

DECISION ANALYSIS - PROPOSED ACTION TO RENEW LICENSE

Colorado Specific Radioactive Material License 660-02

Licensed Activities at the Umetco Uravan Facility

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**DECISION ANALYSIS**

Colorado Radioactive Materials License #660-02

1.0 INTRODUCTION

On December 19, 1986 Amendment 0 to Umetco Minerals Corporation's (Umetco's) Uravan license was approved by the Colorado Department of Health. The license authorized the reclamation activities and monitoring programs for the Uravan Uranium Mill Site in concert with the *Uravan Consent Decree and Remedial Action Plan*. Decommissioning and decontamination of the site was scheduled to take place until sometime after 2003. The primary remedial activities included in the license and RAP were cleanup of contaminated wastes, removal of mill structures, cleanup of contaminated ground water and consolidation of all wastes and residues in secure repositories located on-site.

Amendment 0 was developed based upon reclamation designs and criterion that were submitted by Union Carbide Corporation (Umetco's parent company) in the early 1980's. These designs were reviewed by numerous agencies including the State Engineers Office and the Colorado Geological Survey.

1.1 License Overview

In April of 1991, Amendment 2 was approved by the Department authorizing the receipt and disposal at Uravan of uranium mill tailings and waste from the Naturita, Colorado Site. In late 1991, Umetco Minerals Corporation ("Umetco") submitted a request to renew their radioactive materials license for the Uravan Site. Amendment 3 to the Umetco Uravan license was approved on February 2, 1994 authorizing the receipt of off-site wastes at the Uravan site. This amendment was later disputed in Colorado District Court. On March 28, 1997, the Department approved Amendment 5 to the Umetco Uravan license updating the license to meet administrative changes and to reincorporate provisions of Amendment 3 which had been upheld by the Court. Amendments 1, 4 and 6 to the Umetco Uravan license updated the license to delete obsolete provisions and brought the license up to date with existing conditions at the site. On November 14, 1997, the Department received a revised and updated application to renew the license for the Uravan Site. Along with this updated application, the Department received an updated Environmental Report to go with the updated license renewal application.

The State of Colorado *Rules and Regulations Pertaining to Radiation Control, 6CCR 1007-1* (Regulations) require that a preliminary decision to renew a Colorado uranium milling license be accompanied by a written analysis of the basis of the decision.

The Department has prepared its preliminary licensing decision in the form of this *Decision Analysis*. This analysis serves to:

- ◆ summarize the Department's evaluation of the applicant's qualifications to

use radioactive material for the purpose requested in a manner that minimizes danger to public health safety and property;

- ◆ document that the application has been thoroughly reviewed by the Division;
- ◆ identify requirements not covered by the present license, but addressed in the proposed license;
- ◆ identify areas of the present license for revision or deletion, and;
- ◆ present notice to the public of an opportunity to comment on the amendment to renew the license.

## 1.2 Facility Overview

The Uravan site is located on the valley floor of the San Miguel River and on benches of Club Mesa west of the San Miguel River Canyon in southwestern Colorado. The site lies in parts of Sections 28, 29, 33 and 34, Township 48 North, Range 17 West, and Section 4, Township 48 North, Range 18 West, New Mexico Principal Meridian. Mineral recovery operations began at the Uravan site in 1912 and continued in various forms into the mid-1980's, when all milling operations ceased. The disposal facilities are located on a topographical bench west of the river valley and are approximately 400 feet above the valley bottom. The site is located in an area characterized by an arid climate, sparse vegetation, and rugged topography. Topographic features are dominated by broad mesas and incised canyons. Principal drainages in the area include the Dolores and the San Miguel Rivers.

The licensed Uravan site encompasses more than 806 total acres. Of this, 525 acres are affected by mill wastes, 70 acres are dedicated to existing tailings disposal and 20 acres for the Burbank Crystal Repository and 44 acres in the new B-Plant Area Repository.

The Uravan facility is a National Priorities List (NPL) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site that is undergoing remediation pursuant to a Consent Decree and Remedial Action Plan (RAP) between Umetco and the State of Colorado (Colorado 1987). The facility is licensed by the Colorado Department of Public Health and Environment, (CDPHE) under Radioactive Materials License number 660-02. Current actions related to site reclamation are:

- ◆ Contaminated soils removal;
- ◆ Ground water remediation;
- ◆ Evaporation pond operation; and
- ◆ Tailings pile repository closure.

Radioactive Materials License #660-02 authorizes Umetco to dispose of radioactive materials at the Uravan site. The license also specifies limits for the amount of radioactive materials to be disposed of on site. The limits currently authorized by the license include:

- ◆ 12.5 million dry tons of mill tailings;
- ◆ Unspecified quantities of mill refuse;
- ◆ 516 thousand dry tons of 11e.(2) byproduct material;
- ◆ 204 thousand dry tons of non-11e.(2) byproduct material; and
- ◆ Two (2) radioactive sources for site instrumentation.

Waste materials at the Uravan site are milling and cleanup residues that include mill tailings, evaporation crystals and sludges, milling refuse, and mill debris. These wastes totaling more than 10 million cubic yards contain radioactive elements, metals, and inorganic compounds. Liquid waste from seepage collection and groundwater extraction systems totaled over 800 acre-feet at the end of 1999. These liquids also contain radioactive elements, metals, and inorganic compounds.

The facility is also authorized to accept off-site waste similar in composition to the materials already present at the site. Receipt of these materials is subject to the requirements of the Department approved *Uravan Waste Acceptance Plan*. Handling of these materials is subject to the radiation health and safety requirements of the license.

## 2.0 STATUS OF REMEDIAL ACTIVITIES

### 2.1 Past Activities

Remedial activities, conducted in accordance with the Remedial Action Plan, at Uravan from 1987 through 1998 included the removal and relocation of the majority of contaminants from the San Miguel River Valley, the Uravan Mill and the Club Mesa Area. Remedial activities include decommissioning and demolition of the mill facility complex, installation and operation of the groundwater withdrawal system, and removal of contaminated soils and debris. The following remedial activities have been completed since initiation of the Remedial Action Plan.

- ◆ Removal and cleanup of dispersed materials and contaminated soils from approximately 340 acres,
- ◆ Relocating more than 2 million cubic yards of mill wastes and contaminated materials to secure repositories on Club Mesa,
- ◆ Constructing thick, durable covers for the waste and tailings repositories with more than 1.7 million cubic yards of earthen materials,
- ◆ Constructing five double-lined ponds totaling 40 acres for the evaporation of hillside and tailings pile seepage and the extracted groundwater,
- ◆ Removal of about 50 major mill facility structures and buildings, including the process systems and circuits, and removal of more than 260 buildings in the town of Uravan,
- ◆ Collection and control of about 40 million gallons of hillside and tailings pile seepage that contained more than 3 thousand tons of contaminated inorganic compounds, and

- ◆ Collection of about 190 million gallons of contaminated liquids from the groundwater extraction program with removal of more than 10 thousand tons of contaminated inorganic compounds.

These remedial activities at the site have removed waste materials to secure repositories on Club Mesa for disposal. This disposal has isolated the contaminants from transport and dispersion into the environment. Liquid wastes have been collected and placed in lined evaporation ponds effectively removing them from the hydrologic environment.

The United States Environmental Protection Agency (EPA) has performed two 5 year reviews of the cleanup of the Uranium site under the requirements of Superfund. Their findings are that the remedial activities are protective of human health and the environment.

## 2.2 Future Activities

Renewal of Radioactive Materials License 660-02 would authorize Umetco to continue the decommissioning and decontamination of the Uranium Site, and allow disposal of certain radioactive wastes from off-site sources.

Decommissioning and decontamination activities at the site include remedial actions required under the Uranium Consent Decree. Activities to be conducted under the consent decree and license, in the future include:

- ◆ Removal of remaining contaminated soil from discrete sources;
- ◆ Continued withdrawal and evaporation of ground water;
- ◆ Removal and reclamation of the Club Ranch Ponds;
- ◆ Completion of cover placement on the existing Tailings Repositories;
- ◆ Disposal of materials in the B-Plant Repository; and
- ◆ Final closure of the B-Plant Repository,

Extensive radiation and environmental monitoring activities are conducted in addition to the decommissioning and decontamination activities.

Pursuant to the Consent Decree and the RAP, final closure of the Tailings Pile 1-2 and 3 disposal repositories is scheduled to be completed December 31, 2002. The Tailings Repositories reached their design capacities in 1999. Under the provisions of the RAP, Umetco proposed a new repository in the B-Plant area for the disposal of on-site waste, and the ability to dispose of off-site waste. The Division approved engineering plans and specifications for this disposal area in May 1998. These plans and specifications were based upon the requirements of license amendments 3 and 5.



The license allows the receipt of two kinds of materials at the site. The first type of material authorized to be received at Uravan is "11e.(2) byproduct materials" which include the tailings or wastes produced, by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. 11e.(2) by-product material is defined in 42 U.S.C. 2014. The second type of material Umetco is approved to receive is "non-11e.(2) by-product material." Examples of these "non-11e.(2)" materials include radioactive wastes from vanadium mines and mills and other sources, as well as sludges and/or residues from the treatment of ground water at mill sites. The "non-11e.(2)" materials to be accepted at Uravan are compatible with the wastes already on site since they contain the same inventory of radionuclides.

Plans for the B-Plant Repository include provisions for the receipt of off-site wastes with the closure date, coinciding with the final closure date for the entire facility. This final closure date is dependant on the completion of a groundwater cleanup in the Club Ranch Ponds area. The current schedule by Umetco calls for the closure of the Club Ranch Ponds by the end of 2003 and the final closure of the B-Plant Area Repository in 2004. Waste could be received at the B-Plant Area Repository up to the time of evaporation pond closure in 2003.

The off-site waste volume requested on June 30, 1992, totaled up to 430,000 cubic yards (540,000 tons) of off-site 11e.(2) by-product material and 170,000 cubic yards (220,000 tons) of off-site non-11e.(2) by-product material. Since that time, the existing Tailings Pile 1-2 has been filled with on-site 11e.(2) cleanup materials. Umetco's 1998 B-Plant Area Repository addition to the facility made room for another 1,850,000 cubic yards of waste disposal capacity beyond that available in the already-existing tailings repositories. Of this additional volume Umetco proposed a total 1,250,000 cubic yards of 11e.(2) onsite wastes, and up to 600,000 cubic yards of off-site wastes. Umetco proposed that for off-site wastes, both 11e.(2) and non-11e.(2) wastes be permitted. The compatibility and essential equality between 11e.(2) and non-11e.(2) materials make non-11e.(2) materials suitable for disposal with the 11e.(2) materials in the B-Plant Area Repository. The 600,000 cubic yard volume and type of waste requested in 1992 remain unchanged. The 11e.(2) and non-11e.(2) wastes are similar enough that the same health, safety and environmental protection procedures are sufficient for either.

Umetco has committed that acceptance of waste received commercially will be limited to wastes found within the State of Colorado. All off-site wastes will meet the acceptance criteria which include chemical, physical, and radiological limits and specific legal restrictions. Off-site waste will only be accepted once it has met all CDPHE approved waste acceptance requirements.

Umetco is not allowed to receive:

- ◆ a hazardous waste subject to the Resource Conservation and Recovery Act ("RCRA"),
- ◆ a low level radioactive waste subject to the Rocky Mountain Low Level Radioactive Waste Compact, or
- ◆ a waste subject to a Certificate of Designation from the Montrose County Commissioners.

In other words no conventional "solid waste" is permitted to be received in the repositories. The Waste Acceptance Plan contains specific requirements and guidelines to assure that materials

are properly analyzed, classified and handled.

The remaining cleanup work at the site will require coordination with several agencies including the Colorado Department of Transportation, the United States Bureau of Land Management (BLM), the EPA and Montrose County.

### 3.0 THE DEPARTMENT'S PRELIMINARY FINDING

The CDPHE has determined that Umetco is operating under requirements and procedures sufficient in detail to assure compliance with the Colorado *Rules and Regulations Pertaining to Radiation Control* ( "the Regulations" ) and to assure the responsible management and disposal of wastes in a manner which protects public health, safety and the environment.

The CDPHE's preliminary findings are to authorize Umetco, to continue decommissioning and decontamination of the Umetco-Uravan Site and to dispose of wastes at the site through the time of closure of the B-Plant Area Repository, under the requirements of Radioactive Materials License RML 660-02, amendment seven.

Based upon the requirements of 6 CCR 1007-1, Section 3.9, Umetco Minerals Corporation is qualified by reason of training and experience to handle and dispose of the materials at the Uravan Site. Umetco's proposed equipment, facilities and procedures are adequate to minimize danger to public health, safety and property. Issuance of the license will not be inimical to the health and safety of the public.

