructed. In cases where it is necessary to strip topsoil in relatively large areas, such as a major road or building site, the field mapping and SCS Soil Surveys will be utilized to determine approximate topsoil depths. The extent of topsoil stripping and stockpiling for the remainder of the project's life will be very limited as no new major facilities or roads will require construction.

Salvaged topsoil is stored in designated topsoil stockpiles. These stockpiles are generally located on the leeward side of hills to minimize wind erosion. Stockpiles are not located in drainage channels. The perimeter of large topsoil stockpiles may be bermed to control sediment runoff. Topsoil stockpiles are seeded as soon as possible after construction with the permanent seed mix. In accordance with WDEQ-LQD requirements, all topsoil stockpiles are identified with a highly visible sign with the designation "Topsoil."

During mud pit excavation associated with well construction, exploration drilling and delineation drilling activities, topsoil is separated from subsoil with a backhoe. When use of the mud pit is complete, all subsoil is replaced and topsoil is applied. Mud pits only remain open a short time, usually less than 30 days. Similarly, during pipeline construction, topsoil is stored separate from subsoil and is replaced on top of the subsoil after the pipeline ditch is backfilled. The success of revegetation efforts at the site show that these procedures adequately protect topsoil and result in vigorous vegetation growth.

6.2.4 Revegetation Practices

Revegetation practices are conducted in accordance with WDEQ-LQD regulations and the mine permit. During mining operations the topsoil stockpiles, and as much as practical of the disturbed wellfield and pond areas will be seeded with vegetation to minimize wind and water erosion. After topsoiling for the final reclamation, an area will normally be seeded with oats to establish a stubble crop, then reseeded with grasses the next growing season. A long term temporary seed mix may be used in wellfield and other areas where the vegetation will be disturbed again prior to final decommissioning and final revegetation. The long term seed mix consists of one or more of the native wheatgrasses (i.e. Western Wheatgrass, Thickspike Wheatgrass). Typical seeding rates are 12-14 lbs of pure live seed per acre.

Permanent seeding is accomplished with a seed mix approved by the WDEQ-LQD. The permanent mix typically contains native wheatgrasses, fescues, and clovers. Typical seeding rates are 12-14 lbs of pure live seed per acre.

The success of permanent revegetation in meeting land use and reclamation success standards will be assessed prior to application for bond release by utilizing the "Extended Reference Area" method as detailed in WDEQ-LQD Guideline No. 2 - Vegetation (March 1986). This method compares, on a statistical basis, the reclaimed area with adjacent undisturbed areas of the same vegetation type.

The Extended Reference Areas will be located adjacent to the reclaimed area being assessed for bond release and will be sized such that it is at least half as large as the area being assessed. In no case will the Extended Reference Area be less than 25 acres in size.

The WDEQ-LQD will be consulted prior to selection of Extended Reference Areas to ensure agreement that the undisturbed areas chosen adequately represent the reclaimed areas being assessed. The success of permanent revegetation and final bond release will be assessed by the WDEQ-LQD.

6.2.5 Site Decontamination and Decommissioning

When ground water restoration in the final mining unit is completed, decommissioning of the Central Processing/Office areas at both Smith Ranch and Highland and the remaining facilities (evaporation ponds, purge storage reservoirs, radium ponds) will be initiated. In decommissioning the processing plants, the process equipment will be dismantled and sold to another licensed facility, or decontaminated in accordance with Regulatory Guide 1.86 "Termination of Operating Licenses for Nuclear Reactors" and "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material". Materials that cannot be decontaminated to an acceptable level will be disposed in an NRC approved facility. After decontamination, materials that will not be reused or that have no resale value, such as building foundations, will be buried on-site.

The Central Processing/Office Areas will be contoured to blend with the natural terrain, surveyed to ensure gamma radiation levels are within acceptable limits, topsoiled, and reseeded per the approved Reclamation Plan.

After all liquids in the evaporation ponds, purge storage reservoirs, and/or radium ponds have evaporated or been disposed via a deep disposal well, or irrigation, the precipitated solids and pond liners will be removed and disposed in a licensed facility. The area will then be contoured to blend with the natural terrain, surveyed to ensure gamma levels are not exceeded, topsoiled, and reseeded per the approved plan.

Gamma surveys are also conducted during the decommissioning of each wellfield. Material identified during the gamma surveys as having contamination levels requiring disposal in a licensed facility will be removed, packaged (if applicable), and shipped to an NRC approved facility for disposal.

In the event that soil cleanup is required during decommissioning of facilities and wellfield areas, the cleanup criteria for radium and other radionuclides (uranium and thorium) will be based on the radium benchmark dose approach of 10 CFR 40, Appendix A, Criterion 6(6).

6.2.6 Final Contouring

Recontouring of land where surface disturbance has taken place will restore it to a surface configuration that will blend in with the natural terrain and will be consistent with the post mining land use. Since no major changes in the topography will result from the proposed mining operation, a final contour map is not required.

6.2.7 Financial Assurance

In accordance with existing NRC license conditions and WDEQ permit requirements, PRI maintains surety instruments to cover the costs of reclamation of each operation, including the costs of ground water restoration, the decommissioning, dismantling and disposal of all buildings, wastewater ponds and other facilities, and the reclamation and revegetation of affected areas. Additionally, in accordance with NRC and WDEQ requirements, an updated Annual Surety Estimate Revision is submitted to the NRC and WDEQ each year to adjust the surety instrument amount to reflect existing operations and those planned for construction or operation in the following year. After review and approval of the Annual Surety Estimate Revision by the NRC and WDEQ, PRI revises the surety instrument to reflect the revised amount.

PRI maintains several approved Irrevocable Letters of Credit in favor of the State of Wyoming for the various operations. Currently (February 2003), the amounts of these surety instruments are as follows:

Smith Ranch-Highland Uranium Project	
- Smith Ranch Facilities	$12,256,800
- Highland Uranium Project Facilities	$19,957,000
North Butte/Ruth Facilities	$157,700
Gas Hills Facilities	$617,400

CHAPTER 7
ENVIRONMENTAL EFFECTS

The objective of the mining and environmental monitoring program is to conduct a mining operation that is viable and environmentally responsible. The environmental monitoring programs used to ensure that potential sources of pollution are controlled and monitored are presented in Chapter 5. Chapter 7also discusses and describes the degree of unavoidable environmental change, the short-term and long-term impacts due to the operation and discusses potential impacts of possible accidents associated with the project.

7.1 SITE PREPARATION AND CONSTRUCTION

Impacts from site preparation and construction are limited to the local soils and vegetation. The Central Processing/Office complexes at both Smith Ranch and Highland are located within previously constructed uranium mine/mill sites. Therefore, the use or construction of these facilities did not result in new surface disturbance. Implementation of the ISL mining project has extended the operating life of the site and deferred final reclamation. During this period, livestock grazing will continue to be excluded from limited areas where mining related activities are occurring.

Drilling wells and installation of pipelines result in temporary disturbance to the soils and vegetation in those areas; however, as demonstrated by current practices, the impact is minimal. Topsoil is bladed to one side, then re-spread as soon as construction is complete and the area seeded. Vegetation in these areas is normally re-established within two years of disturbance. Implementation of the project resulted in livestock being excluded from some of the wellfield areas, however, this will vary with the grazing level and the landowner's desires.

Surface disturbances associated with the evaporation ponds and access roads is for the life of these activities as the topsoil will be removed from these areas and stockpiled prior to construction. When these facilities are no longer needed for the operation, the areas will be re-contoured, top-soiled and re-seeded. The primary impact of these activities will be the exclusion of livestock and wildlife from the evaporation pond areas for the life of the ponds. It is expected that grazing will be excluded from as much as 1200 to 1400 acres over the life of the project. After the project is complete, all areas will be reclaimed and the pre-mining use restored. Therefore, there will be no long-term surface impact from the operation.

There will be no subsidence as a result of the operation. The proposed in-situ leach process removes uranium minerals from the surfaces of the host formation along with trace quantities of other elements similarly deposited on the host sandstone and clays. The demonstrated nature of this process is that the physical structure of the host matrix is unaffected. For this reason, subsidence does not result from in-situ leaching, nor does in-situ leaching of uranium alter the potential for subsidence. Because there is no potential for subsidence as a result of the in-situ mining process, no subsidence mitigation or control plan has been included with this application.

7.2 EFFECTS OF OPERATIONS

As shown by numerous years of monitoring data collected at both the Smith Ranch and Highland operations, no significant or measurable impacts to air or surface water quality are anticipated as a result of the operation.

7.2.1 Impact to Ephemeral Drainages

Within the permit area, the main drainages collect surface precipitation and snowmelt in a roughly northwest to southeast direction along Sage Creek. All flow within the permit is ephemeral with no intermittent or perennial stream flows. The volume of flow from these ephemeral drainages is seasonal and directly related to local climatic conditions. The climate is semi-arid with an overall precipitation averaging 12 inches per year. Snow accumulations are generally light and overall contribute little to the total annual precipitation. Most of the precipitation comes in the form of local potentially high intensity thunderstorms.

Mining activities may sometimes come in contact with ephemeral drainages as a result of roads or wellfield operations. The travel roads include two track and/or established roadways. To the extent possible, existing travel roads are utilized when travelling within the permit area. In instances where ephemeral drainages may be impacted by mining operations, whether by road or wellfield operations, the appropriate protection measures will be afforded to minimize impact to the drainage including prevention of erosion.

The primary surface disturbances associated with in-situ leaching occur with well drilling, pipeline installations, road and wellfield construction. These disturbances involve relatively small areas and/or have a very short-term impact. Continuing efforts are made to keep short-term disturbances caused by these operations to a minimum.

Activities associated with drilling include construction of drill pits and preparation of drill sites. Once a drill site has been selected, the appropriate topsoil protection methodology is employed. Erosion protection measures which may be taken, based on the site specific requirements, include the placement of hay bales, sedimentation breaks, placement of water contour bars, grading and contouring both before and/or after drilling operations to minimize erosion.

Road construction is kept to a minimum by utilizing existing roads when possible. When designing and constructing new roads, weather, elevation contours, land rights, and drainages are considered. When constructing new roads, efforts are made to cross ephemeral drainages or channels at right angles to enhance erosion protection measures. However, given that each specific site is different, it may not always be feasible or warranted to construct roads or crossings at right angles or along elevation contours. In such cases, appropriate erosional measures are considered, examined, and utilized to minimize erosion.

During the construction of wellfields, many activities are on-going including drilling, casing of wells, well development, pipeline construction, header house construction, lateral pipeline placement, and access road construction. These activities may have a short term or temporary effect on erosion. To reduce the potential impact of these activities, erosion protection measures are employed based on site specific conditions. These measures may include; the placement of hay bales, sedimentation breaks, placement of water contour bars, installing culverts, grading and contouring to help minimize erosion.

In steep grade areas, in addition to the previously noted erosion protection measures, the disturbed areas are re-seeded as soon as possible after construction is completed. This seeding commences at the appropriate time for optimum growth, whether the next spring or fall planting, and weather permitting.

In areas where wells may be constructed in drainage areas, impacts are minimized through the use of necessary erosion protection structures including but not limited to; placement of hay bales; construction of water contour bars; installing culverts; flow diversion structures; grading and contouring; application of rip rap; and designated traffic routes. Traffic within the drainage bottoms is limited to work activities necessary to construct and service wells. Wells that are constructed in significant drainages where runoff has the potential to impact the wellhead will have added wellhead protection. This protection will vary depending on the drainage and its potential for runoff. Protection measures may include barriers surrounding the wellhead, protective steel casing, and cement blocks or other means to protect the wellhead from damage that may be caused by runoff.

7.2.2 Surface Water Impacts

The potential impacts to surface waters as a result of operations at the Smith Ranch-Highland Uranium Project are considered to be minimal and temporary. There is, however, the potential for impacts to occur during wellfield construction and reclamation activities. During leaching, restoration, and after reclamation, the surface will be vegetated and contoured to minimize temporary effects to surface water quality.

The physical presence of the surface facilities including wellfields and associated structures, access and haul roads, Satellite IX buildings, office buildings, pipelines, Central Processing Plant facilities and other structures associated with the ISL mining and processing of uranium are not expected to significantly change peak surface water flows because of the relatively flat topography of the drainages at the sites, the low regional precipitation, the absorptive capacity of the soils, and the small area of disturbance relative to the large drainage are within and adjacent to the permit area. In areas where these structures may affect surface water drainage patterns, diversion ditches and culverts are used to prevent excessive erosion and control runoff. In areas where runoff is concentrated, energy dissipaters are used to slow the flow of runoff to minimize erosion and sediment loading in the runoff.

During wellfield construction and reclamation, the potential loss of vegetation to those activities may cause increased opportunities for erosion and potential movements of sediments into drainages. Where possible, contouring is used to minimize the potential effects of erosion. Upon completion of construction and reclamation, and as soon as feasible considering growing seasons, re-vegetation work is started using either cover crops or a native seed mix to stabilize the soil and minimize erosion due to runoff.

