Appendix G:
United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

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Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Holonich:

Enclosed is the revised Draft Biological Opinion for the proposed reclamation of the Atlas mill Tailings site in Moab, Utah.

Comments on this draft should be provided to:

Reed Harris, Supervisor
Salt Lake City Ecological Services
Lincoln Plaza, Suite 404
145 East, 1300 South
Salt Lake City, Utah 84115

Please provide a copy of any comments to the address above.

Sincerely,

[Signature]
Regional Director

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opposition to those conclusions drawn by the Nuclear Regulatory Commission and Atlas Corporation.

As discussed under the heading “Scope of the Biological Opinion” earlier in this document, a revised Groundwater Corrective Action Plan has not been proposed by the Nuclear Regulatory Commission. Therefore, the following discussion concerning the long-term contaminant leaching from the pile evaluates the effects of the proposed capping only and does not assume that any further Groundwater Corrective Action will occur.

**Leaching of Tailings Pile Constituents into the Colorado River**

The action as proposed by the Nuclear Regulatory Commission includes the capping of the tailings pile and relocation of Moab Wash. While the Nuclear Regulatory Commission and Utah Department of Environmental Quality have identified that they will require Atlas to cleanup contaminated ground and surface water to applicable standards, plans to achieve this cleanup are not in place. Therefore, the Service cannot evaluate their effectiveness.

Furthermore, the Service cannot simply depend of these two agencies to remove the threats to the species independently. For example, the Nuclear Regulatory Commission currently does not regulate or track ammonia concentrations in the river. Therefore, when the Nuclear Regulatory Commission requires Atlas to comply with water quality standards, this does not include ammonia, the major constituent impacting endangered fish.

Utah Department of Environmental Quality does regulate ammonia concentrations in surface water. However, the Service has been informed by both the Nuclear Regulatory Commission and Utah Department of Environmental Quality that alternate concentration limits may be applied to the Atlas site, meaning that the ammonia standard applied to the site could be relaxed and ammonia concentrations allowed in surface water at levels above the current standard, levels that may be high enough to harm endangered fish. To further complicate the issue, the Nuclear Regulatory Commission has identified that Atlas’ ability to use alternate concentration limits, is dependent on the final disposition of the tailings. The Nuclear Regulatory Commission has stated that if the tailings pile is capped in place, the groundwater standards that are applied to the site may be different than those applied to the site if the pile is moved and the site is available for other uses. Groundwater cleanup must be held to a higher standard if the pile is removed because then the site would be available for human use.
The high concentrations of ammonia in the river are of significant concern to
the Service and are the basis for this jeopardy opinion. The fact that no
specific plan is proposed to address this concern, and that it is uncertain at
this time what levels of ammonia the water will be cleaned up to, make it
difficult to believe that the high concentrations of ammonia will be cleaned
up for decades as part of a future Groundwater Corrective Action Plan.

The Nuclear Regulatory Commission has identified in their supplemental
biological assessment that contaminants from the Atlas tailings pile are
seeping out of the pile and that these contaminants are degrading the quality
of the groundwater that discharges into the Colorado River. This is
repeatedly demonstrated by the concentrations of contaminants in the river, as
identified earlier in the Environmental Baseline section of this document.
The Nuclear Regulatory Commission has further identified that there is
considerable uncertainty regarding the seepage rate, ground water flow rates,
and contaminant concentrations dissolved in seepage and ground water. Given
these uncertainties, the degree of impacts to endangered species and critical
habitat from past, current, and future operations at the Atlas mill are also
uncertain. This major uncertainty and disagreement as to future potential
impacts to endangered fish with the proposed action was the basis for
initiating a series of studies, conducted by Oak Ridge National Laboratories,
Grand Junction, Colorado. These studies were initiated after the Service
issued its Draft Biological Opinion, dated June, 1997, and are discussed
below.