The financial assurance requirements of 6 CCR 1007-1, Section 3.9.5 have been met by Umetco. The latest review and update of reclamation costs and were conducted in September of 1999. At that time, the amount of financial surety was increased to \$21.6 million dollars. The amount of the long term care fund was set at \$605 thousand dollars.

### 4.0 CHARACTERISTICS OF THE REGION THAT CONTAINS THE URAVAN SITE

This section summarizes the key geologic and hydrogeologic characteristics of the region that contains the Uravan site. There are numerous sources of this information. A summary of the regional and local physiography, geomorphology, stratigraphy, structural setting, and seismology, is provided as follows. Specific details are found in Appendix A of the Final Plans and Specifications for Remedial Activities the B-Plant Repository (Umetco August, 1998).

#### 4.1 Physiography

The site region lies entirely in the Canyon Lands section of the Colorado Plateau physiographic province. The Canyon Lands are characterized by deeply incised drainages and isolated mesas. Dominant landforms of the region are the broad Uncompahgre Plateau and the Paradox Basin. Evolution of these landforms dates largely from uplifting of the Colorado Plateau in Late Cretaceous through Miocene time. This uplift resulted in a northward tilt of the entire plateau. Drainages that formed on the low-relief Miocene surface became entrenched as uplift progressed.

## 4.2 Geology

The Uravan site is located in the northeastern part of the Colorado Plateau. The Colorado Plateau is a stable, intracontinental subplate having a greater crustal thickness than the adjoining regions. Its margins exhibit seismic activity and paleovolcanic features similar to the more disturbed adjacent provinces, while the central portion exhibits the more subdued characteristics of a continental plate interior.

Uravan is near the deeply incised San Miguel and Dolores Rivers and their tributary drainages. Both main trunk streams are underfit in their valleys which were shaped by higher average flows during the Pleistocene deglaciation of the region. The braided channel patterns and wide valleys of the trunk streams contrast with the steeper and narrower valleys of their principal tributaries such as Hieroglyphic Canyon and the dendritic, youthful drainages of the headwaters of those tributaries.

Bedrock in the site region consists of a thick sequence of marine and continental sedimentary rocks, representing the Paleozoic and Mesozoic Systems. Tertiary age sediments, if any existed, have been eroded. Mesozoic sedimentary rocks are well exposed in the canyon walls surrounding Uravan. The sedimentary rocks range from Triassic to Cretaceous in age and include the Chinle, Wingate, Kayenta, Navajo, Carmel, Entrada, and Summerville Formations. In addition, the Salt Wash and Brushy Basin Members of the Morrison Formation and the Dakota / Burro Canyon Formation crop out in the Uravan area. The geology is described in further detail in Appendix A of the *Final Plans and Specifications for Remedial Activities the B-Plant Repository* (Umetco August, 1998).

The rocks at the site dip gently eastward, about 1 to 3 degrees, homoclinally toward the axis of the northwest trending Nucla Syncline which lies to the northeast near the site, between the Salt Anticline region of the Paradox Valley and the southwestern flank of the Uncompahgre Uplift. The outcrops are regular and the apparent dips and apparent thicknesses of each rock unit are consistent and even on the steep slopes of the canyons all the way around Club Mesa. No abrupt changes in stratigraphic thicknesses, faults or folds are observed or indicated by the geologic mapping of the nearly continuously exposed rocks in the Uravan area.

## 4.3 Geologic Stability

The site repositories are situated on the erosionally resistant Salt Wash Sandstone within a geomorphically stable area on Club Mesa. There is 120 feet of Salt Wash Sandstone underlying the bottom of the site repositories. The Salt Wash Sandstone is the caprock of Club Mesa. The principal geomorphic process that could affect the stability of the repositories is lateral erosion of the mesa rims. This process is known as rim retreat. The rate of rim retreat in the Uravan Area has been estimated using two independent methods as 1 to 4 feet per one thousand years. Studies based on packrat midden geochronology establish site area rates of cliff retreat of 1 to 4 feet per thousand years. The second method, produced independently of the packrat midden study involved an estimate valley widening based upon the regional rate of downcutting. The mechanism for cliff retreat involves the failure of the sandstone cliff rims along fractures that parallel the valley. The fractures are spaced about 4 to 8 feet apart. At some point in time, a portion of the rim fails, resulting in some small rock falls. The most significant concerns are rockfalls that would occur from the rim on which the repositories reside. Rockfalls that occur

above the repositories would not affect the stability or integrity of the repositories. However, rockfalls above the repositories could lead to the need for maintenance and cleanup of repository runoff control channels. The toes of the repositories are set back from the valley rim and will not be disturbed by the effects of cliff retreat for well over 1,000 years.

The mesa top area around the repositories has a relatively very small catchment area. Drainage modifications have reduced surface runoff so that only rainfall on the disposal cell will contribute to the surface hydrologic processes in the repository area. Erosion will be controlled by riprap and no significant erosion of the repositories is expected during the next one thousand years.

All the repositories are sited in stable locations which will not be affected by lateral rim retreat. The repositories are not located within the 100-year flood plain of any streams. The potential for flooding from watershed runoff has been minimized by the construction of diversion channels designed to convey the Probable Maximum Flood ("PMF").

Flooding from upstream areas along the mesa is another geomorphic consideration. This concern has been addressed by mapping the extent of the watersheds that could affect the repositories and using this information in designing drainage diversion channels sized to convey the PMF. The PMF used is based upon a Probable Maximum Precipitation (PMP) value of 8.3 inches for the one-hour localized event. Use of the local PMP is appropriate for watersheds less than ten square miles in area and maximizes the storm intensity. The design calculations for the channels have been reviewed by CDPHE and are acceptable. The channel roughness coefficients selected are appropriate based upon NRC guidance and engineering judgement. Using the U.S. Army Corps of Engineers computer program model HEC-1, the flow routing is appropriate for the existing conditions. These calculations together with the design assumptions and PMP selected are adequate to assure long-term protection of the repositories from flooding.

#### 4.4 Seismic and Tectonic Characteristics

The Uravan region is in an area which has experienced a relatively low level of seismic activity for as long as first-hand records exist, the last 125 years. The more frequent and larger earthquakes in the region have occurred in the intermountain seismic zone which generally coincides with the Wasatch Mountain range in Utah. This zone of major seismic activity is located about 170 miles to the west of Uravan. Because of its distance from the site, the intermountain seismic zone will not have a major impact at Uravan. Relevant fault systems are associated with the western flank of the Uncompahgre Uplift, 10 to 12 miles to the northeast of the site, resulting in a peak site acceleration of 0.3g.

#### 4.5 Surface Water

The San Miguel River is the primary drainage in the project area. Headwaters of the San Miguel originate in the San Juan Mountains from which the river flows northwest to its confluence with the Dolores River about four miles downstream from Uravan. The San Miguel is perennial with pronounced seasonal fluctuations. This stream flow pattern is characteristic of rivers whose flow is derived primarily from snow melt runoff. Peak discharge on the San Miguel generally occurs in late spring or early summer.

The San Miguel exhibits a seasonal flow pattern typical of streams in the region. Major flows

occur from May to late June with moderate peaks, large volumes, and long flow duration. Average flow is 345 cubic feet per second (cfs) with a range of 12 to 6,690 cfs. The San Miguel flows are influenced by upstream diversions, storage, and irrigation.

Principal tributaries to the San Miguel River in the vicinity of Uravan include Spring, Atkinson, Tabeguache, and Hieroglyphic Creeks. Tabeguache Creek is perennial. The other streams are generally dry and flow in response to rain events. Peak flows occur most frequently in spring and summer.

#### 4.6 Uses of Adjacent Lands and Waters

Land owners adjacent to the facility are the Bureau of Land Management (BLM), Nature Conservancy, and Umetco Minerals Corporation. Land use adjacent to the Uravan site include livestock grazing, uranium/vanadium mining, and recreational use such as hunting and camping. There are no permanent residences within a 5-mile radius of the site. Much of the surrounding land is held by the BLM and is leased to ranchers for grazing. The United States Department of Energy holds title to Upper Burbank Repository where the Naturita Mill Tailings reside. There are no irrigated farmlands or domestic water wells within 5 miles of the disposal site due to the lack of an adequate water supply and general inaccessibility of the area. Population in the area is low with the majority of the population located near small towns. The closest towns are Naturita and Nucla, approximately 12 miles southeast of the disposal area. Major land use activities in the general area include agriculture in the Nucla area and cattle grazing on the mesa tops and in the river valleys.

### 5.0 GROUNDWATER CHARACTERISTICS

#### 5.1 Hydrologic Setting

The Uravan area is situated between the Uncompahgre Plateau and the Paradox Basin and is within the San Miguel River Basin. Regionally, hydrogeologic units potentially capable of producing water in economic quantities include the Dakota and Burro Canyon Formations, the Salt Wash Member of the Morrison Formation, and the Entrada, Kayenta and Wingate Sandstones. Strata which are not capable of transmitting significant amounts of water and represent aquitards in the area include the Brushy Basin Member of the Morrison Formation, and the Summerville and Chinle Formations. The site is divided into two areas for the purpose of describing the hydrogeology: the San Miguel River Valley Area and the Club Mesa Area. The San Miguel River Valley Area is defined as the valley bottom from the Town Area downstream to the Atkinson Creek Disposal Area. The Club Mesa Area is directly west and southwest of Uravan and includes the upper portion of the mill (B-Plant), the former ore storage and barrel storage area, the heap leach site, Club Mesa Tailings Piles, and the Club Mesa Spray Area.

#### 5.2 Regional Hydrogeology

The groundwater hydrogeology of the Uravan area has been described in numerous studies as summarized in Appendix A of the *Final Plans and Specifications for Remedial Activities the B-Plant Repository* (Umetco August, 1998, Peel, 1994a and b).

Five principal hydrostratigraphic units occur within the upper 800 feet of sedimentary rocks in

the Uravan area. In descending order the units are: 1) sandstones and shales of the Jurassic Salt Wash Member of the Morrison Formation, 2) shales and siltstones of the Jurassic Summerville Formation, 3) sandstones of the Jurassic Entrada, 4) sandstones of the Triassic Kayenta, and 5) sandstones of the Triassic Wingate Formation.

The Kayenta/Wingate Formation is the uppermost aquifer beneath the Uravan area. The aquifer is unconfined with an average hydraulic conductivity of 0.12 ft/day ( $4.2 \times 10^{-5}$  cm/sec). Primary recharge to the Kayenta/Wingate aquifer is northeast of the San Miguel River along the Uncompahgre Plateau. Secondary recharge to the Wingate portion of the aquifer is from the Paradox Valley southwest of the site. Ground water levels in the Kayenta/Wingate show flow directions toward the San Miguel River. In the Uravan area a ground water trough exists just southwest and parallel to the river. Discharge from the aquifer is to the San Miguel River. Ground water chemistry of the aquifer is different on each side of the river. Ground water derived from the Uncompahgre Plateau is a magnesium chloride type water low in Total Dissolved Solids (TDS). Ground water under Club Mesa, derived from the Paradox Valley is a sodium chloride type water much higher in TDS.

Club Mesa is underlain by approximately 600 feet of unsaturated sandstone, siltstone and shale. The Summerville Formation, composed of shale and siltstone, has a hydraulic conductivity of less than 0.01 ft/yr ( $1.0 \times 10^{-8}$  cm/sec). This 90-foot thick layer, the top of which outcrops along the canyon walls, effectively isolates any potential seepage from the repositories to the Kayenta/Wingate aquifer.

In the river valley, the Summerville Formation is not present. Therefore, seepage from the Club Ranch Ponds has impacted the Kayenta/Wingate aquifer on the northeast side of the San Miguel River. Groundwater remediation activities has decreased the size of the contaminant plume and reduced contaminant concentrations.

### 5.3 Club Mesa Hydrogeology

Hydrologic units of interest on Club Mesa include the Salt Wash Sandstone and the Kayenta/Wingate aquifer. Perched raffinate liquid is present at the base of the Salt Wash Sandstone. This perched zone resulted from the migration of liquids from the tailings piles and Club Mesa Spray area. The Kayenta/Wingate Formations comprise the first aquifer beneath Club Mesa. The hydrogeology of Club Mesa is evaluated through wells completed in the Salt Wash Member of the Morrison Formation (V-762, V-763S, V-764S, V-770, V-771, and V-772) and wells completed in the Kayenta/Wingate aquifer (V-768, V-769, CRP-15, CRP-16, V-766, CM-93-1, CM-93-2, and CM-93-3). Club Mesa hydrogeology is dominated by unsaturated conditions in the 400 to 600-foot thick strata above the Kayenta/Wingate aquifer. Unsaturated flow is controlled by deep infiltration (percolation) in the Bushy Basin shale and Salt Wash Sandstone that cap the mesa.