7.2.3 Groundwater Impacts

Over the long-term, the groundwater concentration of some parameters in the ore zone may slightly vary compared with the initial condition; however, any changes are minimal and will not alter the potential use category of these waters as defined by the Wyoming Department of Environmental Quality. The most significant water impact will be the withdrawal and beneficial use of about 20,000 acre feet of groundwater over the life of the project; approximately the same volume as was produced from the Bill Smith Mine between 1974 and 1982. Most of the water removed will be returned to the environment after treatment and discharge or used for irrigation, etc. The remaining water removed from the formation will be evaporated or disposed through authorized deep well injection.

7.2.4 Air Quality Impacts

The potential impacts to air quality as a result of ISL mining and processing of uranium are minimal and temporary. During wellfield and plant construction, the principal emissions to air are suspended particulates and gaseous pollutants from vehicle and drill rig exhausts, dust from vehicular traffic on unpaved roads, and dust from disturbed and unprotected soils. Throughout the life of the project, drill rigs and associated mobile equipment will be used during wellfield construction. Diesel powered drill rigs and water trucks associated with wellfield delineation and development, act as non-stationary sources of air pollutants. The drilling activities will proceed through the various wellfields with each drill hole location requiring one to four days of work. Most other equipment associated with wellfield development and construction will experience intermittent use, and its impact on air quality will be negligible. Other mobile vehicles will either be gasoline or diesel powered on-road cars and trucks typically equipped with required emission control devices.

Dust emissions from wind erosion is minimized by promptly reclaiming disturbed soil and establishing vegetative cover to wellfields and soil stockpiles.

Air quality impacts related to operations are largely limited to airborne effluents generated from processing. Air pollution consisting of dust suspended and exhaust emissions by vehicle traffic associated with routine wellfield maintenance is minimal.

Dissolved radon gas, generated by its dissolution from processing solutions, may escape to the atmosphere and potentially adversely impact air quality in the wellfields and immediate vicinity of processing buildings. Radon can be vented to the atmosphere from the wellfields at each wellhead or from the process equipment in the IX facility or the processing plant. PRI is using pressurized downflow IX columns, and therefore radon releases occur only when individual IX columns are disconnected from the circuit and opened to remove the resin for elution. Additionally, the yellowcake dryers could potentially release airborne particulate emissions, including natural uranium and radon daughters, to the environment. Previous modeling of the radiological effects of these emissions upon the local population was completed using the MILDOS-AREA computer code developed by NRC. A more detailed discussion of this model can be found in Section 7.3.

7.2.5 Wildlife Impacts

7.2.5.1 Endangered Species

There are no known endangered species or endangered species habitat within the project area. Therefore, there is no impact to endangered species from the proposed project.

7.2.5.2 Wildlife

The species observed on the permit area are common throughout eastern Wyoming and many other areas of the Rocky Mountain region. Many individuals of the small animal species such as the small burrowing mammals, snakes, lizards, and arthropods that now live in areas that will be disturbed by the proposed project will be destroyed when the vegetation is removed. Since a relatively small number of reptiles inhabit the disturbed portion of the permit area, the impact on these animals is relatively minor. Vegetation removal also has a relatively minor effect on insects and other arthropods because of their ability to quickly re-establish populations on reclaimed area. However, the loss of arthropods does decrease the amount of food available to insectivorous animals, including many species of birds. More small mammals (mice, rats, and ground squirrels) are lost as a result of vegetation removal than any other group of vertebrates. The number of animals lost in any area will generally be proportional to the number of acres disturbed. The short average life cycle of small mammals means that the loss in potential biomass accumulates during each year of project operation and rebounds proportionally once project areas are revegetated and released. It is estimated that as much as 8.4 to 120 lbs/yr of rodent biomass may be lost throughout the life of the recovery plant and associated facilities. A total of 84 to 1200 lbs/yr of rodent biomass may be lost as a result of wellfield installation and operation. Construction and operation of the additional Satellite facilities may result in a loss of 4.2 to 60 lb/yr of rodent biomass. While this does not significantly affect the long-term maintenance of small mammal populations in the area, it does reduce the amount of food available to predatory animals such as raptors, coyotes, and badgers. Whittaker (1970) states that the efficiency of food utilization by primary carnivores may be as high as 15 percent. If this figure is used as a rough estimate, then project operations may result in the loss of a maximum of 14 to 198 lbs/yr of carnivore biomass. Construction of the future additional facilities could result in a loss of 1 to 9 lbs/yr of carnivore biomass.

Highly mobile species, such as the larger mammals (Pronghorn Antelope and Mule Deer) and most birds, will be able to escape the disturbed area. However, the movement of those animals into adjacent undisturbed habitat may result in increased competition for food, shelter, territory, mates, and other necessities. This may result in the loss of some of these animals.

In terms of economic value and public interest, the most important wildlife species that utilizes the permit area is probably the Pronghorn Antelope. It is estimated that the density of antelope in this region is five to seven animals per square mile and that they remain in the area throughout the year. Consequently, the loss of 40 acres of vegetation due to the recovery plant and associated facilities may result in a reduction in antelope carrying capacity on the permit area by less than one (1) animal, while mining activities on an average of 40 acres/year may reduce Antelope carry capacity by the same amount. Operation of the additional Satellite facilities (an average of 80 acres/year) could reduce antelope carrying capacity by one (1) animal.

The increased number of people in the permit area could have an additional impact on Antelope and other wildlife populations, since some animals are likely to be killed by increased vehicular traffic. These additional wildlife losses are not expected to result in any long-term decrease in any wildlife populations, including antelope, since the number lost each year is expected to be a very small percentage of the total population.

Other than actual removal of vegetation and the potential of accidents resulting from activity in the area, project activities are not expected to significantly affect the antelope population. These animals do not appear to be disturbed by mining and processing activities similar to those proposed for this project. This has been well documented at the Highland Uranium Project and the Smith Ranch Operations where Antelope and Mule Deer are commonly observed near active mining areas without any noticeable concern. No reduction in the antelope population has been observed in the vicinity of that facility since it was originally constructed by Exxon in the early 1970's. The Mule Deer population of the area has shown a significant increase since the 1970's.

Continued operation of the SR-HUP should not have a significant effect on raptors utilizing the permit area due to the small percentage of prey that would be lost as a result of vegetation removal.

Wildlife species will re-invade disturbed areas after they are reclaimed. The time required for re-invasion is a function of the habitat requirements of each species. Herbivores capable of feeding on grasses and weedy plant species (e.g., deer mouse, thirteen-lined ground squirrel, mourning dove, and horned lark) would be the first animals to establish themselves on re-vegetated areas. Those animals also nest on the ground and prefer open habitats. Predaceous arthropods, such as ground beetles and assassin bugs, and insectivorous animals, such as the grasshopper mouse, meadowlark, loggerhead shrike, and horned lizard, would also be expected to be early invaders of re-vegetated areas. Several other species of animals (such as sage grouse) that are heavily dependent on sagebrush and other shrubs for food, cover, and/or nesting could take several years to successfully re-invade reclaimed areas because of the time required for shrubs to become re-established.

Although it is likely that noise has some effect on certain species of wildlife, the EPA states that a thorough literature search "revealed an almost complete lack of information concerning the effects of noise on wildlife" (EPA, 1972). Specific effects of mining noise on the wildlife in the permit area cannot be determined; however, from experience at similar mine sites, it is likely that most species will quickly become accustomed to noise from operating machinery. For example, at the SR-HUP, the deer and Pronghorn Antelope are commonly observed within active mining and drilling areas and they display no noticeable concern. Although this does not prove that noise created by mining has no effect on wildlife, it tends to indicate that effects, if any, are minor.

Impacts to wetlands and surface water sources available to wildlife are expected to be minimal during the life of the project. At this time, no disturbances to any wetlands or water sources are planned. If, in the future, a change in the mine plan should involve an impact to a wetlands area or water source, appropriate agencies will be contacted for development of a mitigation plan. All proposed drainage crossings will comply with appropriate regulations.

7.3 RADIOLOGICAL EFFECTS

Exposure pathways to radiological materials at ISL mining operations are considerably different from pathways associated with other uranium mining and milling methods. The environmental advantages of the ISL mining method and the processing of uranium for this project are two-fold. First, the majority of the radioactive daughter products remains underground and is not removed with the uranium. Second, the use of modern vacuum dryers reduces the potential radiological air particulate releases typically associated with conventional uranium milling facilities to insignificant levels (FEIS, NUREG-1508, 1997).

7.3.1 Exposure Pathways

There are no routine particulate emissions from the facility. Liquids released from the facility are treated on site to reduce radiation/ concentration levels of uranium and radium to levels acceptable for release to unrestricted areas as specified in 10 CFR 20 Appendix B Table II (1992). The only avenue, which is considered a potentially significant radiological exposure pathway for the proposed project, is the release of gaseous radon-222 to the atmosphere.

The effects of radon gas release from wellfields, Satellites, Central Processing Facilities, and ponds during production and restoration were modeled with the use of MILDOS-Area, a dispersion model approved by NRC for estimating potential radiological impacts caused by air emissions. The 1997 version of the model allows comparison of specific receptor site air concentrations with the ALCs given in 10 CFR 20.

7.3.2 Background Radiation Exposures to the Population

The major population areas within 50 miles of the recovery plant site are the towns of Glenrock with a population of approximately 2,000 (17 miles SSW), Douglas with a population of approximately 5,000 (23 miles SE), and Casper with a population of approximately 52,000 (36 miles WSW). A regional population within 50 miles of the plant site is approximately 59,000 persons.

In the FEIS for the Teton ISL Project (NUREG-0925, Section 4.5.7), the NRC staff stated the primary sources of radiological exposure to the population in the vicinity of the Teton project were naturally occurring cosmic and terrestrial radiation (174 mRem/yr), naturally occurring radon-222 (up to 625 mRem/yr), and diagnostic medical procedures (75 mRem/yr. Since the Teton ISL project is only some 10 miles from the Smith Ranch Central Processing Facilities, it can be assumed that natural background radiological exposure are similar in nature at Smith Ranch.

7.3.3 Annual Population Doses from the Project

Annual population doses computed by MILDOS-Area for the period of maximum mine emissions of radon-222 indicated a dose of 0.3 person-Rem/yr from mine activities to persons living within 50 miles of the site.

7.3.4 Dose to Individuals

A series of nearby receptors were assessed in the MILDOS-Area model runs. These receptors included nearby dwellings and ranches, towns as far distant as Casper, and a series of hypothetical receptors placed around the perimeter of the project on the permit boundary. These last receptors included locations downwind of the satellites and the main processing facility.

The highest radon working level at a permit boundary receptor with access to an unrestricted area was 7.99E-05 WL compared to an ALC of 1.10E-03 WL.

Dose to Effective was predicted to be 2.24 mRem/yr at this receptor (downwind of the main processing facility). Dose to Bronchi at two unrestricted area boundary receptors were more that 25 mRem/yr but within the error of the model. These two locations are monitored for dosage during the period of maximum mine activity

7.3.5 Radiological Impacts on Biota Other than Man

Standard Operating Procedures for spill prevention and clean-up, restrictive fencing, and equipment design, restrict contact between native biota and the radioactive materials accumulated during mining. Some small mammals, insects, and birds will have occasional contact with materials containing small amounts of radioactivity. No significant impact is expected from this contact.

The primary radioactive emission from the project is airborne radon-222. Since the levels are closely monitored within the restricted area for worker safety, it is reasonable to assume that wildlife mobility and limited access will lead to lower exposures to wildlife in comparison to workers. In unrestricted areas, radiological impacts on biota other than man should be at least as low as the impacts predicted for man.

7.4 NONRADIOLOGICAL EFFECTS

7.4.1 Nonradioactive Airborne Effluents

It is not anticipated that there will be a significant environmental impact from the nonradioactive airborne effluent releases. Nonradioactive airborne effluents at the SR-HUP will be limited to fugitive dust from access roads and wellfield activities and non-radioactive particulate emissions from the Highland Yellowcake Dryer and Packaging Room scrubber exhaust stacks. The project is permitted under WDEQ-AQD Air Quality Permit No. OP-202.

Fugitive dust emissions will be minimal and dust suppressants will only be used if conditions warrant their use. When operational, WDEQ-AQD Permit No. OP-202 requires particulate emission testing of the Yellowcake Dryer (which is fueled with natural gas) and Yellowcake Packaging Room scrubber exhaust stacks annually. Currently (March 2003) the Highland Central Plant is not operational.

7.4.2 Nonradioactive Liquid Effluents

It is not anticipated that there will be any nonradioactive liquid effluents discharged to the environment during the operation of the SR-HUP other than those discussed in Section 4.2 of Chapter 4. During ground water restoration, treated water may be surface discharged under a National Pollutant Discharge Elimination System (NPDES) permit. In the event that restoration water is surface discharged, the treated water will be monitored to ensure that the NPDES discharge limits are not exceeded.

7.5 EFFECTS OF ACCIDENTS

7.5.1 Tank Failure

Under normal operating conditions the process fluids are contained in the process vessels and piping circuits within the CPP and Satellite buildings. Alarms and automatic controls are used to monitor and keep levels within prescribed limits. In the unlikely event of a failure of process vessel or tank in a process building, the fluid would be contained within the building, collected in sumps and pumped to other tanks or to a lined evaporation pond. The area would then be washed down with the water contained in a similar manner eliminating any environmental impact from the failure.