Oak Ridge National Laboratory/Grand Junction (ORNL/GJ) Studies. The Nuclear
Regulatory Commission identified in their biological assessment that the
impacts of implementing the proposed reclamation plan on aquatic biota in the
Colorado River would be a gradual reduction of diluted tailings leachate over
time because dewatering operations at the pile will have reduced saturation
and hydraulic head, and the cover would retard the movement of water through
the tailings pile even further. However, leaching of contaminants would
continue for an undetermined amount of time. Further, the Nuclear Regulatory
Commission maintained that the impacts to endangered fish from the proposed
action were minimal and would not result in jeopardy to the endangered fish.
The Service disagreed with this determination when it issued the Draft
Biological Opinion of the proposal to cap the pile in place.

To resolve conflicting opinions and accurately assess the degree of impacts to
endangered fish, the Council on Environmental Quality facilitated studies in
November and December, 1997, to be conducted by the Oak Ridge National
Laboratory/Grand Junction. Atlas Corporation and the Nuclear Regulatory
Commission agreed to postpone finalizing the Service’s biological opinion
until after these studies were completed. The objectives of the studies were to refine information regarding the extent of groundwater contamination leaching from the Atlas mill tailings pile currently and in the future with the proposed action. This would allow a more accurate assessment of potential future impacts to endangered species from the proposed action. Five tasks were agreed to at a meeting between the Nuclear Regulatory Commission, Atlas Corporation, Harding Lawson Associates, and the Service. Several of these tasks were modified during the study period. The results of these studies relating to future impacts to the endangered species are summarized below (ORNL/GJ 1998a; ORNL/GJ 1998b).

Task A. Install two boreholes through the pile to determine the connection between the tailings and the underlying water table. The purpose of the task was to confirm or deny the presence of tailings slimes within the alluvial deposits under the tailings pile. The Service's concern was that if the tailings were left in place there would be a continual rewetting of the tailings pile, drawing contaminated leachate into the Colorado River indefinitely. The study concluded that, except for the possibility of very high river levels, the tailings are not within the alluvial aquifer. Therefore, continual rewetting of the pile would not occur as a result of the proposed action. However, it has been concluded that spring runoff exceeding 45,000 cfs in the river will inundate the base of the tailings pile. For example, the 1993 runoff of 49,000 cfs left the tailings standing in 7 feet of river water. According to the U.S. Geological Survey, which has a measuring gage nearby at Cisco, this level of flood has occurred in 26 different years since record keeping began in 1916 (Heddon, 1998). While the pile continues to drain, the strong head forcing pore water out of the pile would preclude much seepage of river water into the pile. However, once the pile has drained, these high river flows may seep into the pile, pick up contaminants and leach them out to the river in perpetuity.

Tasks B and C. Delineate the lateral extent of groundwater contamination emanating from the tailings pile and evaluate groundwater quality where it discharges to the Colorado River. Using the available data, a calculation of the flux of selected contaminants (ammonia, uranium, sulfate and molybdenum) from the groundwater to the river was prepared. The purpose of these tasks was to delineate the extent of the contaminant plume to determine the length of river affected by leaching from the pile and to estimate total contaminant discharge rates into the river now and with the proposed action. A total of 21 piezometers and 4 observation wells, for hydraulic testing purposes, were installed between the tailings pile and the Colorado River, both upstream and downstream of the pile. The results are extensive but several of the significant results include:
(1) The distribution of uranium and nitrate suggests the presence of a second source of contamination, other than the tailings pile. The location suggests the source could be a former "catch pit", a site that reportedly received effluent from the mill operations. This is the first reported evidence of a second source of contamination to the groundwater. The proposed action does not address this source of contamination. Therefore, the Service must conclude that it will not be cleaned up as part of the proposed action and will continue to leach highly concentrated uranium into the Colorado River for an undetermined length of time. The effects to the endangered fish from this are discussed below. Furthermore, the costs of cleaning up this additional source of contamination have not been calculated or included in cost estimates of capping the pile in place.