The Salt Wash Member of the Morrison Formation is dominantly sandstone; however, shale lenses are present. These shale layers comprise approximately 25 percent of the formation in the Uravan area. Salt Wash Sandstones have hydraulic conductivities that range from 0.051 ft/day ( $1.8 \times 10^{-5}$  cm/sec) to 0.027 ft/day ( $9.7 \times 10^{-6}$  cm/sec). The Salt Wash Formation is unsaturated with an average sandstone porosity of about 13.6 percent and a moisture content of 4.4 percent and average shale porosity of 16.3 percent and a moisture content of 9.5 percent.

Because of its thickness (90 feet) and low permeability (0.01 ft/yr,  $1.0 \times 10^{-8}$  cm/sec), the Summerville Formation is the controlling hydrogeologic unit beneath Club Mesa. The low permeability of this unit is confirmed by an analysis of past seepage from Tailings Piles 1-2 and 3 and a raffinate spray area on Club Mesa. The tailings disposal system and spray system have existed on Club Mesa since early 1956 and received tailings material until December 1984. Water balance calculations indicate that 250 million gallons of raffinate may have seeped from these tailings ponds and from the spraying system. This seepage migrated downward to the Salt Wash/Summerville contact where the low permeability (0.01 ft/yr) shales of the Summerville Formation stopped the downward migration. Consequently, a saturated zone developed in the Salt Wash directly above the Summerville. This saturated zone, approximately 20 feet (6 meters) in thickness, has not penetrated the Summerville Formation and has not caused mounding of water into the tailings piles. Additionally, the perched zone has not impacted water quality in the Wingate Formation as shown by the static concentrations of radionuclides and heavy metals in the Kayenta/Wingate aquifer beneath Club Mesa. No changes in basic ground water chemistry have been observed in the wells completed in the Kayenta/Wingate aquifer.

Geochemical attenuation of potential leachate would occur as liquid is transmitted through the bedrock formations. The Salt Wash Member is about 120 feet thick with sandstones totaling about 90 feet in thickness and containing calcium carbonate cement. Geochemically, this calcium carbonate would buffer any solutions exiting the repository. The Salt Wash Member also contains about 30 feet of shale. Tests on Salt Wash shales indicate Cation Exchange Capacity (CEC) values ranging from 9.9 meq/100 g to 32 meq/100 g and a pH of approximately 8.4. These tests indicate that the Salt Wash shales would attenuate contaminants contained in repository seepage.

Beneath Club Mesa the direction of groundwater flow is to the northwest with a gradient of 0.018. The linear velocity of the groundwater, using a gradient of 0.018, a hydraulic conductivity of 0.12 ft/day ( $4.2 \times 10^{-5}$  cm/sec) and an estimated effective porosity of 10 percent, is calculated to be about 0.022 ft/day ( $7.7 \times 10^{-6}$  cm/sec) or about 8 ft/yr. This calculation indicates that the groundwater flow velocities are low and that it would take more than one thousand years for groundwater beneath the repositories to discharge into the San Miguel River.

#### 5.4 San Miguel River Valley Hydrogeology

Groundwater in the San Miguel River Valley occurs in the Kayenta and Wingate Formations. Perched raffinate liquids also occur in the Quaternary deposits in the Club Ranch Ponds area. The groundwater remediation program in the Club Ranch Ponds area has removed substantial quantities of contaminated liquid from the Kayenta/Wingate aquifer and terrace gravel. Contaminated terrace materials have also been removed from the Club Ranch Ponds.

Surface impoundments are located along a terrace north of the San Miguel River. The original surface impoundments were unlined pits that were historically (1960 to 1984) used to manage process water and tailings liquids. Leakage through the ponds has adversely impacted groundwater in the underlying Kayenta Formation. A groundwater plume of elevated TDS has been identified and largely delineated (both horizontally and vertically) through an extensive network of monitoring wells. The ponds were emptied during the late 1980s and the bottom sludges and salts were removed.

Unconsolidated sediments present at the site generally consist of either a reddish-brown clayey sand that occurs to depths of eight to 15 feet or a layer of terrace gravel that outcrops beneath the impoundments and subcrops beneath the clayey sand. Thickness of the gravel deposit is variable, ranging from two to 16 ft.

Immediately beneath the unconsolidated sediments of the Uravan terrace is the Kayenta Formation. This formation also forms the bed of the San Miguel River. In the study area, the Kayenta Formation is between 130 and 200 ft thick, as observed in well logs from the area. The formation is predominately a very fine- to medium-grained, subangular to subrounded quartz sandstone. The sandstone is well to poorly cemented with dolomite cement and exhibits fair to good intergranular porosity. Trough crossbedding and the lenticular nature of sandstone units within this formation suggest a predominantly fluvial depositional environment.

Below the Kayenta Formation is the Wingate Sandstone, a massive cliff-forming unit, consisting of well sorted, very fine- to fine-grained sandstone. This formation is approximately 250 ft thick in the Uravan area. Based on the available data, the porosity of the Wingate Sandstone is similar to the Kayenta Formation; however, the hydraulic conductivity of the Wingate Sandstone in the vicinity of the Club Ranch Ponds area is relatively low. The contact between the Kayenta Formation and the underlying Wingate Sandstone dips gently to the north and outcrops along the San Miguel River approximately 5000 feet downstream from the Club Ranch Ponds. The aquifer recharges the river in this area.

The most significant aquifer, with respect to the groundwater plume beneath the Club Ranch Ponds area, is the Kayenta Formation. In the Uravan area, the Kayenta Formation has been documented as having relatively high permeability (700 ft per year) and high porosity (27 percent). Recharge to the Kayenta probably occurs west and northeast of Uravan, where the formation is exposed, from the San Miguel River, from infiltration through the overlying unconsolidated sediments and potentially from the underlying Wingate Sandstone. An extensive network of extraction wells and monitoring wells have been emplaced at the Club Ranch Ponds area. Aquifer pumping test and slug test data from these wells indicate highly variable hydraulic conductivity within the Kayenta Formation.

The water table typically is located near the contact between the Kayenta Formation and the overlying unconsolidated sediments, indicating that most of the entire section of the Kayenta Formation is saturated. Water-level data from 1997, considered representative of steady state nonpumping conditions at the site, indicate horizontal hydraulic gradients from Club Ranch Ponds area to the San Miguel River range from 0.025 ft/ft to 0.007 ft/ft.

## 6.0 WASTE REPOSITORY DESIGN CONSIDERATIONS

There are two tailings repositories that have been completed or are near completion. Construction of the Burbank Repository has also been completed. The Burbank Repository facility is a below grade repository on three sides with a 1.5 meter thick clay cover and a rock protection layer on top of the clay. The one exposed out slope has a 5H:1V slope. The tailings repositories are nearly completed, with the remaining work involving placement of the final top covers. Tailings Pile 1-2 and Tailings Pile 3 are above grade structures and have 3 meter thick clay covers and a rock protection cover. Three meters was the minimum acceptable thickness under the regulations promulgated in the early



1980's, and later revised in the late 1980's. These designs were thoroughly reviewed and approved prior to construction in order to assure that they could withstand the forces of nature including failure by water erosion, weathering of the rock cover and shaking by earthquake. The B-Plant Repository is the remaining waste repository that can receive waste from on-site or off-site sources.

#### Infiltration and Ground Water Summary

Each of the repositories has a clay and rock cover. The clay portion of the cover exists to reduce radon emanations from the waste and to reduce infiltration of precipitation into the waste and into ground water. The clay used for the covers, when properly moisturized and compacted, yields a highly impermeable cover. That feature together with the slopes of the covers are designed to cause precipitation to runoff rather than infiltrate. Umetco's 1998 infiltration analysis, using the HELP model, indicated that for a seven foot thick compacted, clay cover, with a 2% slope, the infiltration from the waste is less than 2% of the precipitation. The amount of infiltration will be even less from the sideslopes that are steeper than 2%. The creation of the repository in the Club Mesa Area will not adversely affect the quality of ground water in the regional aquifer (Kayenta/Wingate). The repository designs together with stringent waste acceptance criteria preclude significant seepage from exiting the repositories.

#### Cover Materials

The clay used for cover material is from the Brushy Basin Member of the Morrison Formation. Testing indicates that the permeability of this clay is low, less than  $10^{-7}$  cm/sec. It is this property that makes the material desirable cover material to control water infiltration and radon flux. A sandstone unit of the Salt Wash Member of the Morrison Formation is being used as the rock cover material for the Uravan disposal cells. The durability of this unit has been evaluated based upon geologic and petrographic examinations. The unit appears as a ridge forming sandstone which indicates its longevity under the climatic conditions. Field examination of the rock shows that it is sound and dense. Rock falls, several hundred years old, below cliff faces show that the rock remains angular and intact. Petrographic analysis indicates that the rock is well cemented and does not contain seams or other zones of weakness. Overall the rock is dense, sound and durable under the conditions present at the site. The rock has been in place on Tailings Pile 1-2 and Tailings Pile 3 for over ten years and shows not evidence of degradation.

### 6.1 Tailings Repositories 1-2 and 3

The three tailings repositories Tailings Piles 1-2 and 3 were placed as a slurry during mill operations. Additional contaminated soils were placed on top of the cells as an engineered structural fill with 5H:1V side slopes. The side slopes of both cells have been covered with clay and rock. Tailings Pile 3 has the clay cover placed across the top and is awaiting the rock cover. The cover for Tailings 1-2 is scheduled for completion by the end of 2002. The clay covers for the tailings repositories are a total of nine feet thick and will be covered with rock.

#### 6.1.1 Seismic Characteristics

The Uravan region is an area of low seismic activity. Peak bedrock accelerations based upon historic earthquake intensity are predicted to be on the order of 0.02g to 0.12g from Table 2.2, Attachment B of the Naturita RAP (DOE 1998). Based upon the historical data of Kirkham and Rogers, and analysis of recurrence rates, the Maximum Credible Event results in a peak bedrock

acceleration of 0.12g for a one thousand year recurrence interval and a peak bedrock acceleration of 0.23g for a 10,000 year recurrence interval. A 0.3g peak bedrock acceleration is used by Umetco as a conservative design event for stability calculations. Recently earthquakes have been reported in the Paradox Valley. These earthquakes were on the order of 3.0 to 3.5 in magnitude, probably associated with injection of saline water being performed by the Bureau of Reclamation. Estimation of peak bedrock acceleration associated with earthquake intensity shows that a magnitude 6.1 earthquake in the Paradox Valley would yield a peak bedrock acceleration of 0.07g at Uravan far below 0.3g used for design purposes.

#### 6.1.2 Seismic Stability and Liquefaction

The slope stability of the existing tailings repositories on Club Mesa have been evaluated by numerous investigators since the late 1970's, including Acres American, International Engineering Company, and Chen. The tailings repositories have 3H:1V slopes. Trimming of the slopes to 5H:1V was considered but rejected due to the decrease in stability caused by the removal of coarser tailings from the out slopes. The NRC concurred with this decision. In order to assure tailings stability during operation of the mill, an earth and rock berm was designed and constructed at the base of the tailings repositories. Once reclamation activities started, an interim soil cover, approximately 12 inches thick, was placed on the repository out slopes. Based upon the stability analyses performed, a final elevation limit was established for the top of the tailings repositories. Contaminated soil and demolished mill structures were placed on top of the tailings repositories as a compacted, engineered fill, at a 5H:1V slope. The top slopes of the piles were designed to drain away from the side slopes at a 2% grade. The latest analysis of slope stability (Umetco, August, 1998) indicated that tailings repositories would be stable under static and pseudostatic conditions.

A liquefaction analysis was performed by evaluating stress ratios derived from cyclical triaxial tests. These ratios indicated that the tailings repositories were not subject to liquefaction.

#### 6.1.3 Settlement Analysis

Settlement of the repositories was predicted in 1987 by Chen and Associates using data obtained from Dames and Moore, Acres American and International Engineering Company. The majority of the settlement was predicted due to consolidation of the tailings resulting from the contaminated soil load. Analysis indicated that the majority of consolidation would occur over a two-year period in response to placement of approximately 25 feet of contaminated materials and would be on the order of five feet. Settlement monitors were placed to record the total settlement of the piles. The data for Tailings Pile 3 have shown a total settlement of three to four feet. Settlement has essentially ceased since the placement of contaminated soils was completed. Tailings Pile 1 and 2 has shown total settlement on the order of five to eight feet in response to placement of contaminated materials. Placement of the twelve to fifteen feet of cover is predicted to induce little additional settlement. The primary objective is to assure that differential settlements are less than the cover thickness. Completion of final cover placement is scheduled for 2001.

#### 6.1.4 Cover Attenuation of Radon

The radon flux for Tailings Piles 1-2 and 3 was calculated model in 1983. The flux limit used was 2.0 pCi/sq-m/sec rather than the 20 pCi/sq-m/sec required under today's regulations. The 2.0 pCi/sq-m/sec flux limit resulted in a much thicker cover than would be required today based on

radon attenuation alone.