Failure of a tank outside the process building could result in the spill of leach solution to a retention or containment system. The liquids would then be pumped to another tank or lined pond. The environmental impact of such an accident could result in some soils being contaminated requiring controlled disposal. All areas affected by such a failure or leak would be surveyed and any contaminated soils or material requiring controlled disposal would be removed and disposed of in accordance with NRC and/or State requirements. Therefore, there would be no long-term impact from such an accident.

7.5.2 Pipeline Failure

The rupture of a pipeline between the CPP or a Satellite and a wellfield could result in a loss of either pregnant or barren solutions to the surface. To minimize the volume of fluid that could be lost, the pipeline systems are equipped with high pressure and low pressure shutdown systems and flowmeters. The systems also are equipped with alarms so the operator will be alerted immediately if a major malfunction occurs. If the volume and/or concentration of the solutions released in such an accident did constitute an environmental concern, the area would be surveyed and the contaminated soils would be removed and disposed according to NRC and/or State regulations. The pipelines will normally be buried approximately five feet below the surface and will be of a corrosion free high density polyethylene material. Therefore, the probability of such a failure after the pipelines have been tested and placed in service is considered small.

A worst case scenario for a pipeline would involve a major pipeline rupture going unchecked for an hour at full operating capacity. This event could potentially release 240,000 gallons of barren or pregnant lixiviant to the adjacent environment. Such an event would involve a complete pipeline rupture, and a failure by operators to detect the rupture in a timely manner. The NRC staff in their review of Hydro Resources Inc. Final Environmental Impact Statement for the Crownpoint Uranium Solution Mining Project, (NUREG-1508, 1997),indicate that the industry experience has been that major pipeline ruptures are not complete breaks in the line, but are more likely smaller openings in the pipes such as cracks, punctures and other types of partial line breaks. Monitoring systems typically enable operators to detect a leak, determine its cause, and shut down the appropriate pumps in less than 15 minutes. According to the NRC Staff in the Crownpoint EIS, actual experience for pipeline ruptures often represents less than 25% of the volume of lixiviant within the pipeline is spilled in the worst-case scenario, and in actuality, most leaks and spills occur through minor cracks or disconnection on smaller pipes.

7.5.3 Fires and Explosions

The fire and explosion hazard of the CPP will be minimal as the plant does not use flammable liquids in the recovery process. Natural gas used for building heat would be the primary source for a potential fire or explosion. In the CPP the uranium will be in solution, adsorbed on ion exchange resin, wet yellowcake slurry, or as a dried yellowcake powder contained in a sealed drum or the vacuum dryer. An explosion, therefore, would not appreciably disperse the uranium to the environment. Spilled liquids or slurries would be confined to the building sump or to the runoff control system. The sealed drums and Vacuum Dryer at Smith Ranch would contain the dried yellowcake powder, and any potential releases would be contained within the Dryer Building.

In the wellfields, injection and recovery well piping systems are manifolded for ease of operational control. Piping manifolds, submersible pump motor starters/controllers, and gaseous oxygen delivery systems are situated within electrically heated, all weather buildings. These are commonly referred to as "Headerhouses". An accumulation of gaseous oxygen would be the primary source for a potential fire or explosion. Such an event could result in the rupture of a leaching solution pipeline within the building and a spill of leaching solution. Both the gaseous oxygen and primary leaching solution lines entering each headerhouse are equipped with automatic low pressure shut off valves to minimize the delivery of oxygen to a fire or of liquids to a spill. Additionally, each Headerhouse is equipped with a continuously operating exhaust fan that would assist in preventing the build-up of oxygen in the building.

7.5.4 Tornadoes

The SR-HUP is located in Converse County Wyoming, in which 30 tornado touch downs were recorded in a period from 1950 through 1995. Of those, 14 tornadoes were classified as F0 with wind speeds of 40-72 miles per hour and described as a gale tornado. F1 tornadoes described as moderate with wind speeds of 73-112 miles per hour accounted for 14 tornadoes. Finally, 2 were classified as F2 with wind speeds of 113-157 miles per hour and described as significant tornadoes. (Tornado Project, State Data from the Storm Prediction Service – Wyoming, 1999). The F scales for the tornadoes is based on the Fujita Scale that is commonly used to measure the relative strength of a tornado based on the destruction.

The probability of occurrence of a tornado in the area in which the project is located is about 3×10^{-4} per year (NUREG 0706 – Section 7.1.3.1). The area is categorized as Region 3 in relative tornado intensity. For this category, the wind speed of the "design" tornado is 240 mph, of which 190 mph is rotational and 50 mph is translational. None of the plant structures are designed to withstand a tornado of this intensity.

The nature of the operation is such that little more could be done to secure the facility with advance warning than without it. The yellowcake product has the highest specific activity of any material processed at the site. However, since the material would be a wet slurry or as a contained dry powder, the potential environmental effects would be minimal. The strongest tornado recorded in Converse county is an F2. Based on the Fujita Scale, the type of damage that can be expected from an F2 tornado is roof damage, unsecured mobile homes pushed off foundations, and light structures severely damaged or destroyed. At the SR-HUP, all of the dried yellowcake is contained and stored in sealed 55 gallon drums or in the vacuum dryer within an engineered metal building. Because of the density of the material, it is not reasonable to expect the container to become mobile due solely to the winds of the tornado. However, if a portion of the building superstructure were to collapse where the dried yellowcake is stored, there is a possibility that a portion of the drums could be crushed and potentially release yellowcake.

In the Generic Environmental Statement for Uranium Milling, (NUREG-0706, NRC, 1980), NRC staff assumed 25,100 lbs. of dry yellowcake, the equivalent of 26 55-gallon drums, were picked up by a tornado. From the model study, NRC staff concluded the maximum radiation exposure due to the accident would occur at a distance of 2.5 miles from the facility, and the 50 year dose commitment to the lungs of an individual was estimated to be 8.3×10^{-7} rem. For the model site, the 50 year dose commitment to an individual of the public at the fenceline, 1,600 feet from the facility, and at the nearest residence, 6,500 feet from the facility, would be estimated to be 2.2×10^{-7} rem and 4.8×10^{-7} rem, respectively.

7.5.5 Well Casing Failure

A casing failure in an injection well would have the potential for the most significant environmental impact because the leaching fluid is being injected under pressure. It is possible that this type failure could occur and continue for several days before being detected by the monitoring system. If such a failure did occur, the defective well would either be repaired or plugged and abandoned. If contamination of another aquifer was indicated, wells would be drilled and completed in the contaminated aquifer then produced until concentrations of leaching solution constituents were reduced to acceptable levels. With proper casing, cementing and testing procedures, the probability of such a failure is very low.

To minimize the risk of a casing failure significantly impacting the environment, should one occur, monitor wells were completed in the aquifers above and below the ore zone. The fluid levels and quality of the water in the adjacent aquifers routinely is monitored during mining to check for fluid movement into these aquifers. In addition, casing integrity tests will be performed on all injection wells prior to using the wells for injection and after any work that involves entering a fiberglass or PVC cased well with a cutting tool, such as a drill bit or underreamer.

Failure of a production well casing would normally not cause fluid migration to overlying aquifers because the production wells operate at pressures lower than the aquifer pressures.

7.5.6 Leakage Through Old Exploration Holes

Movement of leaching solution between aquifers through old exploration holes in the project area is very unlikely. The drill holes were left full of bentonite abandonment mud when they were abandoned and the mud is an effective seal against fluid interchange between the various aquifer units penetrated by the drilling. The rapid swelling and bridging of the isolating shales between the sandstone aquifer units provides additional well bore sealing.

However, to ensure there is no communication between aquifers, monitor wells completed in aquifers above and below the ore zone are checked routinely for changes in aquifer pressure and water composition. In addition, pump tests are conducted prior to start-up of a mining unit to demonstrate no significant communication between the aquifers exists. Should leakage between aquifers through old drill holes be indicated during the tests, the old holes would be re-entered and plugged. If contamination of another aquifer was indicated, wells would be drilled and completed in the contaminated aquifer, water samples collected, and, if needed, the wells produced to reduce the concentration of any leaching solution fluids to acceptable levels.

7.5.7 Transportation Accidents

Materials transportation to and from the processing sites can be classified into four categories:

1) Shipments of dried yellowcake product from the Central Processing Plant to an offsite licensed facility;

2) Shipments of resin to the Central Processing Plant from the Satellite IX Facilities;

3) Shipments of yellowcake slurry from offsite licensees to the central processing plant for drying; and

4) Shipments of process chemicals from suppliers to the processing facilities.

7.5.7.1 Shipments of Dried Yellowcake Offsite

Yellowcake produced by the SR-HUP, and its shipment for further processing, does not differ significantly from yellowcake produced at a conventional mill. The NRC has evaluated transportation accidents associated with yellowcake shipments from uranium mills and published the results in a generic Environmental Statement, (NUREG-0706, NRC, 1980). The following analysis is based upon that earlier study.

The dried yellowcake is generally packed in 55-gallon, 18-gauge steel drums holding an average of 950 lbs. and classified by the Department of Transportation as Type A packaging (49 CFR Parts 171-189 and 10 CFR part 71). The yellowcake is shipped by truck approximately 1,200 miles to a conversion plant, which processes the yellowcake in the first step of manufacturing reactor fuel. An average truck shipment contains approximately 45 to 52 drums, or up to an average net weight of 42,000-lbs yellowcake. Using an average annual production rate of 2 million lbs. U_3O_8 or 2.4 million lbs. yellowcake, approximately 57 such shipments would be required annually. By increasing the annual production rate to 3.5 million lbs. U_3O_8 or 4.2 million lbs. yellowcake, approximately 100 such shipments would be required annually.

Based on published accident statistics, the average probability of a truck accident is $2.1x10^{-6}$/mi (from NUREG-0706). Truck accident statistics include three categories of events: collisions, non-collisions, and other events. Collisions are between the transport vehicle and any other objects, whether moving vehicles or fixed objects. Non-collisions are accidents involving only the one vehicle, such as when it leaves the road and rolls over. Other events include personal injuries suffered on the vehicle, persons falling from or being thrown against the standing vehicle, cases of stolen vehicles, and fires occurring on a standing vehicle. The likelihood that a transport vehicle being involved in an accident of any type during a one-year period is 14 percent.

A generalized accident-risk evaluation was performed by NRC (NUREG-0706) that classified accidents into eight categories, depending upon the combined stresses of impact, puncture, crush and fire. On the basis of this classification scheme, conditional accident probability was developed for eight severity levels (see Table 7-1). The NRC utilized two release models for this analysis. Model I is hypothetical, assuming complete loss of drum contents, and Model II is based on actual tests, assuming a partial loss of drum contents. The quantity estimated to be released in the event of a truck accident was 17,000 lbs. for Model I and 1,200 lbs. for Model II, (NUREG 0706, NRC, 1980). Most of the yellowcake released from the container would be deposited directly on the ground in the immediate vicinity of the accident. Some fraction of the released material would be dispersed to the atmosphere. The NRC used the following expression to estimate material dispersion (NUREG-0706, 1977).

$$F = 0.001 + 4.6x10^{-4} (1 - e^{-0.15ut})\ u^{1.78}$$

where:

F	=	the fractional airborne release
u	=	the wind speed at 50ft in m/s
t	=	the duration of release (hours)

The first term represents the initial "puff" immediately airborne when the container falls in an accident. Using an assumed wind speed of 10 mph (5m/s) and a release time of 24 hours, the environmental release fraction would be $9x10^{-3}$. Since the conversion facility is located in Illinois, a population density of 160 persons/mi^2 was used for the eastern U.S. In NUREG-0706, the NRC found that the 50 year dose commitment to the lungs would be about 2 man-Sv (200 man-rem) and 0.14 man-Sv (14 man-rem) for Models I and II respectively. The integrated dose estimate would be lower for more sparsely populated areas.

An accident involving vehicles transporting the yellowcake product could result in some yellowcake being spilled. In the unlikely event of such an accident, all yellowcake and contaminated soils would be removed and processed through a mill or disposed in a licensed facility. All disturbed areas would then be reclaimed in accordance with all applicable State and NRC regulations.

The risk of an accident involving a yellowcake spill will be kept to a minimum by use of Department of Transportation approved containers and exclusive use shipments. To further reduce the environmental impact should an accident occur, a "Transportation Accident Response Guide" for the facility has been prepared and copies of the special instruction are included with every yellowcake shipment. A copy of the current Transportation Accident Response Guide, which will be updated as needed, is included in Appendix G.

Commercial yellowcake shipments are required to meet the fuel needs of the licensed power generation facilities and all risks associated with the transportation of yellowcake cannot be eliminated. However, the potential environmental impacts of an accident involving the shipment of yellowcake can be kept to a minimum by having proper procedures in place to ensure that the yellowcake is contained and the spill area is secure from unauthorized personnel.