(2) The groundwater contamination plume extends beyond the Atlas property to the south and is over 5,000 feet wide and 40 feet deep discharging directly into the Colorado River. The plume for some contaminants (ammonia, uranium, molybdenum and nitrates) is mature and these constituents have been discharging to the river for many years. For less mobile contaminants like selenium, the plumes are just now beginning to reach the Colorado River. The extent of, and effects of, contamination from these less mobile constituents has not been analyzed. Because the proposed action of capping the tailings pile in place would allow contaminated leachate to indefinitely discharge into the Colorado River over 5,000 feet of riverbank, the future effects that potentially higher concentrations of these constituents may have on endangered fish needs to be considered.

(3) Concentrations of contaminants in the groundwater are exceptionally high. For example, uranium concentrations exceed 26 mg/l, whereas groundwater uranium levels at the Department of Energy Title I sites (Grand Junction and Rifle, Colorado), sites that have been moved away from rivers, were less than 1-2 mg/l. Atlas sulfate concentrations exceed 19,000 mg/l, while levels at Title I sites generally reached a maximum of 2-3,000mg/l, with only small areas approaching Atlas concentrations (Heddon 1998).

(4) Current recharge through the tailings pile resulting from precipitation and subsequent infiltration is estimated to be 3.7 gpm for the entire pile, under the current no cap condition as well as under the proposed cap. Given the above rate of recharge and the estimated total recharge of uranium, residual drainage from water in the pile is estimated at 3.0 gpm. However, current drainage from the pile is
estimated to be between 6.7 and 20 gpm. Based on the estimated tailings volume of $7.5 \times 10^6$ cubic yards (NRC 1997), a tailings porosity of 0.66 (Klute and Heerman 1978), and a residual moisture content of 0.57 (Klute and Heerman 1978) (percent of pore volume that will not drain under gravitational or capillary influences), there are approximately 426 million gallons of water under saturated conditions that are available for drainage from the pile. While the Oak Ridge National Laboratory/Grand Junction study (1998a) acknowledges that the pile may not be fully saturated, considering that the water from the pumping operation (the current Groundwater Corrective Action) has been discharged to the top of the pile and that there is currently a large lake on top of the pile from recent rains, the Oak Ridge National Laboratory/Grand Junction studies identified that it appears likely the moisture content of the pile is high. Using the volume of drainable water divided by the drainage rate of 3.0 gpm in a linear calculation, 270 years would be required to drain the pile. Furthermore, because the 3.0 gpm drainage rate represents a maximum, this 270 year time estimate is a minimum value. Under actual conditions, the drainage rate would decrease exponentially, yielding a significantly higher time estimate for the drainage of the pile (ORNL/GJ, 1998a). Since the proposed cap will not reduce infiltration rates, it will have no effect on the rate of leaching from the pile and, therefore, will not eliminate the adverse impacts to the endangered Colorado squawfish and razorback sucker resulting from the leaching of contaminated tailings water. These adverse impacts will continue for decades.

Task D. Install a new reference well. The purpose of this task was to address concerns about the adequacy of wells being used to assess background conditions at the pile as well as concerns that contamination might have migrated to National Park Service property north of the pile. The task concluded that the reference well is sampling background and that the contamination has not migrated to the National Park Service property.

Task E. Model seepage from the tailings pile. The purpose of this task was to be able to predict future contaminant transport, desaturation of the tailings pile, transient predictions of contaminant mass flux from the tailings pile to the groundwater, and the subsequent discharge of contaminants from the groundwater system to the Colorado River. This would enable the Service to more adequately assess future impacts of the proposed action on endangered species. The original scope of this task included conducting a full scale numerical simulation of seepage from the tailings pile. However, the Nuclear Regulatory Commission limited the scope of work to a steady state calculation of water movement through the tailings pile as a function of
recharge by precipitation. Task E was summarized and reported in a separate
document (ORNL 1998b) because it was tasked and funded by the Nuclear
Regulatory Commission. The limited study concluded that the saturated
hydraulic conductivity of the proposed cap would yield a discharge rate from
the pile of 3.7 gallons per minute.