The CDPHE has reviewed the input data Umetco considered to be representative of design values for the radioactive waste and cover, for license amendments in 1991 and 1993. The latest review was performed in 1998 associated with the plans and specifications for the B-Plant Repository. The NRC has also reviewed and approved the input data for the clay cover material used for the Naturita Cell. It should be noted that the same cover materials are used for all cells on the site including the DOE cell for the Naturita Tailings, the Tailings Repositories, Burbank Repository and the B-Plant Repository. The data reviewed by CDPHE included the radium content, moisture contents and compacted densities. The data are within an accepted range of values for clayey and random fill soil materials. The analysis indicates that the modeled cover meets current CDPHE regulatory criteria for protective cover design and will attenuate radon flux at the surface to less than 20 pCi/sq-m/sec as required by Part 18, Appendix A, Criterion 6 of the Colorado radiation regulations.

The radium content of the clay cover materials for all of the cells on site has also been analyzed by Umetco and reviewed by CDPHE, DOE and NRC. The latest analysis was provided in the plans for the B-Plant Repository (Umetco, August, 1998). The average radium content of the clay cover material is within the regional radium concentration population.

## 6.2 Burbank Repository

The Burbank Repository was designed to provide permanent storage of the residues from the old Club Ranch Ponds. This repository is located in the lower portion of the Burbank Quarry. The upper portion of the quarry is now filled with DOE waste from the Naturita Mill Site. The Club Ranch Pond residues were composed of hydrated ammonium sulfate crystals containing thorium. In order to assure long term stability of the residues, a series of clay cells were constructed to surround the crystals. The cell dimensions are 20 feet by 20 feet by 20 feet. Each cell is covered by a one foot thick clay cover. The final cover over the entire repository is a total of four feet thick and contains a one foot thick radon barrier. A two foot thick layer of rock cover sits on top of the soil cover. The crystals are man made and exhibit some unusual physical properties. During excavation, the crystal lattice was disturbed and hydrated waters were released. This made the wastes quite moist and difficult to handle. Once the crystal residues were placed in the clay lined cells, they hardened into a dry, solid mass.

### 6.2.1 Seismic Stability and Liquifaction

The Burbank Repository was designed as a nest of compacted clay cells to contain the Club Ranch Pond residues. Once the residues were placed in the cells, they hardened into a solid mass of material. In laboratory tests, the shear strength increased toward infinity. The below grade design, combined with the engineered nested construction of the cells make this repository stable under the conditions of the MCE. Liquifaction is not a concern due to the dry nature of the solidified residues and the clay cells that surround the residues.

### 6.2.2 Settlement Analysis

Total settlement of the cells is anticipated to be minimal, (less than 1.0 foot) since the clay cells have been compacted as an engineered fill and the residues harden to a solid mass. Differential

settlement is even less than total settlement. The key to settlement reduction is the placement of a thick clay cover and clay cell walls to reduce the potential for the residues to reach saturated conditions that would lead to dissolution of the crystals. Under the design as constructed, the objective is to remove the crystals from contact with the ground water and precipitation through the use of the nested clay cells and the below grade location.

### 6.2.3 Cover Attenuation of Radon

The radium content of the Club Ranch Pond residues is low with observed radon flux ranging between three and 13 pCi/sq-m/sec. The thorium content of the residues is the factor that determines the long-term radon flux from the repository. An analysis by CDPHE, assuming an initial radium concentration of 17 pCi/g indicated that the radon flux from the repository is less than 2.0 pCi/sq-m/sec. The four-foot thick repository cover, combined with the one foot cell covers for each 20 feet of thickness, substantially decreases the radon flux both now and in the long-term.

As noted under Section 6.1.4, the CDPHE reviewed the input data Umetco considered to be representative of design values for the radioactive waste and cover. These included the radium content, moisture contents and compacted densities. The data is within an accepted range of values for clayey and random fill soil materials. The analysis indicates that the modeled cover meets current CDPHE regulatory criteria for protective cover design and will attenuate radon flux at the surface to less than 20 pCi/m<sup>2</sup> s required by Part 18, Appendix A, Criterion 6 of the Colorado Radiation Control regulations.

### 6.3 B-Plant Repository

The B-Plant Repository design was submitted by Umetco in March, 1998. The repository is designed to contain contaminated soils and debris from the cleanup of the Uravan Site. The repository is also designed to receive off-site waste that can be accepted under the conditions of the radioactive materials license and the waste acceptance plan. The design has been developed in two portions, Phase I and Phase II. Capacity for the Phase I cell is approximately 960,000 Cubic yards. The Phase II cell capacity is 890,000 Cubic yards. The combined Phase I and II repository has a footprint of approximately 44 acres and is designed to contain 1.85 million Cubic yards of contaminated material. The maximum height of the waste is about 100 feet.

The new B-Plant Repository was not constructed with a liner. An exemption from the liner requirement for the B-Plant Repository was given based upon the operation of the facility, the moisture content of the wastes and the hydrologic setting of the facility. Under the requirements of the construction specifications, repository operation and the Waste Acceptance Plan, this repository cannot accept liquid wastes or wastes that contain free liquids. The Summerville Formation, a thick, interbedded clay and sandstone is found beneath the repository and acts as an aquitard and a geochemical barrier. The presence of this formation reduces the mobility of any potential leachate that would exit the repository. Umetco has demonstrated that the B-Plant Repository is not a surface tailings impoundment, will not accept liquid waste and does not need a liner.

The side-slopes and top-slopes of the B-Plant Area Repository have a rock cover located on top of a structural fill (frost protection) layer and a radon control layer. Thickness of the radon control and structural fill layers have been determined based upon modeling to meet radon flux requirements (20 pCi/sq-m/sec). The structural fill layer is also thick enough (more than 7 feet) to protect the

radon control layer from frost penetration. The rock cover is designed to protect the slopes and assure that long-term erosion is minimized.

The side-slopes of the B-Plant Repository are proposed on a slope of five horizontal to one vertical (5H:1V). This grade is acceptable under Criterion 4C of Part 18 of the Regulations. The earth materials used for the cover are the same as used for all the other repositories. The side-slopes of the B-Plant Area Repository will be covered with rock to reduce the potential for long-term erosion. The rock cover has been sized in accordance with methodologies accepted by the Nuclear Regulatory Commission.

#### 6.3.1 Seismic Stability and Liquefaction

The seismic stability of the B-Plant Repository was evaluated using the same peak bedrock acceleration as used for the tailings repositories (see Section 6.1.1) (Umetco August, 1998). The resulting analysis showed the repository design to be stable on the two critical slope sections. The factor of safety for the static conditions is 2.39 and is 1.15 for pseudostatic conditions. The minimum factors of safety are 1.5 and 1.0 respectively.

Liquefaction of the materials will not occur because of the heterogeneous nature of the materials, the compaction during placement and the unsaturated condition of the material.

#### 6.3.2 Settlement Analysis

The predicted maximum total settlement for the B-Plant Repository due to placement of the cover is 12.6 inches. The maximum differential settlement is one foot. The radon attenuation layer is 1.5 feet thick. The entire cover is more than seven feet thick.

The top-slope surfaces have slopes of between one and 3 percent and are designed to handle PMP sheet flow conditions. The use of a rock cover material will greatly limit the potential for gully formation.

The B-Plant Area Repository is not located within a 100-year flood plain of any streams, but is located in the upland areas of a mesa. Drainage diversion channels for the repositories are also located in upland areas of the mesa. Drainage diversion channels for the repositories have been designed to contain the PMF.

#### 6.3.3 Cover Attenuation of Radon

Repository final cover designs were presented in Umetco's application and radon attenuation calculations are contained in the B-Plant Area Final Plans and Specifications of March 1998. Umetco used a U.S. Nuclear Regulatory Commission approved computer program, RADON, for the analysis of cover design.

CDPHE reviewed Umetco's RADON program input data recognizing that input data for the deposited radioactive waste are conservative approximations. The calculations are based on deposition of a radioactive waste layer 500 cm (16.4 ft) thick containing a maximum design value for radium-226 of 200 pCi/g.

Umetco's amendment request specified a 2,000 pCi/g limit for the various isotopes contained in the waste. Based upon experience with materials at the site, an estimate of 200 pCi/g was used for the top 500 cm thickness in the model. This value was reasonable for the purpose of calculating the cover thickness based upon site experience. Prior to construction of the B-Plant Repository cover, license condition LC 17.4.3 requires that Umetco verify the thorium and radium content of the materials placed in the repository. This will allow confirmation of the radon flux requirement. The estimated radium activity (200 pCi/g) is actually five times greater than the average radium content of wastes placed in the existing repositories. CDPHE reviewed the input data Umetco considered to be representative of design values for the radioactive waste and cover. These included the radium content, moisture contents and compacted densities. The data are within an accepted range of values for clayey and random fill soil materials. Umetco's calculations show that the total cover thickness required for waste with this level of activity is a minimum of 6.0 feet (182 cm). The proposed cover would consist of a 45 cm (1.5 ft) clayey radon barrier infiltration layer and a 4.5 feet (137 cm) random fill soil layer. Umetco's repository final cover designs indicate a 7-foot thick cover, including rock cover, over the contaminated soil. CDPHE finds that this design is acceptable. The analysis indicates that the modeled cover meets current CDPHE regulatory criteria for protective cover design and will attenuate radon flux at the surface to less than 20 pCi/sq-m/sec required by Part 18, Appendix A, Criterion 6 of the Colorado Radiation Control regulations.

## 7.0 SOIL CLEANUP ACTIVITIES

Cleanup of radioactive wastes, mill structures, process residues and contaminated soils is one of the primary remedial actions at the Uravan Site. As of the end of 1999, 2.5 million cubic yards of material has been removed and placed in the various repositories on Club Mesa. Under the Uravan RAP, soil cleanup is governed by Table 4.1.2-1 of the RAP. This table specifies soil concentration limits for radium, and establishes a procedure for establishing concentration limits for thorium, arsenic, cadmium, lead, and other metals. The cleanup criterion in this table were designed to achieve soil constituent concentrations which approximated the levels found at Uravan prior to milling operations. In 1990, specific, "No Further Action" cleanup criteria, based upon background soil concentrations, were established for arsenic, cadmium, lead, molybdenum, nickel, selenium, vanadium, zinc and uranium. Six locations were selected for background sampling, three in the river valley and three on the mesas. Areas that exhibited evidence of uranium mining or milling activities were avoided in the selection of these locations. For radium, surface soil concentrations were set at 5.0 pCi/g over the background concentration or 7.1 pCi/g. Thorium concentrations were derived from thorium ingrowth to meet the 5.0 pCi/g radium standard at 1000 years. Soil sampling to determine achievement of cleanup standards was required in all cases except where excavation encountered sandstone bedrock, or the water table was encountered.

The general approach to mill-site cleanup at Uravan includes the removal of contaminated materials in specific project areas and confirmation that the cleanup has been conducted properly. During the course of cleanup activities and of evaluating the various areas that remain to be cleaned up, it became apparent that a site specific approach would be needed to assess the cleanup of areas where physical access is restricted, dangerous or precluded. In order to assure that remedial activities in these remaining areas conform to the Uravan RAP criteria, a report titled "Soil Cleanup Program Methodology for Uravan, Colorado" (Umetco, June, 1999) was developed by Umetco and approved by the State of Colorado. This document outlines the methodology for establishing situation specific soil cleanup objectives. The method uses a progressive, tiered approach to assure

that cleanup activities and cleanup results are health protective. The objective of the activities at the site is to achieve soil cleanup to concentrations that are as low as reasonably achievable. In some instances, physical conditions exist at the site that can hamper or preclude cleanup. The methodology developed, provides estimates of risk based upon future uses of the land, and provides Umetco and the State with the range of risk to members of the public from various soil concentration levels. This approach is consistent with and provides the basis for meeting the acceptance criteria described in Section 5 of the Nuclear Regulatory Commission (NRC, 1999) *Standard Review Plan for Title II Uranium Mill Sites*.

The site-specific methodology includes four assessment categories that can be applied to individual project areas at Uravan. The underlying principle for these categories is the "As Low As Reasonably Achievable" (ALARA) concept. Soil cleanup activities in all project areas will be conducted to reduce contaminant concentrations to levels that are as low as reasonably achievable considering the feasibility, cost-effectiveness, and environmental impact of the proposed remedial activities and potential land use. Incorporation of this basic principle in this document assures that contaminant concentrations will meet the RAP criteria or risk/dose-based concentrations.