7.5.7.2 Shipments of Resin

The operation of Satellite IX facilities requires that the resin used for IX operations be transferred from the Satellite facility to the Central Processing Plant. The resin holds the recovered uranium. While attached to the resin, the uranium will remain fixed until stripped using a strong brine solution. When the resin is transferred, it is moved using barren process water. This process water has uranium concentrations consistent with barren lixiviant (1-3 mg/l U_3O_8). The resin is transported in specially designed 500 to 700 ft^3 aluminum tanks. The tanker trucks typically haul 500 ft^3 of loaded resin. Such tanker trucks would withstand the impact of most collisions.

In the event of an accident that could rupture the tank, a portion of the resin and a small amount of residual water would spill on the ground. Uranium loaded resin is slightly denser than water and settles to the bottom of the tank, and any water decants to the top. Should the tanker truck overturn and rupture, the limited amount of water would carry some of the resin to only a short distance in the proximity of the tank. The risk of environmental impact is slight with respect to uranium loaded resin beads. The beads will retain the uranium, and prevent the contamination of the soil. The resin will typically collect in low places that confines the beads and ensures cleanup. There is no risk of airborne release of uranium since it will remain fixed to the beads.

An accident involving vehicles transporting resin could result in some of the resin being spilled. In the unlikely event of such an accident, all resin and contaminated soils would be removed and processed through the elution circuit or disposed in a licensed facility. All disturbed areas would then be reclaimed in accordance with all applicable State and NRC regulations.

7.5.7.3 Yellowcake Slurry Shipments

The SR-HUP facility receives yellowcake slurry shipments for the purposes of drying from other licensed facilities and potentially Satellite facilities such as those planned for the Gas Hills Project and the Ruth/North Butte Project. When yellowcake slurry is transported, it is carried in specifically designed stainless steel tanks or 55-gallon steel drums that are lined with plastic and contain a waterproof seal. Tanker trucks would withstand the impact of most collisions. In the most severe conditions, an accident would result in a rupture of the tank and the release of only a portion of the slurry. During this accident, the slurry would pour onto the ground and thicken as water in the slurry soaked into the ground.

An accident involving vehicles transporting the yellowcake slurry could result in some yellowcake slurry being spilled. In the unlikely event of such an accident, all yellowcake slurry and contaminated soils would be removed and processed through a mill or disposed in a licensed facility. All disturbed areas would then be reclaimed in accordance with all applicable State and NRC regulations.

The risk of an accident involving a yellowcake slurry spill is kept to a minimum by use of Department of Transportation approved containers and exclusive use shipments. To further reduce the environmental impact should an accident occur, PRI has emergency response procedures which would be used in the unlikely occurrence of a spill of yellowcake, resin, or slurry during transportation.

7.5.7.4 Shipment of Chemicals

Accidents involving truck shipments of process chemicals to the project site could result in a local environmental impact. Any spills would be removed and the area would be cleaned and reclaimed. Shipments of the chemicals used in ISL mining in truck load quantities are common to many industries and present no abnormal risk. These chemicals include dry solid sodium carbonate, liquid carbon dioxide, liquid oxygen, concentrated sulfuric acid, liquid (50%) hydrogen peroxide, and dry solid sodium chloride (salt). Since most of the material would be recovered or could be removed no significant long-term environmental impact would result from a shipping accident involving these materials.

The exception to the above chemicals is anhydrous ammonia, which is used at the facility in the precipitation circuit. If involved in an accident, the presence of anhydrous ammonia could result in a significant environmental impact. It is delivered in bulk shipments of 7,500 gallons using a tanker truck. Approximately 12 to 14 shipments are made annually, and the supplier is assumed to be 150 miles away. From the Generic Environmental Impact Statement for Uranium Mills, (NUREG-0706, NRC, 1980), an accident rate of $4.8x10^{-7}$/mile is used for determining risk of a traffic accident.

7.5.8 Evaporation Pond Failure

The evaporation ponds are constructed with leak detection systems and these systems will be monitored daily. If a liner leak were detected, the fluid would be pumped to another pond and the liner repaired as needed. The pond area will be surveyed and reclaimed as part of the final reclamation eliminating any significant long-term impact.

An evaporation pond embankment failure would be the most severe type of evaporation pond failure. To minimize the risk of an embankment failure, the ponds are inspected daily to ensure there is no significant deterioration of the embankments. Should a failure occur, all impacted areas would be surveyed, cleaned up as needed, and reclaimed.

7.6 SOCIOECONOMIC IMPACTS

Continued operation of the SR-HUP will provide jobs for about 80 company employees and 20 to 40 contract employees. The general population of Converse County declined approximately 20 percent between 1980 and 1984 and the overall economy remains depressed; therefore, the impact of the project, although limited, will be beneficial to the local communities. No adverse impact is anticipated as current housing, schools and other support facilities are more than adequate to accommodate the projected employment.

7.7 MINERAL RESOURCE IMPACTS

The only mineral known to be present in economically recoverable quantities in the project area is uranium. Oil and gas exploration has been conducted and is expected to continue in the general area. However, exploration and production drilling for oil and gas within the permit area is aimed at pay sands at subsurface depths of 8,000 feet or more. To date, such drilling has been unsuccessful. Extensive drilling and evaluation has shown that economic coal beds and coal bed methane prospects are not underlying the SR-HUP. This activity will not be affected by the ISL mining program; therefore, no impact to other minerals is anticipated.

Table 7-1

Fractional Probabilities of Occurrence and Corresponding Package Release Fractions for Each of the Release Models for Low Specific Activity (LSA) and Type A Containers Involved in Truck Accidents (NUREG-0170, NRC, 1977)

Accident Severity Category	Fractional Occurrence of Accident	Release Fractions	
		Model I	Model II
I	0.55	0.0	0.0
II	0.36	1.0	0.01
III	0.07	1.0	0.1
IV	0.016	1.0	1.0
V	0.0028	1.0	1.0
VI	0.0011	1.0	1.0
VII	$8.5x10^{-5}$	1.0	1.0
VIII	$1.5x10^{-5}$	1.0	1.0

CHAPTER 8
ALTERNATIVES TO THE PROPOSED ACTION

The solution mining method is proposed over other mining methods for recovery of uranium from these deposits because in situ mining is the most economical and environmentally sound method presently available for mining these reserves. This conclusion is based on the history of uranium mining in the South Powder River Basin area which includes open pit mining, underground mining, and the solution mining projects.

8.1 ALTERNATE MINING METHODS

Underground and open pit mining represent the two currently available alternatives to solution mining for the uranium deposits in the project area. Both of these methods are not economically viable methods for producing the reserves in these deposits at this time.

From an environmental perspective, open pit mining or underground mining and the associated mill involve higher risks to employees, the public, and the environment. Radiological exposure to the personnel in these processes is increased not only from the mining process but also from milling and the resultant mill tailings. Moreover, the personnel injury rate is traditionally much higher in open pit and underground mines than has been the experience at ISL solution mining operations.

Both open pit and underground mining methods would require substantial de-watering to depress the potentiometric surface of the local aquifers to provide access to the ore. The groundwater would contain naturally high levels of Ra-226 that would have to be removed prior to discharge resulting in additional radioactive solids that would have to be disposed of. For conventional mining, a mill tailings pond that could contain 5 to 10 million tons of solid tailings waste from the uranium mill would also be required.

In a comparison of the overall impacts of in situ leaching of uranium compared with conventional mining, an NRC evaluation [NUREG-0925 (1983) Para. 2.3.5] concluded that environmental and socioeconomic advantages of in situ leaching include the following:

(1) Significantly less surface area is disturbed than in surface mining, and the degree of disruption is much less.

(2) No mill tailings are produced, and the volume of solid wastes is reduced significantly. The gross quantity of solid wastes produced by in situ leaching is generally less than 1% of that produced by conventional milling methods [more than 948 kg (2090 lb) of tailings usually result from processing each metric ton (2200 lb) of ore].

(3) Because no ore and overburden stockpiles, or tailings pile(s), are created and the crushing and grinding ore-processing operations are not needed, the air pollution problems caused by windblown dusts from these sources are eliminated.

(4) The tailings produced by conventional mills contain essentially all of the radium-226 originally present in the ore. By comparison, less than 5% of the radium in an ore body is brought to the surface when in situ leaching methods are used. Consequently, operating personnel are not exposed to the radionuclides present in and emanating from the ore and tailings, and the potential for radiation exposure is significantly less than that associated with conventional mining and milling.

(5) By removing the solid wastes from the site to a licensed waste disposal site and otherwise restricting them from contaminating the surface and subsurface environment, the entire mine site can be returned to unrestricted use within a relatively short time.

(6) Solution mining results in significantly less water consumption than conventional mining and milling.

(7) Socioeconomic advantages of in situ leaching include:

- ability to mine a lower grade ore,
- a minimum of capital investment,
- less risk to the miner,
- shorter lead time before production begins, and
- lower manpower requirements.

8.2 ALTERNATIVE SITES FOR THE PROCESSING PLANTS

No alternative sites for the processing plants was considered since most of the facilities and support systems are already in place from past uranium operations. Additions to the existing facilities will be required; however, no new surface disturbances will be needed for the yellowcake processing facilities.

8.3 ALTERNATIVE ENERGY SOURCES

A discussion of alternative energy sources available to the USA has been prepared by US NRC in prior solution mining licensing actions. A summary of the subject is included in Chapter 2.2 of NUREG-0925 (US NRC, 1983) prepared for the Teton Uranium ISL Project (Docket 40-8781).

8.4 ALTERNATE LEACH SOLUTIONS

The sodium carbonate/carbon dioxide leach solution was selected for the proposed project because of favorable performance in the pilot programs and other commercial ISL operations with no significant adverse environmental impact. Alternate leach solutions include ammonium carbonate solutions and acidic leach solutions. These solutions have been used in solution mining programs; however, operators have experienced difficulty in restoring and stabilizing the aquifer, therefore these solutions were excluded from consideration.

8.5 GROUNDWATER RESTORATION ALTERNATIVES

The proposed combination of groundwater sweep and EDR/RO clean water reinjection was selected because of the proven success in the pilot program and other commercial ISL operations. It is currently considered the Best Practicable Technology (BPT) available by the NRC and state regulatory authorities.

8.6 LIQUID WASTE DISPOSAL ALTERNATIVES

The use of deep waste disposal wells in conjunction with storage/evaporation ponds to dispose of the high TDS liquid wastes that primarily results from the yellowcake processing and drying facilities is considered the best alternative to dispose of these types of wastes. The zones receiving these wastes are approximately 9,000 – 10,000 feet below the ground surface and are authorized by the State of Wyoming and the EPA UIC Program to receive such wastes.

The use of the deep disposal wells in combination with the existing land application (irrigation) facilities to dispose of the treated wellfield purge fluids has proven to be the most cost effective way to dispose of this relatively good quality waste water.

CHAPTER 9
MANAGEMENT ORGANIZATION AND ADMINISTRATIVE PROCEDURES

9.1 ENVIRONMENT, HEALTH, AND SAFETY MANAGEMENT

Power Resources, Inc. (PRI) will maintain a performance-based approach to the management of the environment, health and safety program, including radiation safety. The Environment, Health and Safety Systems Management Program encompasses licensing, compliance, environmental monitoring, industrial hygiene, and health physics programs under one umbrella, and it includes involvement by the individual worker to the senior management of PRI. This program will allow PRI to operate efficiently and maintain an effective Environment, Health and Safety Program (EHS Program).

9.2 ENVIRONMENT, HEALTH AND SAFETY MANAGEMENT ORGANIZATION

Figure 9-1 is a partial organization chart for PRI with respect to the operation of the Smith Ranch – Highland Uranium Project (SR-HUP) and associated operations, and represents the management levels that play a key part in the Environmental, Health and Safety Systems Management Program and may serve a functional part of the Safety and Environmental Review Panel (SERP) described under Section 9.5.2.1. The dashed line of reporting signifies a dual reporting function. This organization allows environmental, health, industrial safety, and radiation safety matters to be considered at any management level.

9.3 ENVIRONMENT, HEALTH AND SAFETY MANAGEMENT QUALIFICATIONS

9.3.1 Board of Directors

The Board of Directors has the ultimate responsibility and authority for radiation safety and environmental compliance for PRI, including the SR-HUP. The Board of Directors sets corporate policy and provides procedural guidance in these areas. The Board of Directors directly provides operational direction to the President of PRI.

9.3.2 President

The President is responsible for interpreting and acting upon the Board of Directors policy and procedural decisions. The President directly supervises the Senior Vice President of Operations. The President is empowered by the Board of Directors to have the responsibility and authority for the radiation safety and environmental compliance programs. He is responsible for ensuring that Operations staff are complying with all applicable regulations and permit/license conditions through direct supervision of the Senior Vice President of Operations.

9.3.3 Senior Vice President of Operations

The Senior Vice President of Operations reports to the President and is directly responsible for ensuring that Corporate Operations personnel (including the Smith Ranch - Highland Uranium Project) comply with Industrial Safety, Radiation Safety, and Environmental Protection Programs as stated in EHS Management System. The Senior Vice President of Operations is also responsible for company compliance with all regulatory license conditions/stipulations, regulations and reporting requirements. The Senior Vice President of Operations has the responsibility and authority to terminate immediately any activity that is determined to be a threat to employees or public health, the environment, or potentially a violation of state or federal regulations as indicated in reports from the Manager-Health, Safety and Environmental Affairs/CRSO or the RSO.