The results of these initial studies, in particular the changes in Task E,
prompted the Service to request additional modeling that would allow a more
complete evaluation of future impacts to endangered fish with the proposed
action. The Oak Ridge National Laboratory/Grand Junction was tasked by the
Service, with concurrence from the Nuclear Regulatory Commission, to model
transient simulations of pile drainage, transient simulations of the
contaminant concentrations discharging from the pile, and impacts of tailings
removal on contaminant flux discharging to the alluvial aquifer and the
Colorado River. The Nuclear Regulatory Commission further tasked the Oak
Ridge National Laboratory/Grand Junction to complete a sensitivity analysis of
the hydrologic parameters used in the model, assess impacts of retardation on
contaminant migration in the alluvial groundwater, assess transient affects of
river stage fluctuation, conduct a review of historical water level and water
quality data and the subsequent impact on seepage rates from the tailings
pile, and evaluate impacts of construction activities during tailings pile
removal on contaminant discharge to the groundwater. The time frame agreed
upon for the Service to issue a revised draft biological opinion required that
these tasks be completed in a very short time frame, approximately 2 weeks.
therefore, the Oak Ridge National Laboratory/Grand Junction addressed several
of the tasks only in limited detail. However, some significant information
pertaining to the future probable impacts to endangered fish were reported by
the Oak Ridge National Laboratory/Grand Junction (1998c) and they are
summarized below.

In the supplemental modeling effort conducted by the Oak Ridge National
Laboratory/Grand Junction (1998c), a rapid decline analysis in the pile
drainage rate was modeled. This report identified that the bulk of the
tailings pore water would drain after 100 years with 238 years required to
reach steady state conditions. It is obvious from this information that the
proposed action of capping the pile in place will not eliminate the adverse
impacts to the endangered Colorado squawfish and razorback sucker resulting
from the leaching of contaminated tailings pore water. While no one has
calculated or estimated how long it will take for concentrations of the
contaminants of concern to reduce to the point they will no longer adversely
affect the endangered fish, the above information identifies that the adverse
impacts will continue for decades. Currently, we are into the 41st year of
the simulations. Therefore, it will be another 59 years before the bulk of
the tailings water is drained. During that time, the tailings water will continue to leach elevated amounts of contaminated water into the groundwater and Colorado River, adversely impacting the endangered fish.

In addressing the transient simulations of contaminant concentrations discharging from the pile, the Oak Ridge National Laboratory/Grand Junction report identified that a mature contaminant plume from the pile had reached the Colorado River several years ago. However, it also identified that the contaminant concentrations at the river would continue to increase for 9 more years. Furthermore, contrary to information supplied by the Nuclear Regulatory Commission and Atlas Corporation, the trend analysis conducted identified that there is no strong evidence that contaminant levels in the groundwater are decreasing due to a decrease in the contaminant concentrations in the tailings pile or because of reduced discharge rates. Therefore, the impacts to endangered fish are not and will not decrease with the proposed action for approximately 9 more years.

Due to time constraints, the sensitivity analysis was not conducted. Furthermore, no specific studies were performed to address retardation of contaminants, although retardation of uranium and molybdenum in the alluvial aquifer is not believed to be significant (ORNL/GJ 1998c). While a full analysis was not conducted on how contaminant flux rates from the alluvial groundwater to the Colorado River are affected by river stage rises during spring runoff, the flux rates supplied in the earlier Oak Ridge National Laboratory/Grand Junction (1998a) report were determined to be a reasonable estimate of a yearly average.

In a review of historical water level data from the Atlas wells, the Oak Ridge National Laboratory/Grand Junction (1998c) report revealed several things. Fluctuations in monitoring well water levels corresponded to river stage fluctuations indicating that there is hydraulic connection between the river and the alluvial aquifer down gradient of the tailings pile. A comparison of water elevation in the pond at the top of the tailings pile to the river stage from 1989 to 1994 indicated no hydraulic connection. Furthermore, the report identified that there is a larger average decline in water levels for the 17 months prior to the initiation of the dewatering program than for the 42 months after pumping began, indicating that the pumping is having little or no effect on the dewatering of the tailings pile. Lastly, the discharge rate from the pile using several different porosity values was estimated to be somewhere between 2.5 and 20 gpm.
The results of the impact analyses of moving the pile and the source removal simulations are reported later in this document under the “Effects of Moving the Tailings Pile” section.