The following assessment categories were developed for site-specific Uravan cleanup activities:

- Category 1 - RAP Soil Criteria
- Category 2 - Risk-Based Soil Cleanup Objectives for Residential Land Use Scenarios
- Category 3 - Site-Specific Risk and Dose Based Objectives
- Category 4 - Alternative Concentration Objectives

These categories allow for the assessment of specific project areas on a constituent by constituent basis and assure that cleanup activities are protective of human health given site specific land uses and topographic constraints in the area. Specifically, the categories will be used to evaluate residual concentrations in the cleanup areas so that constituents of concern can be identified and potential risks and doses can be assessed. Each category requires sufficient data and information so that potential human health impacts can be fully evaluated. Such information will be used to determine if additional remedial actions are necessary considering such factors as feasibility, cost-effectiveness, environmental impacts and future land use.

Soil cleanup has been going on at the site since 1987. More than 160 acres have been cleaned up to constituent concentrations within background ranges. Cleanups have been conducted using the concepts of ALARA (As Low As Reasonably Achievable). Where "No Further Action" soil cleanup criterion could not be achieved, a risk based approach has been developed to protect public health.

## 8.0 GROUND WATER CLEANUP ACTIVITIES

Ground water monitoring and cleanup activities at the site are described in detail in Section 5 of the Uravan RAP. Activities in the river valley include monitoring of a background well, a point of compliance well and multiple wells in the contaminated plume. Ground water monitoring under Club Mesa includes a background and point of compliance well. These activities are also regulated under portions of *Appendix A of Part 18 6CCR 1007-1*. The CDPHE performed a technical evaluation of the monitoring program for the entire site and the corrective action program for the river valley under the requirements of Criterion 5, 7 and 10 of Appendix A (CDPHE, 2000). Based upon this evaluation the RAP activities are in conformance with the requirements of Appendix A. Requirements concerning ground water are found under license conditions 11.1, 11.2, 11.13, 24.2,

and 28.6.

## 8.1 River Valley Activities

The original Club Ranch Ponds were unlined pits, located adjacent to the San Miguel River, that were historically (1964 to 1984) used to manage process water and tailings liquids. Leakage through the ponds has adversely impacted groundwater in the underlying Kayenta Formation. A groundwater plume of elevated TDS and metals has been identified under the footprint of the old ponds and extending down river toward Atkinson Creek. Ground water monitoring has been conducted since 1983. Under the RAP, starting in 1987, 40 constituents have been monitored. Based upon over 10 years of data, the primary constituents of concern are cadmium, fluoride, nickel, selenium, vanadium, zinc, radium and uranium.

A groundwater remediation program was initiated by Umetco in the Club Ranch Ponds area during 1991. Under the RAP, the remediation program called for the construction of two wells, with a combined pumping rate of 60 gpm. The system performance was to be evaluated every two years and optimized as needed. The ground water withdrawal program was to operate for a total of 11 years. This system has been evaluated every two years by Umetco and changes have been made in order to optimize system performance. The remediation program includes seven extraction wells (WD-1, WD-2, WD-3, WD-4, CRP19B, CRP19C and CRP21) and five, lined, evaporation ponds. Three of the six original ponds have been lined (Club Ranch Ponds 1, 4, and 6) and are currently used in conjunction with two newer lined ponds (Club Ranch Ponds 7 and 8) to dispose of groundwater recovered from the extraction system. The combined annual average pumping rate was approximately 62 gallons per minute (gpm) or slightly greater than 32 million gallons per year (gpy), during the period from 1990 to 1997. However, the extraction wells were not operated continuously throughout the year. Pumping rate data indicate the typical combined pumping rate during periods the extraction wells were operating was between 100 and 120 gpm.

The distribution of the elevated TDS plume within the Kayenta is delineated by the monitoring well network. The highest levels of TDS are detected in the immediate vicinity of the Club Ranch Ponds. The downgradient limit of the elevated TDS plume extends beyond monitoring well CRP23 (Peel, 1991). The upgradient limits to the TDS plume do not extend as far as monitoring well CRP1 which consistently has TDS levels below 1,000 mg/L. Recent water quality data indicate there is a 63% reduction in the levels of TDS since the old ponds were decommissioned.

In January 1998 a proposal was submitted, and approved, to drill and monitor additional wells in the Club Ranch Ponds area and Town Dump areas to attempt to enhance the groundwater remedial action goals. This new effort was driven by a fundamental shift in focus from water volume removal to contaminant removal. The concept was to shift the withdrawal points to zones of high contaminant concentration to determine if the overall mass balance of contaminants could be reduced more rapidly and/or efficiently.

Eight new wells were drilled, logged and pump tested in vertical increments to identify highly contaminated candidate zones for preferential pumping. Based on the results of that activity, a new withdrawal plan has been implemented and is currently being evaluated for its performance with respect to the new objectives. As of this time the data is insufficient to make any determinations regarding the success of the system or to develop any recommended modifications to it.

The January 1998 proposal also contained a request to drill and construct a replacement monitor well for CRP-18, the point of compliance well for the Uravan RAP. It is likely that the annulus of well CRP-18 was backfilled with contaminated materials during completion. The location of the well in the middle of the Town Dump also led to concerns about contamination down the well bore,



once radioactive contamination was found in the dump area. Four new monitoring wells, completed in the Kayenta/Wingate aquifer, were installed surrounding CRP-18 to evaluate the downgradient water quality in the Kayenta Formation, analyze the condition of CRP-18 and determine the feasibility of abandoning CRP-18 and relocating the river valley POC. Based upon an evaluation of cation and anion data from the four 1998 wells, TD-98-3 has been selected to replace CRP-18 as the Point of Compliance for the River Valley under the RAP and the license. Water quality data from the four 1998 wells, completed in the Kayenta, also indicates that the contaminant plume from the Club Ranch Ponds area has not migrated down the river to this location.

## 8.2 Club Mesa Activities

Five wells on the mesa and two wells between the mesa and the river have been completed in the Kayenta/Wingate aquifer. Wells V-768, V-769, CM-93-1, CM-93-2 and CM-93-3 are on the mesa, adjacent to the tailings piles and Burbank Repository. Wells CRP-15 and V-766 are located in the valley, adjacent to the San Miguel River. All seven wells are completed in the first aquifer below the repositories, the Kayenta-Wingate. Six other wells are completed in the Salt Wash Member of the Morrison Formation to monitor the quality of the perched liquids. Three wells (CM-93-1, 2 and 3) were drilled in 1993 in order to provide detection monitoring information for the aquifer under Club Mesa. Water quality data from these wells has provided information about the spacial variation in the quality of the Kayenta/Wingate aquifer. Data from westernmost wells CM-93-1 and CM-93-2, when plotted on stiff and trilinear diagrams, show a distinct difference in the basic cation/anion balance when compared with data from wells such as CM-93-3, V-768 and V-769, or unaffected wells in the river valley which are located further east. Wells CM-93-1 and CM-93-2 show much higher milli-equivalent concentrations of sodium, calcium, chloride and sulfate than in wells CM-93-3, V-768 and V-769. The total dissolved solids concentrations in the ground water decrease from the southwest to the northeast (from proximity to the Paradox Valley toward the San Miguel River). Well CM-93-1 contains TDS concentrations of about 3500 mg/l. Well CM-93-2 contains TDS concentrations of about 4800 mg/l. Well CM-93-3 contains TDS concentrations of about 1500 mg/l. This indicates the strong influence of the evaporite deposits in the Paradox Valley. When constituents are detected in wells CM-93-1, CM-93-2, the concentrations are higher than in down gradient well CM-93-3.

Because of the spacial variations in ground water quality, Umetco proposed that the Point of Compliance Well CM-93-3 also be used as the background well. Under this proposal, data from the period 1994 to 1999 would be the background data for comparison with data collected later. The key issue with regard to using data from well CM-93-3 is to assure that the data represent unaffected aquifer conditions. Based upon review of the water quality data in Umetco's Annual Reports from 1993 to 1998, there is no evidence of changes in basic water chemistry or any increasing trends in constituent concentrations. Therefore, the use of the 1994-1999 data from well CM-93-3 as background is acceptable. Well CM-93-3 has been selected as the background well for Club Mesa, as approved by the CDPHE. A statistical analysis of water chemistry, based upon Student's t test, will be conducted on a routine basis to determine compliance under license condition LC 28.6.

## 9.0 SAFETY EVALUATION

### 9.1 Background

Umetco's procedures relating to safety can be found in the UraVan Remedial Action Plan - Health and Safety Manual (Umetco's Health and Safety Manual). The procedures specified in this manual are reviewed, modified to meet Department comments and concerns and then accepted by the CDPHE. They are reviewed by Umetco and the Department on a regular basis. Procedures currently used at the site are protective of health and safety for workers and the environment during reclamation activities.

### 9.2 Facility Organization and Authorized Procedures/Management Structure

The management organization of Umetco is described in Section 3.0 of Umetco's Health and Safety Manual and is updated by Umetco as needed. Current management personnel are known to have experience in the uranium industry and with the disposal of mill tailing materials. The organization and management of Umetco at the UraVan site have been effective during past and present reclamation activities.

The Radiation Safety Officer (RSO) has the majority of the responsibility for radiation safety at the site. His duties include the development of radiation safety procedures and policies, routine site inspections, training of personnel, issuing radiation work permits, ALARA reports, and ensuring that the workers comply with the established procedures. The training and experience of the Radiation Safety Officer have been reviewed and are on file with the CDPHE. In addition to the requirement that the RSO be qualified by training and experience, License Condition 14.4 requires the RSO to attend refresher training every two years.

The RSO supervises a staff of several radiation safety and environmental technicians who are responsible for day-to-day monitoring activities. The RSO reports to the site manager and prepares a monthly report concerning site conditions and activities for the review of the site manager. The RSO has the authority to take appropriate action to protect the health and safety of personnel at the site. Management control over the program includes written procedures for all aspects of operations which are routinely performed at the facility. These procedures are reviewed and approved by the RSO and the CDPHE.

When non routine activities are necessary, a Radiation Work Permit (RWP) is required. License Condition 19.4 requires that these permits be prepared by the RSO or his designee prior to the start of any work or maintenance having radiation safety implications and for which no written procedures exist. The purpose of the permit is to assure there is a review of safety-related issues prior to beginning non routine activities and functions to unite the management through the RSO with the activities at the site.

The current radiation safety staff arrangements and management organization are acceptable. Personnel have adequate training and experience to oversee radiation safety aspects of the current activities and those proposed in this amendment request.

### 9.3 Inspections

Umetco's site inspection program is described in Procedure E-31 of the Umetco's Procedures Manual. Weekly inspection of all active work areas is conducted by the RSO or his designee. Results are filed with the site manager. The RSO reviews the results of the

daily and weekly inspections, along with all monitoring data, on a monthly basis. A monthly ALARA report is prepared for the site manager. An annual ALARA audit is performed by designated members of the site management. Umetco's site inspection procedures have been reviewed by the Department and are acceptable to identify problems quickly and address them effectively.

The CDPHE also conducts a site inspection and records review at Uravan on an annual frequency. The last inspection was conducted in September of 1999. No items of non-compliance were noted in that inspection. In addition to the routine site inspections conducted by the CDPHE, non routine site inspections will be conducted prior to the receipt of any off-site wastes. These inspections are to verify that the facility is in conformance with the statements made in the amendment request and to assure that appropriate license conditions and regulatory requirements are satisfied.

The receipt of off-site waste and release of drivers and equipment will require inspections to be performed by Umetco. The inspections include such items as shipping documents, contamination surveys, exposure rate surveys, and waste characteristics. The new inspections to be conducted are similar to inspections which are currently performed at the site. The CDPHE will conduct additional inspections at the Uravan site and the waste generating sites during the shipments of waste to Uravan.

#### 9.4 Radiation Safety

##### 9.4.1 Radiation Safety Training

Part 10 of the Colorado *Rules and Regulations Pertaining to Radiation Control* (the Regulations) establishes requirements for the instructions which must be provided by the licensee to individuals engaged in activities under a license. All individuals working in or frequenting any portion of a restricted area will be instructed in the radiation health protection problems associated with the restricted area. They will also be instructed in procedures to minimize exposure. The extent of this instruction will be commensurate with potential radiological health protection problems in the restricted area. License Conditions 14 and 19 also address training requirements for the Uravan site.

Training procedures are described in Section 12.0 of the Health and Safety Manual and training is a part of each procedure in the Procedures Manual. New or inexperienced employees are not permitted to begin work until all training requirements are satisfied. The training includes items such as radiation safety, emergency procedures, task related training, and applicable regulations. Each worker also receives one hour of radiation safety refresher training annually. Time is also allocated at safety meetings throughout the year for the employees to discuss their concerns regarding radiation topics.

Umetco's waste acceptance plan prescribes training for waste shipment drivers prior to allowing access to the restricted areas on the site. The drivers will be required to demonstrate that they have satisfied the training requirements of Title 49 of the Code of Federal Regulations. The drivers will also receive site specific training commensurate with their activities on the site.