The Senior Vice President of Operations directly supervises the Manager-Health Safety and Environmental Affairs/CRSO, and the General Manager of Operations.

9.3.4 Manager-Health, Safety and Environmental Affairs/Corporate Radiation Safety Officer (CRSO)

Reporting directly to the Senior Vice President of Operations, the Manager of Environmental and Regulatory Affairs/Corporate Radiation Safety Officer (CRSO) oversees all Radiation Protection, Health and Environmental Programs as stated in the EHS Management System, at company operations, including the SR-HUP. This position assists in the development and review of radiologic and environmental sampling and analysis procedures and is responsible for routine auditing of the programs. The Manager-Health, Safety and Environmental Affairs/CRSO has the responsibility and authority to suspend, postpone, or modify any activity that is determined to be a threat to employees, public health, the environment or potentially a violation of state or federal regulations. As such, he Manager-Health, Safety and Environmental Affairs/CRSO has a secondary reporting requirement to the General Manager of Operations.

The position of Manager-Health, Safety and Environmental Affairs/CRSO requires a Bachelor's degree in an engineering or science field from an accredited college or university, or an equivalent level of work experience. Additionally, a minimum of five years of experience in environmental and safety management and operations functions will be required as well as the ability to meet the requirements of Regulatory Guide 8.31 for the position of RSO.

9.3.5 General Manager of Operations

The General Manager Operations is responsible for managing the day to day operations at the SR-HUP, and reports directly to the Senior Vice President of Operations. The General Manager Operations is responsible for ensuring that SR-HUP personnel comply with Industrial Safety, Radiation Safety, Environmental Protection Programs, and all relevant state and federal regulations.

The General Manager of Operations has the responsibility and the authority to suspend, postpone or modify, immediately if necessary, any activity that is determined to be a threat to employees, public health, the environment, or potentially a violation of state or federal regulations. The General Manager Operations cannot unilaterally override a decision for suspension, postponement or modification if that decision is made by the Senior Vice President of Operations, the Manager-Health, Safety and Environmental Affairs/CRSO, or the Environmental Superintendent/RSO.

The position of General Manager of Operations requires a Bachelor's Degree in engineering or science form an accredited college or university, or equivalent work experience, and a minimum of five years supervisory experience. Work experience will include industrial process/production experience, and industrial process/production management.

9.3.6 Environmental Scientist

The Environmental Scientist is responsible for assisting in the implementation of the industrial and radiation safety and environmental programs. This position may be used as a training position for Radiation Safety Officer (RSO). This position reports directly to the Manager, Health-Safety and Environmental Affairs/CRSO.

The position of Environmental Scientist requires a minimum of a Bachelor's Degree from an accredited college or university in the physical sciences, biology, engineering or related discipline and must be computer literate and have at least one year's experience in environmental compliance and permitting.

9.3.7 Radiation Safety Technician (RST)

The Radiation Safety Technician (RST) conducts radiological surveys, collects air, water, soil and vegetation samples, performs analyses and collects data for the radiation safety program, performs calculations of employee radiation exposures, keeps records, and conducts various other activities associated with implementation of the environmental and radiation protection programs.

The position of RST requires a minimum of a high school diploma, or alternatively, an equivalent combination of experience and training in radiation protection at uranium mining and/or processing operations.

9.3.8 Safety Superintendent/RST

The Safety Superintendent is responsible for the non-radiation related health and safety programs. Responsibilities include the development and implementation of health and safety programs in compliance with the Wyoming State Mine Inspector Office regulations. Responsibilities include safety traning of new and existing employees, and the maintenance of appropriate records to document compliance with regulations. The Safety Superintendent is also a qualified RST and functions in this capacity when needed. The Safety Superintendent reports directly to the Manager-Health, Safety and Environmental Affairs/CRSO.

In addition to meeting the qualifications and training requirements of the RST (as described in Section 9.3.7 above), the Safety Superintendent should have two (2) years of college in the physical sciences, engineering, or health fields. Two years of applied occupational safety experience may be substituted for each one (1) year of college. In any event, a minimum of a High School Diploma or equivalent is required.

9.4 ALARA POLICY

The purpose of the ALARA (As Low As Reasonably Achievable) Policy is to keep exposures to all radioactive nuclides and other hazardous material as low as possible and to as few personnel as possible, taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

In order for an ALARA Policy to correctly function, all individuals including management, supervisors, health physics staff, and workers, must take part and each share in the responsibility to keep all exposures as low as reasonably achievable. This policy addresses this need and describes the responsibilities of each.

9.4.1 Management Responsibilities

Consistent with Regulatory Guide 8.31, the licensee Management is responsible for the development, implementation, and enforcing the applicable rules, policies, and procedures as directed by regulatory agencies and company policies. These shall include the following:

1. The development of a strong commitment to and continuing support of the implementation and operations of the ALARA program;

2. An Annual Audit Program which reviews radiation monitoring results, procedural, and operational methods;

3. A continuing evaluation of the Health Physics Program including adequate staffing and support;

4. Proper training and discussions which address the ALARA program and its function to all facility employees and, when appropriate, to contractors and visitors.

9.4.2 Radiation Safety Officer Responsibility

The RSO shall be charged with ensuring technical adequacy, proper radiation protection, and the overall surveillance and maintenance of the ALARA program. The RSO shall be assigned the following:

1. The responsibility for the development and administration of the ALARA program;

2. Sufficient authority to enforce regulations and administrative policies that affect any aspect of the Health Physics Program;

3. Assist with the review and approval of new equipment, process changes or operating procedures to ensure that the plans do not adversely affect the Health Physics Program;

4. Maintain equipment and surveillance programs to assure continued implementation of the ALARA program;

5. Assist with conducting an Annual ALARA Audit with Management to determine the effectiveness of the program and make any appropriate recommendations or changes as may be dictated by the ALARA philosophy;

6. Review annually all existing operating procedures involving or potentially involving any handling, processing, or storing of radioactive materials to ensure the procedures are ALARA and do not violate any newly established or instituted radiation protection practices;

7. Conduct or designate daily inspections of pertinent facility areas to observe that general radiation control practices, hygiene, and housekeeping practices are in line with the ALARA principle.

9.4.3 Supervisors Responsibility

Supervisors shall be the front line for implementing the ALARA program. Each shall be trained and instructed in the general radiation safety practices and procedures. Their responsibilities include:

1. Adequate training to implement the general philosophy behind the ALARA program;

2. Provide direction and guidance to subordinates in ways to adhere to the ALARA program;

3. Enforcement of rules and policies as directed by regulatory agencies and company management;

4. Seek additional help from management and the RSO should radiological problems be deemed by the supervisor to be outside their sphere of training.

9.4.4 Worker Responsibility

Because success of both the radiation protection and ALARA programs are contingent upon the cooperation and adherence to those policies by the workers themselves, the facility employees must be responsible for certain aspects of the program in order for the program to accomplish its goal of keeping exposures as low as possible. Worker responsibilities include:

1. Adherence to all rules, notices, and operating procedures as established by management and the RSO;

2. Making valid suggestions which might improve the ALARA program;

3. Reporting promptly, to immediate supervisor, any malfunction of equipment or violation of procedures which could result in an unacceptable increased radiological hazard;

4. Proper use and fit testing of any respirator;

5. Proper use and returning of any bioassay sample kit at its required time.

9.5 MANAGEMENT CONTROL PROGRAM

9.5.1 PRI Environment, Health and Safety Management System

PRI's Environment, Health and Safety (EHS) Management System formalizes the Company's approach to EHS management to ensure a consistency across its operations. The management system is a key element assuring that the management demonstrates "due diligence" in addressing EHS issues and describes how the operations of the facility will comply with the requirements of the PRI EH&S Policy and Regulatory requirements.

The EHS Management System:

- Assures that sound management practices and processes are in place to ensure that strong EHS performance is sustainable.

- Clearly sets out and formalizes the expectations of EHS management.
- Provides a systematic approach to the identification of EHS issues and ensures that a system of risk identification and management is in place.
- Provides a framework for personal, site and corporate EHS responsibility and leadership.
- Provides a systematic approach for the attainment of PRI's EHS objectives.
- Ensures continued improvement of EHS programs and performance.

The EHS Management System has the following characteristics:

- The system is compatible with the ISO 14001 Environment Management System.
- The system is straightforward in design and is intended as an effective management tool for all types of activities and operations, and is capable of implementation at all levels of the organization.
- The system is supported by standards that clearly spell out PRI's expectations, while leaving the means by which these are attained as a responsibility of line management.
- The system is readily auditable.
- The system is designed to provide a practical tool to assist the operations in identifying and achieving their EHS objectives while satisfying PRI's governance requirements.

The EHS Management System uses a series of standards that aligned with specific management processes and sets out the minimum expectations for EHS performance. The standards consist of management processes that consist of assessment, planning, implementation (including training, corrective actions, safe work programs, and emergency response), checking (including auditing, incident investigation, compliance management, and reporting), and management review. PRI has developed procedures consistent with these standards and regulatory requirements to implement these management controls.

9.5.1.1 Historical Management Program Activities

Commercial operations at the Highland Facility were authorized by the NRC in July 1987. Both the Smith Ranch and Highland operations are located at past surface or underground uranium mining operations and substantially use buildings and other facilities remaining from those historic operations. Both operations utilized numerous Standard Operating Procedures (SOPs) to assist with implementation of radiation safety, environmental monitoring, and management procedures.

In July 2000, Rio Algom Mining Corp. (RAMC) finalized the EHS Management System Procedures for the Smith Ranch Facility. The procedures are contained in the following 8 volumes:

Volume 1 – Management System Manual
Volume 2 – Management Procedures
Volume 3 – Operating Procedures (SOPs)
Volume 4 – Health Physics Manual
Volume 5 – Health and Safety Manual
Volume 6 – Environmental Manual
Volume 7 – Training and Awareness Manual
Volume 8 – Emergency Procedure Manual

In July 2002 PRI acquired the Smith Ranch facility and combined operations with the Highland operation into the Smith Ranch – Highland Uranium Project (SR-HUP). Soon after the workforces of both operations were combined and EHS Department personnel were consolidated at the Smith Ranch Main Office complex, activities began to modify the EHS Management System Procedures in order that it could be utilized by PRI Management and the newly combined SR-HUP workforce. The initial focus of these efforts included revising procedures detailing emergency procedures and the processing of resin from the Highland Satellites at the Smith Ranch CPP. Currently (February 2003), revisions to the EHS Management System are approximately 60% complete, with revisions to SOPs approximately 80 to 90% complete.

As committed to the NRC during the license transfer process as well as during the September 9-11, 2002 NRC Inspection for the combined SR-HUP facilities, PRI is committed to revising the EHS Management System Procedures accordingly and utilizing the system to augment the operation of the combined operations. No violations were determined during the latest (September 9-11, 2002) NRC inspection.

9.5.2 Performance Based License Condition

This license application is the basis of the Performance Based License, and under that license PRI may, without prior U.S. Nuclear Regulatory Commission approval or the need to obtain a License Amendment:

1) Make changes to the facility or process, as presented in the license application (as updated).

2) Make changes in the procedures presented in the license application (as updated).

3) Conduct tests or experiments not presented in the license application (as updated).

A License Amendment and/or NRC approval will be necessary prior to implementing a proposed change, test or experiment if the change, test or experiment would:

1. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);

2. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);

3. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);

4. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);

5. Create a possibility for an accident of a different type than any previously evaluated in the license application (as updated);

6. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);

7. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or technical evaluation reports (TERs) or other analysis and evaluations for license amendments.

8. For purposes of this paragraph as applied to this license, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments thereof.

Additionally the licensee must obtain a license amendment unless the change, test, or experiment is consistent with the NRC conclusions, or the basis of, or analysis leading to, the conclusions of actions, designs, or design configurations analyzed and selected in the site or facility Safety Evaluation Report, TER, and EIS or EA. This would include all supplements and amendments, and TERs, EAs, EISs issued with amendments to this license.

Determination of compliance concerning the above listed conditions will be made by a "Safety and Environmental Review Panel (SERP)." The SERP will consist of a minimum of three individuals. One member of the SERP will have expertise in management and will be responsible for managerial and financial approval for changes; one member will have expertise in operations and/or construction and will have expertise in implementation of any changes; and one member will be the Radiation Safety Officer (RSO), or equivalent. Other members of the SERP may be utilized as appropriate, to address technical aspects of the change, experiment or test, in several areas, such as health physics, groundwater hydrology, surface water hydrology, specific earth sciences, and others. Temporary members, or permanent members other than the three identified above, may be consultants.

9.5.2.1 Organization of the Safety and Environmental Review Panel

The composition of the SERP shall be as follows:

Number of Participants: No less than 3 persons. It may consist of more participants.

Required Participants:

Radiation Safety Officer or equivalent (such as the CRSO)

A member of Facility Management
(e.g. Facility General Manager)

A member of Operations Management
(e.g. Plant Manager, Wellfield Manager, etc.)