Both Atlas and the Nuclear Regulatory Commission supplied numerous comments on the results presented in the three separate Oak Ridge National Laboratory/Grand Junction reports. The comments mainly dealt with the limited analyses and assumptions used in drawing the conclusions. However, both parties, in cooperation with the Service were aware in the development of these studies that the scopes would be limited by both time and funds. The complexities, unknowns, and sensitivity of the environmental influences controlling the leach rate and contaminant concentrations in the leachate from the pile make definitive conclusions regarding the future impacts of leachates from the pile nearly impossible. The Service, therefore, in its mandate to use the best scientific information available, deems it appropriate to use the information provided in the Oak Ridge National Laboratory/Grand Junction reports in its evaluation of the effects of the action on endangered fish. Given these conclusions, the Service has determined that the proposed action of capping the pile in place, with the cap proposed, will not limit rainwater infiltration into the tailings pile. Furthermore, it will not minimize, reduce or eliminate the amount or shorten the length of time that contaminated leachate from the tailings pile will continue to leach into the Colorado River, harming endangered fish. While Harding-Lawson Associates and Atlas, in their comments on the Oak Ridge National Laboratory/Grand Junction (1998c) report, disagree regarding the amount of rainwater that will infiltrate with the proposed cap, neither they nor the Nuclear Regulatory Commission have disputed the fact that leaching will continue with the proposed action. The point of contention is the amount of time required before the leaching drops to a level that will not harm endangered fish.

Harmful Effects of the Leachate. The Nuclear Regulatory Commission repeatedly minimizes the impacts of the tailings leachates by citing that endangered fish are able to successfully avoid areas of potential toxicity. First, fish may not know or be able to avoid a toxic area. Larval endangered Colorado squawfish, that drift passively with the current until they reach a quiet backwater at or downstream of the Atlas tailings pile, would not be able to avoid a toxic area. Second, avoidance behavior is considered an adverse impact to fish by the Fish and Wildlife Service. pursuant to the Endangered Species Act. The Act defines “take” of a species to include harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding.
feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include but are not limited to, breeding, feeding, or sheltering. Thus, take of listed species includes behavioral abnormalities such as avoidance. Therefore, if endangered fish in the Colorado River are avoiding contaminated reaches due to leaching of Atlas contaminants, that constitutes a take of endangered species.

Certain constituents of the tailings leachate are known to be toxic to aquatic life. The following constituents from the Atlas tailings pile have been found to exceed the Utah State surface water quality standard in the Colorado River. It can be assumed, therefore, that impacts to endangered species have occurred in the past, presently occur, and because leaching of contaminants would continue for at least 238 to 270 years with the proposed action, impacts to endangered species would continue into the future. The trace elements and radionuclides that were found to increase in sediment and fish tissue downstream of the Atlas mill tailings pile also are included in the list of contaminants of concern. Contaminants of concern include the following: aluminum, ammonia, arsenic, boron, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, molybdenum, nickel, selenium, strontium, vanadium, gross alpha, gross beta, thorium 228, thorium 230, thorium 232, uranium 234, uranium 235, uranium 238, total uranium, and total dissolved solids (salinity control standard). While the literature does not identify adverse impacts to aquatic life for some of these individual contaminants, the Service is concerned about the probable additive or synergistic effects of the cumulative contaminant plume.