#### 9.4.2 Personnel Dose Monitoring

Part 4 of the Regulations establishes standards for protection against radiation hazards. Umetco completely revised its system of procedures to meet the changes in the U.S. Nuclear Regulatory Commission regulations and those changes in the State of Colorado Radiation Health regulations. Regulations and Umetco internal policies and procedures limit occupational doses of radiation to those which meet or exceed the requirements of the Nuclear Regulatory Commission. Each individual who enters a controlled area must have their radiation dose monitored if it is likely that he or she could receive, a dose exceeding 10% of the regulatory limits in any year.

In addition to complying with the requirements specified in Part 4, each licensee is required to make every reasonable effort to maintain radiation exposures As Low As is Reasonably Achievable ("ALARA"). In keeping doses "as low as is reasonably achievable" one takes into account the state of technology, the economics of improvements in relation to benefits, and other societal and socioeconomic considerations. Current personnel monitoring shows that the existing site procedures for radiation safety have maintained the exposure to radiation workers below the limits specified in the Regulations. The low exposures typical for site personnel show that the concept of ALARA is being applied.

Umetco's program for monitoring doses to personnel is appropriate to demonstrate compliance with Part 4 of the regulations for protection of health.

##### Penetrating Radiation

Mill workers are currently monitored for exposures to external penetrating radiation by using thermoluminescent dosimeters (TLD). TLD badges are obtained from, and evaluated on a quarterly basis by, vendors accredited by the National Voluntary Laboratory Accreditation Program. The TLD program is acceptable.

##### Airborne Particulate Sampling

Monitoring of airborne particulate exposures to workers is an important aspect of radiological health protection at the Uravan site. The excavation, transportation, and compaction of tailings, contaminated soils and other radioactive residues produce a wide range of worker environments which must be monitored. The program for monitoring airborne radionuclide levels is described in Procedures E-2, E-3, and R-4 of Umetco's current Procedures Manual. Airborne radioactive particulates are routinely monitored by both breathing zone sampling and general air sampling.

Quarterly breathing zone sampling is performed on five categories of workers at the site. Sampling and analyses are done for uranium and the results compared to the Annual Limit on Intake (ALI) for uranium in ore dust. Additional air monitoring of breathing zones is conducted when the potential exists for elevated levels of airborne radioactive materials. General air sampling is done at each project site using high-volume samplers and is conducted on a frequency determined by initial sampling results. Sampling locations are chosen to be representative of those areas with a maximum potential for worker exposure.

Personnel exposures are tracked and documented in accordance with Procedure R-1 of Umetco's current Procedures Manual. Past monitoring has shown airborne exposures to workers to be minimal. The Uravan Procedures have been shown to be effective as shown by past experience, and especially with the revisions of 1994-1998. No changes will be

needed in order to accept off-site waste. The existing procedures are acceptable for assessing airborne radionuclide exposures during remedial activities and the receipt of off-site wastes.

#### Bioassays

Bioassays are conducted to determine actual intake of radioactive materials into the worker's bodies. The bioassay is also an effective means for verification that the health protection procedures and equipment are maintaining exposures ALARA. The existing bioassay program is acceptable.

#### 9.4.3 Contamination and Exposure Control

The control of contamination is essential to maintaining doses to workers ALARA. To prevent the spread of contamination, equipment and personnel released from a restricted area are surveyed and decontaminated if necessary prior to release. Survey procedures have been closely monitored by the CDPHE during reclamation activities at the Uravan site. No significant problems have been observed during CDPHE inspections.

Alpha survey procedures are described in Procedure R-9 and R-10 of Umetco's current Procedures Manual. Surveys for alpha contamination are conducted monthly in those areas designated by the radiation safety officer as lunchroom areas. These are areas within the restricted area where eating is permitted. These areas include the main office lunch room and project trailers. The purpose of the survey is to identify areas which may be contaminated so that sources of exposures to workers can be eliminated or reduced. In the areas where eating is permitted, the principal concern is to prevent the ingestion of alpha emitting radionuclides. The health hazard is greatest due to the qualities of alpha radiation when the radioactive materials are inside the body. Action levels have been established which, if exceeded, require decontamination of the effected areas. Smoking is not permitted in the restricted area, or in any Umetco facility.

Spot surveys are required on workers leaving the site. These surveys are performed on a quarterly basis for at least 10 percent of Uravan employees. The scan covers exterior clothing, hands, face and hair surfaces. If excessive contamination is found, the employee is required to wash before leaving the site. The procedures and equipment are consistent with U.S. Nuclear Regulatory Commission and State of Colorado regulatory policies for contamination control.

Contamination surveys of the numerous waste transport vehicles and drivers will be of primary importance during the transfer of any off-site wastes. Umetco's procedures as described in Procedure R-6 of Umetco's current Procedures Manual will apply. Alpha and gamma surveys of trucks exiting the site will be performed. These surveys will be performed after cleaning of the trucks at a wheel-wash facility. The wheel-wash stations have been used by Umetco for several years in connection with Uravan remedial actions and are proven to be effective at preventing contamination from leaving the site on emptied trucks.

#### 9.4.4 Personal Protective Equipment

Personnel can be effectively protected from radioactive materials by strict adherence to established radiation health and safety procedures. Additional protection is afforded workers by the use of protective equipment such as coveralls, boots, hard-hats, gloves and respirators. Appropriate protective equipment is provided to each employee.

Radioactive materials which emit alpha particles pose their greatest threat to the health of an individual when ingested or inhaled. Personal hygiene and the restriction of eating to designated areas are the principal methods used to eliminate or reduce the ingestion of radioactive materials. Procedures for controlling dust, such as watering the roads, have been established and have been effective. When procedural methods do not provide sufficient personal protection, individuals are issued respirators.

Umetco's respiratory protection program is described in Umetco's Current Respiratory Protection Manual. Management policy is that routine respirator usage will be held to a minimum in favor of workplace controls to minimize airborne contaminants. A full program for monitoring airborne particulate exposures has been established to ensure there is adequate protection of the workers.

The *Umetco Minerals Respiratory Protection Manual* describes all aspects of the program and complies with standards of the American National Standards Institute Z66.2-1980. NIOSH-OSHA-MSHA certified respirators are provided and individually fitted for workers requiring their use. The employees also receive training classes in the proper use of the equipment. Although generally not necessary, respirators are available to employees for added protection. CDPHE has reviewed the respirator program and found it to be acceptable.

The duties of the waste shipment drivers while on-site will be limited to the transportation of the waste to the repository area. Radiation health and safety procedures are designed to provide adequate protection to the drivers. The monitoring program should detect any unforeseen conditions which would require the drivers to use additional personal protective devices and is acceptable.

#### 9.4.5. Restricted Area Access Control

The UraVan site is located away from large population centers, in a remote section of Colorado. The site is on the southwest side of State Highway 141, approximately 14 miles northwest of Naturita, Colorado. Access to the site may be made from the highway across either of two bridges.

The site currently has restricted areas which are fenced to prevent unauthorized access. The fences are well maintained and are posted at regular intervals with signs reading: "Caution - Radioactive Materials." Entrances to the facility have been posted in a conspicuous manner with a sign stating "Any Area or Container on this Property May Contain Radioactive Materials." The posting of warning signs is in accordance with the requirements of the regulations and the UraVan license. Umetco maintains 24-hour security controls on the UraVan site. Site inspections by CDPHE staff have verified that appropriate security measures to control access to restricted areas have been enforced by Umetco personnel.

The license will not require the creation of additional restricted areas to the site. The existing security procedures are adequate for additional materials to be disposed of at the site.

#### 9.4.6 Emergency Procedures

Umetco's emergency response procedures are provided in Section 11.0 of Umetco's Health and Safety Plan and throughout the site procedures. The procedures describe appropriate measures to be taken to prevent and deal with emergencies occurring at the site. The

procedures and precautions are designed to address unusual events which could occur during disposal of off-site wastes. Equipment is available on-site for use in controlling on-site spills of radioactive materials. These include such items as loaders, trucks, shovels, plastic sheeting, drums, barricades, monitoring equipment and personnel.

In its September 1999 *Waste Acceptance Plan, Final Plans and Specifications and Quality Plan*, Umetco provided additional contingency plans specific to the receipt of the off-site wastes. Umetco committed to the construction of a staging area adjacent to the receiving station. The staging area would be constructed in such a way as to mitigate the spread of radioactive materials should a truck arrive that is damaged or leaking.

Umetco's procedures will require the immediate notification of the waste owner and the Colorado Department of Public Health and Environment upon receipt of a waste shipment which is leaking or has been damaged.

#### 9.4.7 Transportation of Radioactive Wastes

Part 17 of the Colorado *Rules and Regulations Pertaining to Radiation Control*; the regulations of the U.S. Department of Transportation (DOT), Title 49 of the Code of Federal Regulations, Parts 171, 172, 173, 177, 178; and the regulations of the Colorado State Patrol, Transporting and Shipping of Hazardous Materials, (8 CCR 1507-9) establish requirements for packaging, preparation for shipment, and highway transport of radioactive material. These regulations apply to persons who transport radioactive material or deliver radioactive material to a carrier for transport.

General requirements applicable to the waste generator and the carrier are specified in 49 CFR 171.2. Specifically, no person may offer or accept a hazardous material for transportation in commerce unless that material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required by the regulations. Specific requirements of Title 49 CFR, and of 8 CCR 1507-9 of the Colorado State Patrol include radiological health and safety criteria such as removable contamination limits, exposure rates to the drivers, and exposure rates to the public from the transport vehicle.

The responsibility for compliance with these regulations during the transportation of the radioactive waste belongs to the transport company and the shipper of the materials. The CDPHE will perform spot check inspections of the waste, prior to shipment to Uravan, to assure that the shipper and carrier comply with applicable regulations. Equipment is available at the Uravan site for use in controlling on-site spills of radioactive materials. Umetco has committed to make these resources available to transportation companies (upon their request) should there be an accident or spill while the waste materials were in transport to the Umetco-Uravan Site. Waste characterizations and acceptance criteria will limit the free liquid content of the waste to 1% or less at the time of shipment. The physical form of the waste (a dry solid) is more manageable (as compared to a liquid) in the event of a spill or transportation accident. The same limits on moisture apply to the waste at time of disposal.

#### 9.5 Environmental Protection

A revised Environmental Report was submitted by Umetco in November of 1997. The analysis presented shows that those impacts that were historically measurable have been reduced during the course of remedial activities. Reductions have been noted in radiation exposure and in the potential

for windborne releases of tailings. No new threatened or endangered species were identified in the area and no new information was obtained that would change the proposed remedial activities. Overall the environmental impact of the facility has been reduced through the implementation of remedial actions.

#### 9.5.1 Airborne Emission Controls

Point-emissions sources no longer exist at the Uravan site. The chief concern for both current and proposed activities is the potential for generating dusts containing radioactive material. An air pollution control permit #88M0020F has been issued to govern particulate releases from remedial activities. Procedures to limit the production of radioactive dust are documented in Procedure E-12 of Umetco's Procedures Manual.

Routine observations for site conditions which could contribute to dust production are made by site staff and supervisors. Road dust is reduced by adherence to a 20 m.p.h. speed limit on site. Dust is also controlled by sprinkling water on roadways regularly on a daily basis, and by applying magnesium chloride to selected areas. Road watering is accomplished by the use of tank trucks equipped with sprinklers. Supervisors determine the proper application rate by visual observations of site conditions. In areas where dumping and reshaping of soils occurs, dust is controlled by vehicle washing, speed limits, and sprinkling. Vehicle washing consists of a wheel-wash which is conducted prior to the truck leaving the area. The wheel-wash helps prevent the spread of contamination by trucks having worked on or dumped wastes on the repository area. Umetco's fugitive dust procedure provides guidance for visual inspection for determination of the need and frequency of dust control measures.

Umetco has considerable experience in controlling dusts. Umetco has developed the procedures during its experience with the disposal of mill tailings. The control of dust from off-site wastes will require the same types of activities as are currently in use at the site. The procedures for controlling dust will be applied to the off-site waste and should be equally effective.

#### 9.5.2 Liquid Effluent Controls

Liquid effluent is not expected to be a problem from activities proposed in the license. The mill no longer exists and thus no longer generates effluent. Liquids that are intercepted from the hillside seepage collection system, ground water withdrawal system and surface runoff control are directed to lined ponds for containment and evaporation. Thus, release of liquid effluents is controlled.

#### 9.6 Environmental Monitoring Program

The Uravan environmental monitoring program is designed to identify and quantify releases of radioactive materials into the environment. Environmental monitoring is described in Umetco's current procedures manual, in its health and safety plan, and in the details of final plans and specifications for individual projects on the site. The program is extensive in scope and has been closely reviewed by the CDPHE.