Other members of the SERP may be utilized as appropriate to address technical aspects described in Section 9.5.2 shown above in several areas of expertise such as health physics, groundwater hydrology, surface water hydrology, specific earth sciences, and other areas. Temporary or permanent members other than the three above may be consultants

9.5.3 Safety and Environmental Review Panel Responsibilities

This procedure will be used for the evaluation of all major changes to the facility operations as described in Section 9.5.2 of this chapter. The changes may be derived from operational and/or economic considerations, and can include changes dictated by regulatory requirements including Federal and State agencies outside of the NRC organization. The following reviews shall be carried out by the SERP. The SERP may delegate any portion of these responsibilities to a committee of two or more members of the SERP. This committee will report their findings to the full SERP for a determination of compliance with Section 9.5.2 of this chapter.

1. Operations / Technical Review
   a. Review operating criteria and critical equipment and determine the following:
      i. Does the proposed change impact the operations as described in the license application?
      ii. Does the proposed change significantly change the processes used at the facility as described in the license application?
   b. Review the Standard Operating Procedures, (SOP), for the proposed change and determine the impact on current SOP's. Make the necessary updates to the current SOP's or develop new ones.
   c. If applicable, review the Emergency Response Plan and determine compatibility with it.

2. Environmental / Health Physics / Safety Review

   a. Review the proposed change to determine if any changes in monitoring and record keeping are required to ensure compliance with existing programs.
   b. Review the proposed changes and determine the need for additional training.
   c. Review key personnel training records and determine training needs as required by the proposed change.

3. Compliance Review

   a. Review the proposed change and determine whether it will conflict with Corporate or facility policies regarding training, safety, and responsibility concerns.
   b. Review the proposed change and determine compliance with the facility NRC Source Material License.
   c. Review the proposed change and determine compliance with NRC regulations and other Federal and State regulations.

Upon completion of this review, the SERP will determine if the proposed change meets the criteria listed in Section 9.5.2. If the proposed change does not meet those criteria, then the SERP may implement the change and provide a record of that change as described in Section 9.5.4 of this chapter. If the proposed change does meet those criteria, then the change will not be implemented until approval of a License Amendment is received from the U.S. Nuclear Regulatory Commission.

9.5.4 Record Keeping and Reporting

Records will be kept of all changes made following the Performance Based License requirements. These records shall include written safety and environmental evaluations, performed by the SERP, that provide the basis for the determination that the change is in compliance with the requirements referred to in Section 9.5.2. These records shall be maintained by the RSO and a copy provided to the facility General Manager and members of the SERP.

An Annual Report will be submitted to the U.S. NRC that provides a description of changes, tests, or experiments made pursuant to the SERP approval process including a summary of the safety and environmental evaluation of each review. Additionally, all pages that reflect a change made to the license application under the Performance Based License Condition will be submitted with this report. Each replacement page shall include both a change indicator for the area of change, (e.g., Bold marking vertically in the margin adjacent to the portion actually change), and a page change identification, (date of change or change number, or both).

9.6 EMPLOYEE TRAINING

All newly hired permanent facility employees will attend a training program conducted by the RSO or another qualified individual on the basic principles of radiation safety, health hazards of exposure to uranium, personal hygiene practices for uranium facilities, radiation safety procedures, and responses to emergencies or accidents involving radioactive materials. A written examination will be given at the completion of the training and the instructor will review all questions with incorrect answers with the employees. Each worker must achieve a predetermined passing score before being allowed to work in a controlled or restricted area of the facility. The written examination for these employees shall be maintained on file.

All permanent facility workers will also receive an Annual Refresher Training course that includes a review of any new radiation safety regulations, site safety experience and radiation exposure trends. Radiation safety problems or subjects will also be offered for discussion at least four times per year in the Quarterly Safety Meetings. Safety Meeting subjects and attendance records will be maintained on file at the site. Specialized instruction on the radiation health and safety aspects of jobs involving higher than normal exposure risks will be provided by the RSO, RST and/or Supervisor.

Each worker who may be required to use respiratory protective equipment will receive training in the use of the specific equipment to be used. No person shall use respiratory equipment until they are specifically trained in the use of the equipment.

9.7 STANDARD OPERATING PROCEDURES

Written Standard Operating Procedures (SOPs) will be established for all operational activities involving radioactive materials that are handled, processed, stored, or transported by employees. The procedures will enumerate pertinent radiation safety procedures to be followed. Written procedures shall also be established for in-plant and environmental monitoring, bioassay analysis, and instrument calibration for activities involving radiation safety. A copy of the written procedure will be kept in the area where it is used. All procedures involving radiation safety will be reviewed and approved in writing by the RSO or another individual with similar qualifications prior to being implemented. The RSO and/or his designee(s) will review the operating procedures annually.

In the case that employees are required to conduct activities of a nonroutine nature where there is the potential for significant exposure to radioactive materials, and no SOPs exist for the activity, a Radiation Work Permit (RWP) will be required. The RWP will describe the scope of the work, precautions necessary to maintain radiation exposures to ALARA, and any supplemental radiological monitoring and sampling to be conducted during the work. The RWP shall be reviewed and approved in writing by the RSO, RST, or a designated supervisor in the absence of the RSO or RST, prior to initiation of the work.

9.8 EXTERNAL RADIATION EXPOSURE MONITORING PROGRAM

External radiation exposure was monitored at the Highland Uranium Project during the period 1988 through 1993 by the use of personal radiation dosimeters, such as Thermoluminescent Dosimeter badges (TLDs) or Optically Stimulated Luminescent dosimeter badges (OSLs). All employees, except several office personnel that did not enter areas where potential exposures existed, utilized dosimeters. During the period 1988 through 1993 the monitoring data collected from the dosimeters shows that the annual dose to all workers was less than 10 percent of the 5000 mrem annual limit contained in 10 CFR 20.1201(a). Therefore, consistent with 10 CFR 20.1502, beginning on January 1, 1994, individual monitoring devices, such as TLDs, were only used to monitor occupational exposures to Central Plant Operators because they could potentially exceed 10 percent of the annual limit contained in 10 CFR 20.1201(a) due to the potential exposure to airborne uranium. Accordingly, it is not required that occupational exposures to external radiation be determined or recorded for other workers, although PRI has continued to monitor some additional workers.

To ensure that potential exposures to gamma radiation remain less than 10 percent of the annual limit (or less than 500 mrem), the two work groups with the greatest potential for exposure (Central Plant Operators and Satellite Operators) will wear dosimeters. Quarterly monitoring data collected from these badges will be recorded and reviewed annually to ensure that exposures do not exceed 500 mrem.

Additionally, quarterly gamma surveys are performed at specified locations throughout the Satellite buildings and Central Processing Facilities (CPFs) to assure that areas requiring posting as "Radiation Areas" are identified, posted, and monitored to assess external radiation conditions. "Radiation Areas" are those areas exhibiting 5 to 100 mrem per hour at a distance of 30 cm from the source. Radiation Areas are posted at various locations in the yellowcake processing areas of the CPFs and Satellites, and consist of IX columns and, various tanks and filter apparatuses. Both Yellowcake Warehouses, located at each CPF, are posted as Radiation Areas.

9.9 BIOASSAY PROGRAM

A Bioassay (urinalysis) Program consistent with the program outlined in Revision 1 of NRC Regulatory Guide 8.22 "Bioassay at Uranium Mills" has been implemented and will be maintained at the SR-HUP. All permanent employees that will handle yellowcake submit a baseline urinalysis prior to their initial assignment at the facility. A urinalysis is also required from all permanent employees at the time of termination of employment if they were recently involved in yellowcake processing activities. Central Plant and Dryer Operators, who are the only workers to routinely work in the yellowcake precipitation, drying and packaging areas, are required to submit monthly urine specimens for uranium analysis. Specimens are collected 2 to 4 days after the employee has left the work area (i.e., after a weekend and prior to entering the work area). Consistent with Regulatory Guide 8.22, quality control of the monthly urinalyses is assured by including one blank and two spiked samples with each month's batch of specimens. The blank and spiked samples are labeled with non-employee names in order that the contract laboratory is not aware of the particular specimens content. Laboratory results for these specimens are compared with known values to ensure that laboratory results are accurate.

Workers potentially exposed to concentrations of uranium above regulatory limits are also required to submit urine specimens for uranium analysis 2 to 4 days following the potential exposures. Workers meeting this requirement are typically working under the direction of a Radiation Work Permit (RWP). This is done even if respiratory protection has been utilized to ensure that the respiratory protection equipment has been worn properly and to ensure that respirators are functioning as designed.

PRI also randomly obtains, on a monthly basis, urine specimens from other workers at the facility to confirm that workers are not subject to an unknown uptake of uranium.

The contract laboratory provides immediate notification (via telephone or fax) of all urinalyses exceeding 15 µg/L uranium. Table 9-1 lists the actions taken for individual urinalysis results.

9.10 AIRBORNE RADIATION MONITORING PROGRAM

9.10.1 <u>Airborne Uranium Particulate Monitoring</u>

There is no potential for exposure to ore dust at the SR-HUP since the facility is an ISL uranium mine. However, there is the potential for exposure of workers to yellowcake dust in certain areas of the SR-HUP. In the drying and packaging areas at Highland the potential exists for exposure to yellowcake dust that is classified as "insoluble" since the operating temperature of the Dryer is in excess of 400°C (752°F) The Highland Dryer typically operates at about 600°C (1100°F).

In the drying and packaging areas at Smith Ranch the potential exists for exposure to yellowcake dust that is classified as "soluble" since the operating temperature of the Vacuum Dryer is low (about 77°C or 170°F). In the slurry unloading area the potential for exposure to airborne uranium is considerably less than in the drying and packaging areas. The yellowcake dust is classified as soluble in the slurry unloading area. Slurry unloading is performed on a very infrequent basis.

9.10.1.1 Airborne Uranium Monitoring at the Highland Central Plant

When the Highland Central Plant is operating, there is continuous monitoring of airborne uranium particulates at the drying and packaging areas. During periods of drying and packaging activity, the filters of the continuous air monitors are changed and analyzed daily. During periods that drying and packaging activities are not occurring, the filters are changed and analyzed on a weekly basis.

Exposures to workers are determined from the conservatively estimated uranium particulate concentration data, occupancy time studies, and the application of the Applied Protection Factor (APF) of 100 for the routine use of fullface air purifying respirators. Consistent with the Respiratory Protection Program, all Highland Central Plant Operators utilizing negative pressure respirators are required to pass the quantitative fit test.

When the Highland Central Plant is operating, the Precipitation Area of the plant is monitored on a quarterly basis for airborne uranium. A review of the historic data shows that maximum airborne uranium concentrations were less than 1% of the DAC for soluble uranium (5E-10 μCi/ml).

9.10.1.2 Airborne Uranium Monitoring at the Smith Ranch Central Processing Plant (CPP)

Airborne uranium particulate monitoring at the Smith Ranch CPP and Pilot Building was historically performed on a monthly basis. Given the extensive data base that exists for the Pilot Building that shows the virtual lack of airborne uranium in this area, and the fact that IX equipment and tanks have been removed, it is not necessary to further monitor this area for airborne uranium.

Airborne uranium particulates at the Smith Ranch CPP are monitored to assess any unanticipated occurrence of uranium in the air and provide uranium airborne concentration data used in the exposure determinations for the CPP Operators and the Dryer Operators. The monitoring locations and frequency are as follows:

Location	Frequency
Precipitation Area	Monthly
Yellowcake Storage Area	Monthly
Dryer Room	Weekly

It should be noted that continuous airborne uranium samples are collected during yellowcake packaging operations by the Dryer Operator. These samples are obtained by the use of a Breathing Zone (BZ) pump or a higher volume sampler set up within the packaging area. Uranium concentration-data from these samples are utilized to assist with determining routine exposures to the Dryer Operator(s).

9.10.1.3 Airborne Uranium Monitoring at Satellites

Due to the fact that the uranium bearing fluids at the Satellite facilities are fully contained within pipes, tanks, and IX vessels the likelihood of any significant quantities of uranium in the air is very remote. This is supported by many years of data collected at both Smith Ranch and Highland Satellites that show virtually no occurrence of airborne uranium at these facilities. Therefore, uranium particulates are not routinely monitored at these facilities.

9.10.1.4 Radon Daughter Monitoring

Radon daughters are routinely monitored on a monthly basis at the Highland CPF (when operating), the Smith Ranch CPP, and Satellite facilities. Routine exposures to radon daughters are only determined for Central Plant Operators. The method of analysis is the modified Kusnetz method or other commonly accepted method of measurement. In the case that radon monitoring determine concentrations above 0.08 WL, the monitoring frequency will be increased to weekly until the following four samples return to less than 0.08 WL.

During the period 1988 through 1993, weekly and monthly monitoring results at numerous sites throughout the project showed that radon daughter concentrations were routinely less than 10% of the regulatory limit of 0.33 working level. Therefore, it was determined that the routine exposure of workers to radon daughters only needed to be determined for Central Plant Workers (Central Plant and Dryer Operators).