Synergistic Effects of Chemical Toxins. The effects analyses provided by the Nuclear Regulatory Commission and Atlas fail to address the synergistic effects of toxicants leaching into the Colorado River. Hamilton and Buhl (1997) performed acute toxicity tests for larval Colorado squawfish and razorback sucker in reconstituted water simulating the San Juan River near Shiprock, New Mexico, to determine biological effect concentrations. Tests conducted with arsenate, copper, selenate, selenite, zinc, and numerous mixtures of inorganics simulating environmental mixtures, identified that the major toxic component in the mixtures was copper. Hamilton and Buhl (1997) stated that the high hazard ratios suggest inorganic contaminants could adversely affect larval Colorado squawfish and razorback suckers at sites receiving elevated inorganics such as from nonpoint discharges. Although concentrations of inorganics in the mixtures tested by Hamilton and Buhl (1997) may not be sufficiently elevated to pose a hazard, they were found to contribute to the toxicity of the inorganic mixtures. Hamilton and Buhl (1997) further state that National Water Quality Criteria for individual
inorganics would be protective, but not of the toxicity of four mixtures of these inorganics based on the margins of uncertainty. The high numbers and concentrations of inorganic chemicals leaching into the Colorado River at and below the Atlas site, identify this site as a nonpoint source discharge, similar to that described by Hamilton and Buhl (1997). Therefore, it is reasonable to assume that synergistic effects may be harming Colorado squawfish and razorback sucker at and below the Atlas site.

Ammonia. Intensive ammonia sampling identified dramatic increases in ammonia (as N) in the Colorado River adjacent to and downstream of the Atlas tailings pile. The Utah Department of Environmental Quality reported concentrations of ammonia as high as 15.8 mg/l adjacent to the Atlas mill tailings pile. Concentrations remained above the State standard as far as 1.5 mile below the tailings pile on the Atlas bank of the Colorado River. These concentrations were greatest adjacent to the Atlas tailings pile and gradually decreased downstream.

The toxic effects of ammonia to aquatic species are well documented. Thurston et al. (1983) documented that acute toxicity, as the 96-hour median lethal concentration (LC50), occurred in fathead minnow (Pimephales promelas) at ammonia concentrations ranging from 0.75 to 3.4 mg/l un-ionized ammonia (34-108 mg/l total ammonia nitrogen). DeGraeve et al. (1980) reported a 96-hour LC50 of 1.59 mg/l un-ionized ammonia for fathead minnow. Ammonia toxicity has been reported for numerous other nonsalmonid fishes. LC50's ranged from 0.14 to 4.2 mg/l un-ionized ammonia for these fishes (Thurston et al. 1983).


The U.S. Environmental Protection Agency has recommended a criterion for unionized ammonia concentrations of 0.02 mg/l as the "safe" limit for aquatic life (USEPA 1979). The Harding-Lawson Associates (1998) data shows concentrations of unionized ammonia in the Colorado River at the Atlas site well in excess of this criterion.
Furthermore, at high pH values and very low levels of the free carbon dioxide, the levels of unionized ammonia found to be toxic may be about five times greater than those applicable to waters with lower pH values (USEPA 1979). The National Park Service has identified that pH values in the Colorado River have increased over the past 50 years and are considered high at the Atlas location (Roy Irwin, National Park Service, pers. comm.). At the Atlas site pH values have been reported to increase (HLA 1998), possibly due to the high sulfate concentrations leaching into the river. Therefore, the ammonia leaching into the river at the Atlas site is considerably more toxic to aquatic wildlife (42 percent for the Harding-Lawson Associates 1998 reported data) than the same concentrations of ammonia at other sites with lower pH values.

The U.S. Geological Survey, Environmental Contaminants Research Center, located in Columbia, Missouri, has conducted ammonia toxicity tests with the endangered Colorado squawfish and razorback sucker and has reported the results of these tests to the Service in a letter dated January 23, 1998 (USGS 1998). They found that based on mean LC50s (the concentration at which 50 percent lethality occurs), fathead minnows, razorback sucker and Colorado squawfish appear to be similar in sensitivity to ammonia toxicity. However, individual ammonia trials for a particular species exhibited a large degree of variability. They further determined IC25s (25 percent inhibition concentration) for each of the species but found that there was little difference between the LC50s and IC25s, probably due to the fact that both estimates were calculated after seven (7) days of exposure and survival is the primary endpoint affecting the IC25 calculation. The U.S. Geological Survey data is summarized in Table 13 below.