The monitoring program will continue to enable Umetco and the CDPHE to assess any environmental effects associated with reclamation and disposal activities on the site. Off-site wastes proposed to be received at the site are similar to the waste materials currently disposed of on the site. Therefore, it is not anticipated that the containment areas for any such waste will release effluent in concentrations exceeding current levels.



### 9.6.1 Airborne Particulates

Air particulate sampling is done at sampling stations on and off the mill site. The samples are taken with high-volume air samplers set at six locations at or near the Uravan Facility boundaries. Samples are taken at two locations on Club Mesa, at the Tabeguache No. 2 groundwater monitoring well (the air background site) and at three locations within the San Miguel River Valley. Sampling is done continuously except during maintenance of the samplers. Filters are analyzed for U-nat, Th-230, Ra-226 and Pb-210. Calculations for inhalation doses to the nearest resident have shown negligible doses from past tailings management. The receipt and disposal of additional waste material will not cause a significant change in the exposure to nearby residents.

The airborne monitoring procedures are acceptable to identify any potential releases of dusts as shown by years of experience with their use on the site. Monitoring results have been shown to accurately correlate to events on the site.

### 9.6.2 Radon Gas

Radon progeny sampling is performed at ten sampling locations, using track-etch detectors supplied by a commercial vendor. Sampling is also performed at each active work area as required in the RWP for the project. Radon gas emanation rates are monitored at locations on the Uravan site during special studies, and as required for repository area closure.

The monitoring program is acceptable. Radon emanation from the B-Plant Area Repository will be controlled by an appropriately designed radon barrier which will take into consideration the amount of radiation received in off-site wastes.

### 9.6.3 Groundwater

Groundwater sampling is being performed to determine the existence of any contamination originating from the site. The ground water monitoring and restoration program in the river valley has been in existence since 1987. The Club Mesa area underlying the repositories has been monitored for many years in association with Uravan tailings disposal activities. The Club Mesa monitoring system includes wells are completed at depths ranging from 50 to 860 feet.

Umetco installed additional ground water monitoring wells in 1993 to monitor the Kayenta/Wingate aquifer. CDPHE approved the background and point of compliance well for the Club Mesa Repositories in November of 1999. The ground water technical evaluation report (CDPHE, 2000) reviewed the status of Umetco's ground water monitoring and remedial program at the site and found them to be acceptable. Section 8 of this decision Analysis provides a more detailed discussion of ground water at the site.

### 9.6.4 Surface Water

The San Miguel River is the major surface water in the Uravan area. No discharge to the river occurs from the site repositories. The San Miguel River is sampled at six locations, which are upstream, adjacent to and downstream of the Uravan Site. Samples taken from these locations include water chemistry, algae and macro invertebrates. The monitoring program is acceptable in determining any impact from operations.

### 9.6.5 Soils

The routine soil sampling program consists of sampling near the six ambient air monitoring stations at annual intervals. Numerous non routine soil samples have been taken in

association with RAP activities at the site and provide an adequate characterization of area background and affected area radionuclide concentrations. Deposition sampling has been done in the past to determine any effect of site operations. Sediment sampling has been done in the San Miguel River on a non routine basis and presents further site characterization. The existing program is acceptable to monitor site activities.

#### 9.6.6 Vegetation and Foodstuffs

Vegetation has been sampled near the six air monitoring sites at Uravan. The addition of off-site wastes should not necessitate any vegetation sampling in addition to that required by current license conditions. Sampling of beef cattle, occasionally observed to graze in the area, has been accomplished in the past. No detectable bio-accumulation has been observed.

#### 9.7 Quality Assurance Program

Umetco has expanded their quality assurance program to include measures to address the potential receipt of off-site wastes. Many of the quality assurance mechanisms used in the current activities are applicable to the receipt of off-site wastes, and were further refined in the process of developing the WAP.

A review of the site conditions is conducted daily by site personnel. A weekly review of site operations is conducted by the radiation safety officer. The monthly report prepared by the radiation safety officer is reviewed by the site manager. There is also an annual independent audit and audits by the Umetco corporate management. The personnel monitoring program is effective. Bioassays are used to verify the results of airborne monitoring and health physics procedures.

### 10.0 FINANCIAL ASSURANCE ARRANGEMENTS

In accordance with the requirements of the Regulations, an applicant for a uranium mill license must furnish the State with financial assurance arrangements to ensure decontamination and decommissioning of the facility. This financial assurance is for the protection of the public health and safety and the environment in the event of abandonment, default, or inability of the licensee to meet the requirements of the Colorado *Rules and Regulations Pertaining to Radiation Control* or the license.

The Uravan Consent Decree required Umetco to establish and maintain a full surety by April 1989. License Condition 31 also requires Umetco to maintain a surety in accordance with the Regulations. The CDPHE is required to review the surety provided by Umetco on an annual basis. The current total value of the construction fund is \$21,600,000. The construction fund is to be used for the remaining reclamation activities. An additional \$605,000 is dedicated to the long term care of the facility after termination of the license.

Additional financial assurance will be needed for the management of off-site wastes. Under License Condition 31.5, Umetco is required to maintain compliance with the Financial Assurance Requirements contained in RH 3.9.5 of the Regulations. The CDPHE will continue to review the surety provided by Umetco on an annual basis.

### 11.0 COMPLIANCE WITH COLORADO REGULATIONS PERTAINING TO RADIATION CONTROL

#### 11.1 Part I: General Provisions of the Regulations

The Colorado *Rules and Regulations Pertaining to Radiation Control* ("the Regulations") are adopted pursuant to the provisions of Section 25-1-107(1)(s) and (1)(t), 25-1-108 and 25-11-104, CRS 1982.

Scope. Except as otherwise specifically provided, the Regulations apply to all persons who receive, possess, use, transfer, own, or acquire any source of radiation unless that person is subject to regulation by the U.S. Nuclear Regulatory Commission.

#### General Regulatory Requirements

Each licensee will maintain records showing the receipt, transfer, and disposal of all sources of radiation.

Each licensee will afford the CDPHE reasonable opportunity to inspect sources of radiation, the licensee's facilities wherein such sources of radiation are used or stored, and records maintained pursuant to the Regulations.

Umetco has complied with the general requirements of the Regulations regarding the maintenance of records and has afforded ample opportunity for inspections. Umetco has committed to maintain all appropriate records concerning the receipt and disposal of off-site wastes at the Umetco-Uravan site.

#### 11.2 Part 3: General Requirements for the Issuance of Specific Licenses

This part provides general requirements for the licensing of radioactive material. No person shall receive, possess, use, own, transfer, or acquire radioactive material except as authorized pursuant to Parts 3, 7, 14, 17, or 18 of the Regulations. In addition to the requirements of Parts 3 and 18, Umetco is subject to the requirements of Parts 1, 4, 10, 12 and 17 of the Regulations.

Pursuant to RH 3.9 of the Regulations a license application will be approved if the Department determines that:

- (A) the applicant is qualified by reason of training and experience to use the material for the purpose requested in accordance with the Regulations and in such a manner as to minimize danger to public health and safety or property;
- (B) the applicant's proposed equipment, facilities, and procedures are adequate to minimize danger to public health and safety or property; and
- (C) the issuance of the license will not be inimical to the health and safety of the public.

#### Applicant's Training and Experience

Umetco's current radiation safety officer, management, and technicians, conducting reclamation activities at the Umetco-Uravan site, are adequately trained in health and safety and have sufficient experience in the performance of their duties. Refresher training in health and safety is conducted annually for all site personnel involved in reclamation.

The CDPHE concludes that the applicant is qualified by reason of training and experience to perform final reclamation of the site and to dispose of off-site wastes at the Umetco-Uravan site in accordance with the Regulations and in a manner which minimizes the danger to public health and safety or property.

#### Applicant's Equipment, Facilities and Procedures

Umetco has established acceptable safety and operational procedures for the Uravan site. These procedures have been thoroughly reviewed by the CDPHE during previous licensing actions and site inspections.

The design specifications for the waste repositories meet the requirements established in Part 18 of the Regulations. Site inspections conducted by the CDPHE have verified the adequacy of the reclamation activities in meeting the design specifications. The repositories will provide appropriate protection of the environment and human populations from off-site wastes disposed of at Uravan.

Umetco's equipment, facilities and procedures are adequate and appropriate for reclamation of the Uravan site. The receipt and disposal of off-site wastes are to be conducted using available equipment and facilities. Safety and operational procedures currently used are appropriate. Additional procedures for the receipt of wastes and safeguards for the drivers have been developed by Umetco and approved by CDPHE, prior to the receipt of off-site wastes.

#### The Amendment Will Not Be Inimical to the Public Health and Safety

The CDPHE concludes that Umetco's proposal to undertake final site reclamation and to receive and dispose of off-site wastes is not contrary to the interests of public health and safety. The disposal of wastes from multiple locations within the State of Colorado at a single site is in compliance with the broad objectives for the protection of public health and safety and the environment, as specified in Part 18 of the Regulations. Disposal of this waste at the Uravan Site will not increase the dose to an individual member of the public over the existing levels since the inventory of radionuclides will remain unchanged and the volumes of materials to be added to the site will be less than 10% of the existing inventory on site.

#### 11.3 Part 4: Standards for Protection Against Radiation

The procedures and equipment used by Umetco during site reclamation are adequate to demonstrate compliance with the radiation protection standards specified in Part 4 of the Regulations. Umetco has established an effective program for maintaining the radiation exposures to their workers *As Low As Reasonably Achievable* ("ALARA").

The monitoring program has been extended to the drivers of waste shipments. Radiation protection procedures are adequate and appropriate for the receipt of off-site wastes.

Additional procedures have been developed by Umetco which are specific to the receipt and inspection of off-site wastes, including a waste manifest. These procedures were reviewed and approved by CDPHE prior to the receipt of off-site wastes at Uravan.

#### 11.4 Part 10: NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS

Part 10 establishes requirements for notices, instructions, and reports by licensees or registrants to individuals engaged in activities under a license. It also specifies options available to such individuals in connection with Department compliance inspections.

All individuals working in or frequenting any portion of a restricted area must be kept informed of the storage, transfer, or use of sources of radiation in the restricted area. These individuals shall be instructed in the health protection problems associated with exposure to the radioactive material and in the procedures for health protection.

The requirements of Part 10 regarding the training of personnel will apply to the drivers of the waste shipments. Umetco has committed to include the drivers in their safety training program. The drivers will be trained in the fundamentals of radiation protection, personal hygiene, facility provided protection, emergency procedures, regulations, and health physics measurements. All drivers will be required to demonstrate compliance with the training requirements of 49 CFR (Code of Federal Regulations regarding Transportation). In addition the drivers must have proof of medical examination required by 49 CFR.

11.5 Part 12: Fees for Radioactive Materials Licenses

Umetco has paid all current fees accrued under Radioactive Materials License #660-02.

11.6 Part 14: Land Disposal of Low Level Radioactive Wastes

No Low Level Radioactive Wastes will be received at Umetco site. Therefore, the requirements of Part 14 do not apply to the Umetco license.

11.7 Part 17, Transportation

Umetco meets the requirements for transportation of waste under Part 17.

11.8 Part 18, Appendix A: Uranium Mill Disposal Criteria

Part 18, Appendix A of the Colorado *Rules and Regulations Pertaining to Radiation Control* establishes criteria relating to the operation of uranium mills and the disposition of radioactive tailings or wastes. Flexibility is provided in the criteria to allow achieving an optimum tailings disposal program on a site-specific basis. All site-specific licensing decisions based on the criteria in this Appendix or alternatives proposed by licensees or applicants are required to take into account the risk to the public health and safety and the environment, with due consideration to the economic costs involved, and any other factors the Department of Public Health and Environment determines to be appropriate. In implementing this Appendix, the regulations require CDPHE to consider "practicable" and "reasonably achievable" as equivalent terms, and that decisions involving these terms must take 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.

CRITERION 1:

CRITERION 1A: The broad objective in siting and design decisions is the permanent isolation of radioactive materials so that disturbance and dispersion of these materials by natural forces are minimized and the closed site requires no ongoing maintenance.

The siting of all the repositories, including alternative sites, was thoroughly evaluated during the license renewal process in the early to mid 1980's. The site selected will provide permanent isolation of the materials with minimal disturbance and minimal maintenance. The cover designs have also been evaluated under the license renewal process and Uranium Remedial Action Plan to assure permanent isolation of the waste.

CRITERION 1B: The site selection process must be an optimization to the maximum extent reasonably achievable in terms of the following features:

- (1) Remoteness from populated areas;

- (2) Hydrologic and other natural conditions as they contribute to continued immobilization and isolation of contaminants from groundwater sources;
- (3) Potential for minimizing erosion, disturbance, and dispersion by natural forces over the long-term.

The Uravan repository is located in a site remote from populated areas. The nearest resident is more than 5 miles from the site.