9.10.1.5 Airborne Radioactive Areas

Any area, room, or enclosure will be designated an "Airborne Radioactivity Area" as defined in 10 CFR 20.1003, if at any time the uranium concentration exceeds 5E-10 µCi/ml for soluble uranium or 2E-11 µCi/ml for insoluble uranium.

When operating, both the Yellowcake Dryer Room and Yellowcake Packaging Room at Highland are posted as Airborne Radioactivity Areas as concentrations of insoluble uranium may at times exceed 2E-11 µCi/ml. Because the predominant form of airborne uranium in these areas is comprised of high-fired (above 400°C) dried yellowcake, the insoluble uranium DAC (2E-11 µCi/ml) is used.

Additionally, areas will be posted as "Airborne Radioactivity Areas" in the case that an individual present in the area without respiratory protection could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the ALI or 12 DAC-hours. Airborne Radioactivity Areas are posted in accordance with 10 CFR 20.1902. PRI will avoid posting radiation hazard signs in areas that do not require them.

9.11 EXPOSURE CALCULATION

Employee exposures at the SR-HUP are monitored in accordance with USNRC Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses." A bioassay program consistent with USNRC Regulatory Guide 8.22, Rev. 1 "Bioassay at Uranium Mills" is utilized as a means of ensuring the adequacy of the monitoring and respiratory protection programs for protection from airborne uranium dust.

Employee exposure to airborne uranium is estimated for routine and non-routine activities. The exposure to dried yellowcake at Highland is considered "insoluble" (Y-Class) and the exposure to dried yellowcake at Smith Ranch is considered "soluble" (D-Class). Exposure to any uranium that has not been through any drying process is considered "soluble" (D-Class).

The exposure estimates are based on exposure times and the concentrations of airborne uranium as determined from routine air monitoring or non-routine air monitoring (i.e. breathing zone monitoring or specific area air monitoring). Routine exposures to uranium and radon daughters are only determined for the Central Plant Workers (Central Plant Operators, Dryer Operators) as, in accordance with 10 CFR 20.1502(b)(1), they are the only workers routinely exposed to airborne radionuclides in concentrations which are likely to result in annual exposures in excess of 10% of the ALI, without respiratory protection. These potential exposures result from the need to work in the yellowcake dryer and yellowcake packaging facilities. Routine exposures are estimated using exposure times generated from Annual Time Studies or actual occupancy times. Time Studies are updated after any significant change in equipment procedures, or job functions.

Non-routine exposures to uranium result from performing non-routine operational or maintenance tasks that have the potential for creating a significant exposure to airborne uranium. These types of exposures are monitored utilizing a Radiation Work Permit (RWP). The RWP specifies the types of radiological monitoring required for the task (soluble or insoluble uranium) and the protective equipment and clothing employees must wear while performing the task. The sampling results are evaluated and documented. This data, together with the employee's time in the area, is used to estimate the non-routine exposure. Each Central Plant Worker's routine and non-routine exposure to soluble and insoluble uranium is recorded at least monthly and summarized annually.

Routine employee exposure to radon daughters is determined for only the Central Plant Workers. Similar to non-routine uranium exposures, non-routine radon daughter exposures are monitored utilizing an RWP. Routine exposure times are determined by annual time studies or actual occupancy times. Time studies are also updated after any significant change in equipment, procedures, or job functions. Each Central Plant Worker's routine and non-routine exposure to radon daughters is recorded monthly and summarized annually.

9.11.1 Airborne Uranium Exposure Calculation

The intake of soluble or insoluble yellowcake during the weekly or annual period being evaluated is estimated using the following equation:

$$I_u = \sum_{i=1}^{n} \frac{(x_i)(t_i)}{(DAC)(PF)}$$

Where:

I_u	=	uranium intake, DAC-hours
t_i	=	time that the worker is exposed to concentration x_i, hr
x_i	=	average concentration of uranium in the air, µCi/ml
DAC	=	the derived air concentration value for uranium (5E-10 µCi/ml for soluble, 2E-11 µCi/ml for insoluble) from Appendix B Table 1 of 10 CFR Part 20
PF	=	respirator protection factor from Appendix A of 10 CFR Part 20
n	=	number of exposures during the period of evaluation

9.11.2 Radon Daughter Exposure Calculation

The modified Kusnetz or equivalent method for determining exposure to radon daughters is utilized at the SR-HUP. From the monitoring data collected, the employees intake of radon daughters is calculated using the following equation:

$$I_r = \sum_{i=1}^{n} \frac{(w_i)(t_i)}{(DAC)(PF)}$$

Where:

I_r	=	radon daughter intake, DAC-hours
t_i	=	time of exposure to concentration W_i, hr
w_i	=	average number of working levels in the air during time t_i
DAC	=	the derived air concentration value for radon daughters, (3E-8 µCi/ml or 0.33 WL) from Appendix B of 10 CFR Part 20
PF	=	respirator protection factor
n	=	number of exposure periods during the year

Section 20.2203 of 10 CFR requires that overexposure reports be made to the appropriate NRC Regional Office if the intake of uranium and/or radon exceeds the quantities specified in 10 CFR 20.1201. The following exposure limits require NRC notification:

1. Soluble Uranium - if an employee has an intake of more than 10 mg of soluble uranium in one week. This intake is in consideration of chemical toxicity.

2. Total Effective Dose Equivalent (TEDE) - if an employee exceeds the TEDE annual limit of 5 rem. The annual TEDE is determined by summing annual doses from soluble uranium, insoluble uranium and radon.

9.11.3 Calculation of Total Effective Dose Equivalent (TEDE)

In accordance with 10 CFR 20.1201, the Total Effective Dose Equivalent (TEDE) is determined on an annual basis for each Central Plant Worker by adding the deep dose external gamma exposures for the year to the internal exposures to radon daughters and uranium. The annual limit for the TEDE is 5 rem.

9.12 ADMINISTRATIVE ACTION LEVELS

An administrative action level is set at 3 mg of soluble uranium for any calendar week. An administrative action level is set at 130 DAC-hours for exposure to insoluble uranium and/or radon daughters for any calendar quarter. If the action level is exceeded, the RSO will initiate an investigation into the cause of the occurrence, determine any corrective actions that may reduce future exposures and document the corrective actions taken. Results of the investigation will be reported to management within one month of the action level being exceeded.

The results of the personal gamma radiation monitoring from the dosimeters are evaluated on a quarterly basis and an administrative action level is set at 312 mrem per quarter. If an employee's exposure exceeds this level, the RSO will investigate the reason for the exposure and initiate corrective measures to prevent a recurrence.

The results of the bioassay program are also used to evaluate the adequacy of the respiratory protection program at the facility. An abnormally high urinalysis will be investigated both to determine the cause of the high result and determine if the exposure records adequately reflected that such an exposure may have actually occurred.

9.13 CONTAMINATION CONTROL PROGRAM

9.13.1 General

The primary sources of potential surface contamination at the SR-HUP Project are associated with yellowcake precipitation, drying, and packaging activities. The recovery and elution portions of the process do not present a significant surface contamination problem except for dried spills or when special equipment maintenance is required. The primary method for control of surface contamination is instruction in, and enforcement of, good housekeeping and personal hygiene practices. Any visible yellowcake or production fluid spills will be cleaned up as soon as possible to prevent drying and possible suspension into the air which could pose an inhalation hazard. Plant Operators are instructed in the proper use of equipment and the prevention of spills and solution leaks at various stages of the process. Inadvertent contamination of designated Clean Areas is controlled by instructing employees not to enter such areas with clothing or equipment contaminated with radioactive materials.

9.13.2 Surface Contamination Control

To ensure these administrative controls are effective in controlling surface contamination, alpha contamination surveys are performed monthly in Process Areas and weekly in designated Clean Areas. Routine surveys in the Process Areas of the Central Processing Plants and Satellite facilities consist of both a visual inspection for obvious signs of contamination and instrument surveys to determine total alpha contamination. Visible yellowcake, outside the drying and packaging facilities, will require prompt cleanup to minimize the potential for the material to become airborne. If the total alpha survey indicates contamination greater than 200,000 dpm/100 cm^2, the area will be cleaned and resurveyed.

In designated Clean Areas, such as Lunch Rooms and offices, the target level of contamination is "nothing detectable". If the total uranium alpha survey in these areas indicates contamination in excess of 500 dpm/100 cm^2 (50% of the Table 9-2 Removable Contamination Limits) a smear test will be performed to assess the level of removable alpha activity. If smear test results indicate removable contamination greater than 500 dpm/100 cm^2, the area will be cleaned promptly and resurveyed. The RSO will investigate the cause of the contamination and implement corrective action to minimize the potential for a recurrence. Total alpha surface contamination levels exceeding the Table 9-2 limits will also require cleanup and investigation.

Before yellowcake drums leave the packaging area, they are washed to remove all visible yellowcake. Prior to shipment, the drums are surveyed for total alpha contamination. Although the limit for removable contamination on drums shipped in sole use vehicles is 2.2x10^4 dpm/100 cm^2, a target level of 1000 dpm/100 cm^2 is used at the SR-HUP. If the total alpha survey results reveal contamination in excess of 1000 dpm/100 cm^2, a smear survey is performed. If this survey indicates contamination in excess of 1000 dpm/100 cm^2, the drums will be rewashed and resurveyed.

Yellowcake processing equipment that must be removed for maintenance or repair is thoroughly decontaminated prior to its removal from the area to prevent the possibility of contamination in the Maintenance Shop or other areas.

9.13.3 Personnel Contamination Control

Change rooms, showers and lockers for clean clothing are provided for employee use. An operable and appropriately calibrated alpha survey meter is made available for employee use at the exit of the Central Processing facilities and at the entrance to the Lunch Room at these facilities.

Employees are instructed in the use of the survey meter, techniques for minimizing contamination, for maintaining good personal hygiene, and in basic decontamination methods. Employees are also instructed on methods and procedures for good housekeeping practices within process areas to minimize the potential for contamination of personnel and equipment. The RSO or designee performs unannounced spot check surveys for alpha contamination on workers leaving the yellowcake production facilities. These unannounced spot check surveys are conducted on at least a quarterly basis.

Employees working in the precipitation, drying and packaging areas, as well as those involved in process equipment maintenance or repair are provided with appropriate protective clothing and equipment. Protective clothing is laundered on site or, if a disposable type, is disposed of in a facility licensed to accept such wastes.

All employees with potential exposure to yellowcake dust can shower and change clothes each day prior to leaving the site. An employee who showers and changes clothes is considered to be free of significant contamination. In lieu of showering, employees are required to survey their clothing, shoes, hands, face and hair with an alpha survey instrument prior to leaving the site. These surveys and/or showers are documented and maintained on site.

9.13.4 Surveys for Release of Potentially Contaminated Materials and Equipment

Materials and equipment which have been used or stored in an area where contamination by uranium or uranium daughters could have occurred are surveyed for contamination prior to release from the site. The survey is conducted in accordance with the limits specified in Table 9-2. If the equipment or material does not meet the limits, it will be decontaminated and resurveyed. The survey results are documented and maintained on site.

9.14 PROTECTIVE EQUIPMENT & PROCEDURES

All process and maintenance workers who work in yellowcake areas or work on equipment contaminated with yellowcake will be provided and required to wear protective clothing including coveralls, boots or shoe covers. Workers who package yellowcake for transport will also be provided gloves. Before leaving the yellowcake processing area, all workers involved in the precipitation or packaging for transport of yellowcake, will, at a minimum, monitor their hands and feet using a calibrated alpha survey instrument. In addition, spot surveys will be performed for alpha contamination at least quarterly on all workers leaving the recovery plant area. The monitoring results are documented and maintained on file.

At the Central Processing Plants, eating is only allowed in designated Lunch Room areas that are separated from the process areas. Eating or smoking in the plant controlled areas is prohibited and violators are subject to disciplinary action.

9.15 MANAGEMENT AUDIT AND INSPECTION PROGRAMS

Routine inspections of yellowcake processing areas at the CPP and Satellite facilities are conducted daily by the RST, or trained designee, to ensure that all radiation protection, monitoring, and safety requirements are being followed and/or are properly functioning. The EHS staff performs a Weekly Safety and Environmental Inspection that covers all major facilities at the SR-HUP, including the CPP areas, Satellites, and Wellfields.

In accordance with NRC requirements, an "Annual ALARA Audit" is performed to review the radiation safety program and associated monitoring data and survey results to ensure that the program is acting consistent with the ALARA philosophy. An important part of this audit includes recommendations to further improve the radiation safety and environmental programs.

In accordance with the EHS Management System, audits of the environmental, radiation safety, and industrial safety programs are periodically conducted by PRI's parent company, or outside consultants specializing in these types of operations.

9.16 RECORD KEEPING AND RETENTION

PRI, as part of its EHS Management System, maintains a record keeping and retention program that is consistent with requirements of 10 CFR 20 Subpart L, 10 CFR 40.61 (d) and (e). Records of surveys, calibrations, personnel monitoring, bioassays, transfers or disposal of source or byproduct material, and transportation accidents will be maintained on site until license termination. Records containing information pertinent to decommissioning and reclamation such as description of spills, excursions, contamination events, and etc. as well as information related to site and aquifer characterization and background radiation levels will be maintained on site until license termination. Duplicates of all significant records will be maintained in the corporate office or other offsite locations.

9.17 SECURITY

Measures to secure licensed material from unauthorized removal and access are in place at the SR-HUP. The operating facilities are manned 24 hours per day, 7 days per week, and in controlled and/or unrestricted areas, surveillance is maintained through the presence of the operators and workers on site. Licensed Material in the form of dry and slurry yellowcake is stored at the Smith Ranch Central Processing Plant. Access to both the Smith Ranch and Highland Central Processing Plants by the public is limited by the use of a locked, automatic gate. All visitors are required to check and sign in at the office before being allowed to enter the controlled access areas of the facility. PRI intends to further increase security at the Smith Ranch CPP/Main Office Complex by installing continuous video surveillance of outside areas. This additional security system is planned for operation by April 1, 2003.

9.18 QUALITY ASSURANCE

PRI has established the following Quality Assurance Program for all radiological, non-radiological effluent and environmental (including ground water) monitoring programs at the SR-HUP. This Quality Assurance Program addresses elements discussed in USNRC Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment."

Quality assurance comprises those planned and systematic actions which are necessary to provide adequate confidence in the results of a monitoring program. Quality control includes those quality assurance actions that provide a means to control and measure the characteristics of measurement equipment and processes to established requirements. Therefore, quality assurance includes quality control.

The overall objectives of the Quality Assurance program are:

1. To identify deficiencies in the sampling and measurement processes to those responsible for these operations so that corrective action can be taken.

2. To obtain a measure of confidence in the results of the monitoring programs to assure regulatory agencies and the public that the results are valid.

The first step of any reliable Quality Assurance Program is a formal delineation of the organization structure, management responsibilities, and training requirements for management personnel. These items have been covered in the previous section. Other components of the program are described below.

9.18.1 Standard Operating Procedures (SOP's)

A critical step to insuring quality assurance objectives includes written Standard Operating Procedures (SOP's) for various aspects of the radiological and environmental monitoring programs. The SOP's describe the procedures used to collect samples, complete laboratory analyses and survey, calibrate equipment, evaluate data, etc. for the radiological and environmental monitoring programs.

Since the beginning of operations, PRI has developed numerous SOP's which assure that the critical aspects of the radiological and environmental monitoring protocols are properly implemented by trained technicians and other personnel. Some of the current SOP's which assist in insuring that quality assurance objectives are met include:

1. Bioassay Sampling
2. Respiratory Protection
3. Gamma Surveys
4. Processing of Data for the Routine Monitoring Well Program
5. Sampling Waste Disposal Well Fluids
6. Analysis of Monitor Well Samples
7. Employee Exposure Determinations

9.18.2 Duplicative Sampling and Inter and Intra Laboratory Analyses

A good Quality Assurance Program provides provisions to ensure that contract and in-house laboratories are accurately analyzing and reporting radiologic and chemical analyses. PRI utilizes an EPA certified laboratory for all off site radiologic and chemical samples.

For every 20 excursion monitor well samples, a duplicate sample and a spiked sample are analyzed by PRI's in-house laboratory. The duplication begins with original sample aliquots and allows the analyst to determine the precision of the analytical result. Standard addition spikes consist of the addition of a known amount of analyte to a duplicate sample aliquot. These spiked samples are useful in estimating the accuracy of an analytical result as well as identifying potential interferences.

In accordance with the applicable SOP's, baseline water quality samples for new wellfield areas are filtered and preserved on site and transported to an EPA approved laboratory for analysis. Additionally, protocols have been established for the storage and shipment of samples, including standard Chain of Custody procedures.

9.18.3 Instrument Calibrations

Electronic instruments used to conduct radiologic surveys or determine the concentrations of radiologic material are calibrated by a qualified contractor on a routine basis to ensure that they are operating within specified ranges for the radionuclides being measured. In accordance with SOP's certain instruments, such as alpha and GM probes, are functionally checked with a known radiologic source on a more frequent basis (daily or weekly). Additionally, air pumps used to collect environmental or breathing air samples are routinely calibrated. PRI only utilizes EPA approved laboratories which adhere to strict protocols to ensure that their electronic instruments are properly calibrated to ensure valid results.

9.18.4 Records

Records of radiologic surveys, instrument calibrations, radiological and chemical analyses, and employee exposures are retained on site under the direction of the RSO. To maintain the integrity of the program, the RSO and others, through the audit program, periodically review records to ensure that they are complete and accurate, and calculations have been done properly. These types of records are maintained on site until license termination. Critical records are periodically duplicated and stored in a second location in the case of fire or a similar type disaster. Computer programs used to determine employee exposures or other components of the program are verified with hand calculations to ensure that they are accurate.

9.18.5 Audits

PRI management periodically conduct audits of the radiation safety and environmental monitoring programs to verify compliance with applicable rules, regulations, license requirements and to ensure that exposures of employees, the public, and the environment are ALARA. Audit teams are comprised of knowledgeable individuals from within the project or from other PRI operations, the parent company, or outside contractors specializing in such audits. The Annual ALARA Audit is conducted on an annual basis to assist with achieving the above objectives.

Table 9-1
Actions Taken for Individual Urinalysis Results

Uranium Content of Specimen	Required Action(s)
a) Less than 15 μg/L or 9 nCi in vivo	None
b) 15 to 35 μg/L or 9 to 16 nCi in vivo	1) Confirm results (repeat analysis) 2) Attempt to identify cause of elevated result 3) Take corrective measures and/or limit employee's exposure 4) Document corrective actions 5) Submit documentation to NRC, as part of required 10 CFR 40.65 report
c) Greater than 35 μg/L	1) Take actions specified for (b) above 2) Restrict employee from yellowcake area work until results of subsequent specimens are less than 15 μg/L 3) Notify NRC in writing within 30 days of exceeding the action level
d) Greater than 35 μg/L for 2 consecutive specimens, or greater than 130 μg/L for any single specimen	1) Take actions specified for (c) above 2) Analyze urine specimens for albuminuria

Table 9-2

ALLOWABLE LIMITS FOR REMOVAL TO UNCONTROLLED AREAS

These values are taken from: Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors," and "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source or Special Nuclear Material."

Surface contamination levels for uranium, radium and their associated decay products on equipment to be released for unrestricted use, clothing and nonoperating areas of mills are as follows:

a Nuclide	b Average	c Maximum	Removable
Natural Uranium	5,000 dpm/100 cm^2	15,000 dpm/100 cm^2	1,000 dpm/100 cm^2
Radium-226	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2

a. Averaged over no more than 1 cm^2

b. Applies to an area of not more than 100 cm^2.

c. Determined by smearing with dry filter or soft absorbent paper, applying moderate pressure and assessing the amount of radioactive material on the smear.

Beta-Gamma Radiation

Average: 0.2 mR/hr above background
Highest: 1.0 mR/hr above background

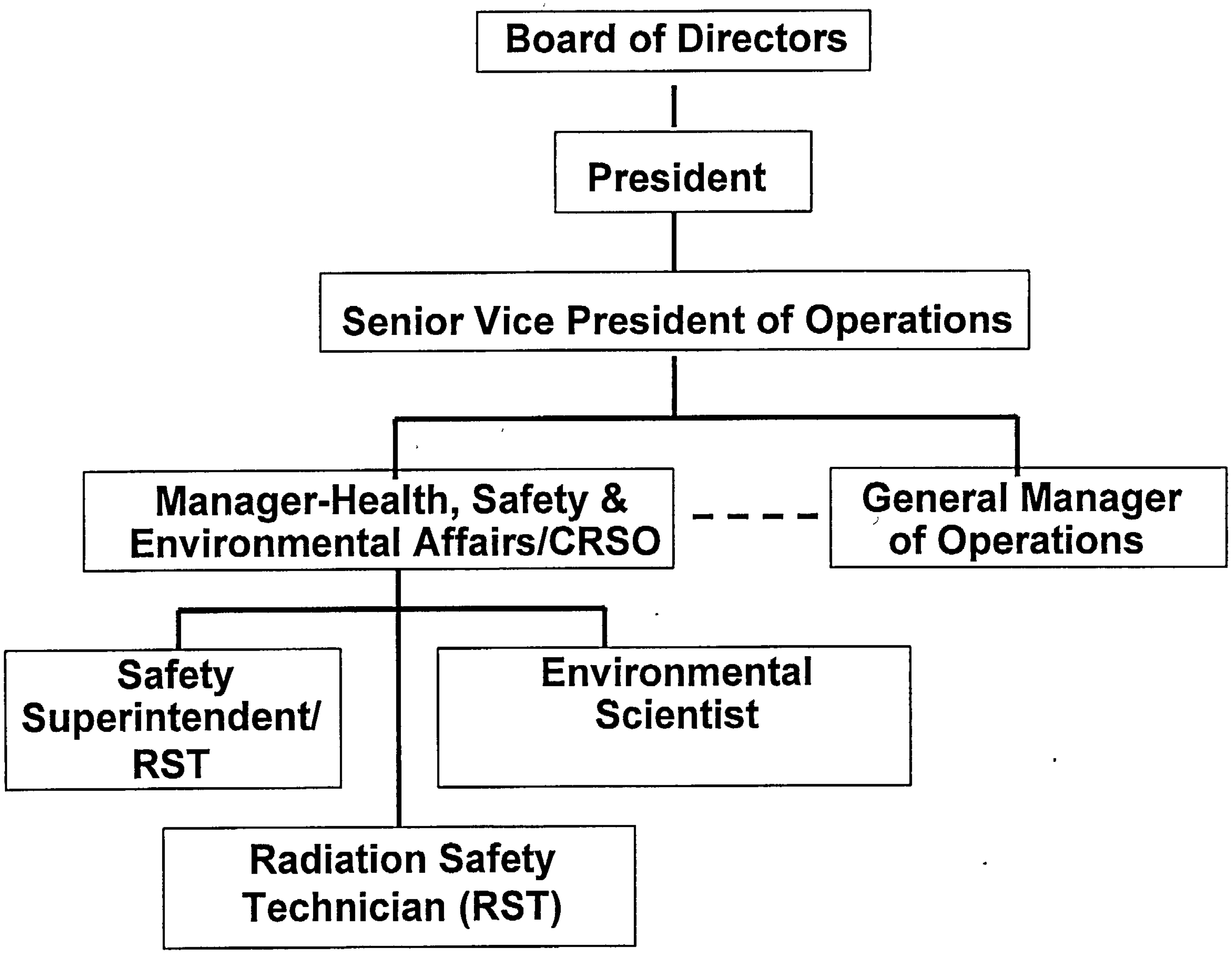

Figure 9-1: PRI Environmental, Health, and Safety Reporting Structure

CHAPTER 10
BENEFIT-COST SUMMARY

10.1 GENERAL

The general need for uranium is for replacement of the uranium consumed in the operation of nuclear power reactors. In reactor-licensing evaluations the benefits of the energy produced are weighted against related environmental costs, including a prorated share of the environmental costs of the uranium fuel cycle. The incremental impacts of typical mining and milling operation required for the fuel cycle are justified in terms of the benefits of energy generation to the society in general. However, the specific site-related benefits and costs of an individual fuel-cycle facility must be reasonable as compared to that typical operation.

10.2 QUANTIFIABLE ECONOMIC IMPACTS

Monetary benefits will accrue to the local community from the presence of the SR-HUP, from employees living in the community, local expenditures of operating funds and the state and local taxes paid by the project. Against these monetary benefits are potential monetary costs to the communities involved, such as those for new or expanded schools and other community services. For this project however, the local communities currently have a surplus of such facilities and the only new costs for these facilities will be the additional operational costs. It is not possible to arrive at a numerical balance between the benefits and costs for any one community, or for the project, because of uncertainties in the market place and the ability of a community to alter the benefits and costs. For example, the community can use its various taxing powers to change tax rates, however the effect of such a change could be either offset or compounded by changes in price the operator receives for the end product.

10.3 ENVIRONMENTAL COST

The benefit-cost comparison for a fuel-cycle facility such as the SR-HUP also involves comparing the benefits to the United States and to the society in general of an ensured U_3O_8 supply for generating electrical energy against local environmental costs for which there may be no directly related compensation. For the SR-HUP, there are basically only three of these environmental costs: groundwater impact, radiological impact, and disturbance of the land. The radiological impacts of the project during operation are small, and during reclamation the remaining solid radioactive wastes will be disposed at a facility licensed by the NRC to receive these low level wastes. Therefore, there will be no long-term impact at the site from these materials. The disturbance of the land is also a small environmental impact. All of the disturbed land will be reclaimed after the project is decommissioned and will become available for the pre-mining uses. Restoration of aquifers impacted by the ISL mining will be restored to conditions such that the pre-mining use suitability of the ground water is maintained.

10.4 SUMMARY

In considering the energy value of the U_3O_8 produced, the economic benefit to the local communities, the minimal radiological impacts, minimal disturbance of land, and mitigable nature of all other impacts, it is believed that the overall benefit-cost balance for the project is favorable, and that extending the license for the SR-HUP is the appropriate regulatory action.