The first aquifer of local significance is the Kayenta/Wingate. Monitoring wells completed in this aquifer located beneath the Tailings Repository have shown no signs of contamination. The tailings piles 1-2 and 3 were designed and constructed without liners and have been in existence since the 1950's. The Burbank Repository has a clay liner. The B-Plant Repository is not lined but has restrictions on the amount of liquid that can be contained in the waste. The Summerville Formation, located beneath the site, acts to retard the vertical movement of any seepage that would leave the tailings repositories and travel down toward the Kayenta/Wingate aquifer. Overall, the locations of the disposal repositories in relation to the Kayenta/Wingate aquifer are conducive to the isolation of contaminants from usable groundwater sources. The interception of seepage from the site also helps to achieve conformance with this criterion.

The potential for erosion and dispersion of contaminated materials is minimized through the cover design employed for the disposal repositories. Wind and water erosion are minimized by the application of a rock cover across the top and side-slopes of the repositories. The location of the B-Plant Area Repository will act to buttress a portion of the existing tailings pile.

CRITERION 1C: In the selection of disposal sites, primary emphasis must be given to isolation of tailings or wastes, a matter having long-term impacts, as opposed to consideration only of short-term convenience or benefits, such as minimization of transportation or land acquisition costs.

The Uravan Site was selected from three alternatives as the primary site for long-term isolation of tailings. The relocation of radioactive wastes from various population centers within Colorado to the Uravan site would also be a significant step in the isolation of these materials from the environment and human populations.

Criterion 1D. Tailings should be disposed of in a manner that no active maintenance is required to preserve conditions of the site.

The Uravan site and cover design have been thoroughly evaluated for long-term containment of the waste under the existing license, under the Uravan Remedial Action Plan and in sections of this decision rationale. The cover and repository configurations are designed in a manner consistent with the Colorado *Rules and Regulations Pertaining to Radiation Control* and regulatory guidance of the U.S. Nuclear Regulatory Commission. These regulations and policies are designed to assure that no active maintenance is required. This site is geologically stable and will be adequate for the long-term containment of radioactive waste.

CRITERION 2: To avoid proliferation of small waste disposal sites and thereby reduce perpetual surveillance obligations.

The proliferation of small waste sites is avoided by combining up to 600,000 cubic yards of 11e.(2) material and non-11e.(2) material with the 12,500,000 dry tons (10 million cubic yards) of tailings and more than one million cubic yards of demolition and soil clean up wastes at UraVan. The disposal of all these materials at one location will reduce reclamation costs and long-term maintenance costs. The co-disposal of these waste reduces reclamation cost while maintaining the ALARA concept for radiation exposure.

CRITERION 3: The "prime option" for disposal of tailings is placement below grade.

The pre-existing condition and nature of the tailings disposal sites on Club Mesa have made below-grade disposal impractical. For the new B-Plant Repository, 11e.(2) materials and non-11e.(2) material will be placed above grade adjacent to the existing tailing repositories. This location and its designed cover and diversion channels are adequate to resist the long-term forces of erosion. The Burbank Repository is located below grade.

CRITERION 4: Design criteria for a repository include minimization of upstream catchment areas, good wind protection and flat covers to minimize erosion constructed of vegetation or durable rock. A rock cover should be designed to withstand the PMP and areas of concentrated runoff need to be rip-rapped. The repository should not be sited near a capable fault and should be designed to withstand the maximum credible earthquake ("MCE").

The location and design of the repositories incorporate runoff control channels to contain the PMP and to reduce the upstream watershed areas. The repository covers maximize wind protection and minimize erosion. The rock selected is a ridge forming sandstone capable of withstanding freeze-thaw and wet-dry conditions. The rock is sound and durable based upon geologic analysis and the conditions present at the site.

The UraVan Site is not located near a capable fault and the repositories have been designed to withstand a peak bedrock acceleration of 0.3g. The MCE for a one thousand-year event would generate a peak acceleration of 0.12g. Stability analyses indicate that the repositories have significant factors of safety for static and pseudostatic conditions. All design analyses indicate that the covers will withstand wind and water erosion for more than one thousand years.

CRITERION 5: Criterion 5 of Colorado's Rules and Regulations pertaining to Radiation Control sets forth ground water protection standards.

Criterion 5A: Surface impoundments shall, unless exempted, have a liner that is designed, constructed and installed to prevent any migration of wastes out of the impoundment. The liner shall be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure and shall be placed upon a foundation capable of providing support, and installed to cover surrounding earth likely to be in contact with the wastes or leachate. A

surface impoundment must be designed, constructed, maintained and operated to prevent overtopping, resulting from operations, overfilling, wind and wave activities, rainfall, run-on, malfunctions, equipment error and human error.

The ponds used to manage byproduct materials, Tailings Piles 1- 2 and 3 were constructed without liners and prior to the establishment of those requirements. The Burbank Repository is a lined facility and meets the Criterion 5 A requirements. The new B-Plant Repository does not have a liner. Under the requirements of the construction specifications and the Waste Acceptance Plan, this repository cannot accept liquid wastes or wastes that contain free liquids. Umetco has demonstrated that the B-Plant Repository is not a surface tailings impoundment, will not accept liquid waste, does not need a liner, and is exempt from the requirements of Criterion 5A.

Criterion 5B: Criterion 5B states that as a secondary groundwater protection standard, hazardous constituents entering the ground water from a licensed site must not exceed the specified concentration limits in the uppermost aquifer beyond the point of compliance (POC) during the compliance period.

The uppermost aquifer under the entire site is the Kayenta\Wingate aquifer. The site can be subdivided into two units, the Club Mesa area and the River Valley area. In the River Valley, cleanup of contaminated ground water is taking place. A point of compliance and ground water protection standards have been established in the River Valley Area under the Uravan RAP. The compliance period for the Kayenta-Wingate aquifer is established under Section A5.4.3.3.1 (4) of the Uravan RAP as a period of three years after the termination of ground water withdrawal system operation.

A Point of Compliance has been established for the Tailings impoundments and Burbank Repository located on top of Club Mesa. Well CM-93-3 is the Point of Compliance well. Well CM-93-3 is also the background well. The nature of the ground water quality under Club Mesa is unique due to the influence of the salt formations that underlie the Paradox Valley, located up gradient from Club Mesa. Well CM-93-3 has been selected as the background well for Club Mesa in order to minimize the influence of the salt formations. A statistical analysis of water chemistry will be conducted on a routine basis to determine compliance. A methodology for determining compliance with ground water protection standards have been established under the Uravan RAP and is consistent with Criterion 5 and 7 (CDPHE 2000). The compliance period for monitoring of the Club Mesa wells is established as one year after the closure of the B-Plant Repository.

Criterion 5C: Criterion 5C contains the Maximum Values for Ground Water Protection including concentration limits for arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, radium, gross alpha, endrin, lindane, methoxychlor, toxaphane, 2,4-D and 2,4,5-TP silvex.

The maximum concentration values for inorganic elements found in Criterion 5C are identical to the values found in Uravan RAP.



Criterion 5D: This criterion requires that if the ground water protection standards are exceeded a corrective action program must be put into operation.

The purpose of the Uravan RAP is to conduct remedial actions for aquifer restoration in order to improve groundwater quality to a beneficial use.

Criterion 5E: In conducting ground water protection programs, licensees shall also consider:

(1) installation of liners and leak detection systems, (2) mill process designs which provide the maximum practicable recycle of solutions and conservation of water, (3) dewatering of tailings by process devices and/or in situ drainage systems and (4) neutralization to promote immobilization of hazardous constituents.

All ponds that handle liquids on the site, including hillside seepage storage ponds and evaporation ponds have liners. The five evaporation ponds located on-site also have leak detection systems. The mill went out of operation in 1984, thus recycling, dewatering and neutralization of active operating systems are not applicable.

Criterion 5F: Where ground water impacts are occurring due to seepage, action must be taken to alleviate conditions that lead to excessive seepage impacts and restore ground water quality. Technical specifications and a quality assurance, testing and inspection program must be established.

Historic seepage impacts from the Club Ranch Ponds are being addressed through ground water extraction and treatment under the *Uravan Consent Decree and Remedial Action Plan*. The cleanup program, as approved by the state, contains specific actions to be taken, specifications for well construction and operation, as well as provisions for quality assurance, testing and inspection. No impacts to ground water have been observed from the tailings impoundments on Club Mesa. Monitoring of the aquifer continues per the requirements of Criteria 5B and 5C.

Criterion 5G: Applicant or operator will supply information concerning 1) the chemical and radioactive characteristics of the waste solutions and 2) the characteristics of the underlying soil and geologic formations particularly as they will control the transport of contaminants and solutions (gradient, hydraulic conductivity, thickness, orientation of strata, chemical attenuation properties of underlying soils.) The location extent quality capacity and current uses of any ground water near the site shall also be included.

The characteristics of the waste solutions have been provided in the various locations including license documents, environmental reports and in the 1986 Remedial Action Plan. Tables 1.1-1 and 5.1.1-1 of the RAP provides data on the chemical makeup of tailings liquids and constituents in the Club Ranch Ponds during the period from 1974 to 1986. The hydrogeologic characteristics of the site are summarized in the 1999 CGS report *A Technical Evaluation, Geologic and Hydrologic Conditions Affecting Water Quality, Uravan Colorado*.

Seepage will be reduced to the maximum extent reasonably achievable. Past releases from the tailings piles have occurred and created a perched zone of contaminated liquids on top of the Summerville Formation. No evidence of contamination exists in the Kayenta/Wingate aquifer. Cessation of active operations and placement of side-slope covers on the tailings piles have reduced the liquid level in the piles which in turn should reduce seepage from the bottom of the piles. Contaminated liquids are also being collected in toe drains and with a hillside seepage collection system. Unlike the materials disposed of originally in the tailings piles, wastes received at the B-Plant Area Repository will contain no more than 1% free liquids.

The UraVan site has been required to meet the ground water standards of the Environmental Protection Agency in *40 CFR Part 192, Subparts D and E*. Monitoring of the aquifer has been on-going since 1988. Umetco has installed additional monitoring wells for the formation adjacent to the B-Plant Area Repository and the Upper Burbank Repository. Umetco is required by license condition to the further monitoring of ground water.

CRITERION 6: An earthen cover shall be placed over tailings or wastes which provides reasonable assurance of control of radiological hazards for 1,000 years to the extent reasonably achievable, and, in any case, for at least 200 years.

The earth and clay cover design for the tailings repositories are at least 10 feet thick, with 2 feet of rock on the top and sides of the earthen cover, and additional rock protection in channels. The covers are designed to reduce radon emanations to less than 2 pCi/sq-m/sec. The Burbank Repository has a 4 foot thick top-cover and an additional three, one foot thick, clay, interim cell covers. A rock cover protects the top. The Burbank Repository is designed to reduce radon emanations to less than 20 pCi/sq-m/sec. The B-Plant Repository has a 7 foot thick cover and is designed to reduce radon emanations to less than 20 pCi/sq-m/sec. The B-Plant Repository is also designed with a rock cover. All design analyses indicate that the covers will provide adequate radiological protection for over 1000 years.

CRITERION 7: The licensee shall establish a detection monitoring program to detect leakage of hazardous constituents and to demonstrate compliance with established protection standards.

A detection monitoring program was established for the Club Mesa Area in 1993, and for the San Miguel River Area in the mid-1980's. Monitoring for hazardous constituents has been ongoing at the site since 1987 for the Club Ranch Ponds Area as required under the UraVan RAP and since 1993 For the Club Mesa compliance wells.

CRITERION 8: Milling operations must be conducted so that all airborne effluent releases are reduced to levels as low as is reasonably achievable ("ALARA").

Point-emissions sources no longer exist at the UraVan site. The chief concern for both current and proposed activities is the potential for generating dusts containing radioactive material.

Umetco has considerable experience in controlling dusts and has developed effective

procedures during the disposal of mill tailings. The control of dusts from off-site wastes will require the same type of activities as are currently in use at the site. These procedures will be applied to the off-site waste and should be equally effective.

CRITERION 9: The ownership of the tailings and the disposal sites must be transferred to the United States or the State in which such land is located prior to termination of the license.

Current license condition (LC) 13.4 requires that Umetco make the tailings confinement areas of the property readily transferable to either the State or Federal government. Umetco's license will not be terminated until the final disposition of the Umetco-Uravan site is complete. The U.S. Department of Energy will take custody of the site's repositories on license termination. Outlying areas of the site will be transferred to the U.S. Bureau of Land Management and to local government.

CRITERION 10: Establishes concentration limits for non-radioactive hazardous constituents.

Table 5.4.3.2-2 of the Uravan RAP establishes the concentration limits for the radioactive and non-radioactive, hazardous constituents from the Criterion 10 table that have been detected at the Uravan site. Constituents in Table 5.4.3.2-2 are those that have been detected based upon over 10 years of monitoring, or could reasonably be expected to be in the waste.

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