Table 13. Individual trials of ammonia toxicity. Ammonia stock solutions were measured and total N concentrations (mg/l) are corrected for the measured stock concentration. Data noted with an * have not been corrected and are nominal concentrations. Unionized ammonia concentrations were calculated using the equations provided by Thurston et al. (1977). Unionized ammonia concentrations were estimated by calculation using the total ammonia IC25 or LC50 concentrations, the test temperature (25°C) and test pH. The pH used for estimation was the mean of all pHs recorded during a particular test.

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NC<sup>1</sup> = not calculated.

The U.S. Geological Survey letter identifies that based on the ammonia levels reported by the State of Utah (letter dated 6/20/97 to the Nuclear Regulatory Commission from Loren Morton), in comparison with the U.S. Geological Survey data, the ammonia levels in the Colorado River at and below the Atlas site would be toxic to Colorado squawfish and razorback sucker. It should be noted that this statement is based on LC50s and IC25s. The concentrations that would harm endangered fish would be lower than these values because the “harm” standard is more stringent than an IC 25 or LC50. Harm would apply if only one individual of a species were affected by any of the activities defined by harm under the Act.

The ammonia concentrations leaching into the Colorado River from the Atlas tailings pile are well above these chronic and acute effect levels, as far as 1.5 mile downstream. In examining the Interagency Standardized Monitoring Data for the Colorado River Fishes Recovery Program, young-of-year fish collected in the Colorado River at and below the Atlas tailings site were observed to be smaller than young-of-year fish collected in the Green River (pers. comm., Dr. John Carter, Willow Creek Ecology, Inc., 1997). While this information has not been statistically verified, and there are many possible reasons for these size differences observed, the possibility that it could be related to chronic exposure to ammonia leaching from the Atlas tailings pile cannot be dismissed. The Colorado River below the Atlas tailings pile is a known nursery site for Colorado squawfish. Slower growth rate in Colorado squawfish exposes them to a larger predator base for a longer time frame, making them more vulnerable to predation. Poor recruitment to the adult population has been identified as a limiting factor in Colorado squawfish recovery. Further adverse impacts to Colorado squawfish and razorback sucker from both chronic and acute exposure may be occurring in the form of reduced
gamete production, avoidance behavior, gill and kidney malfunction, body deformities and malformations, as well as lethality. Therefore, the possible impacts from this ammonia exposure could be significantly affecting Colorado squawfish and razorback sucker populations.

Ammonia as an Indicator for Contaminant Distribution. The Division of Water Quality conducted intensive ammonia sampling of the Colorado River in 1996. Although other contaminants could have been and need to be selected for intensive study, it was the Department of Environmental Quality's intent to use ammonia as an indicator parameter with the hope that it may disclose important information about local water quality conditions and contaminant distribution. The high ammonia concentrations found through intensive study indicate that additional analyses needs to be conducted for other known tailings constituents and that the extent of the toxicity of the tailings leachates also needs to be further characterized.

Total Dissolved Solids. Salinity alone can be toxic to many aquatic species. Total dissolved solids (salinity) in excess of 15,000 mg/l is considered unsuitable for freshwater fishes (USEPA 1986, Rawson and Moore 1944). However, the toxicity of salinity is dependent upon the ionic composition which produces the salinity (Dwyer 1994). While the actual ionic compositions which are toxic to fish are unknown, Pimental and Bulkley (1983) reported salinity concentration which were avoided by several endangered fish. Pimental and Bulkley (1983) found total dissolved solids above 4,400, 5,100, and 6,600 mg/l were avoided by juvenile Colorado squawfish, humpback chub, and bonytail chub, respectively. Pimental and Bulkley further stated that eggs and larval fish may be more sensitive to elevated total dissolved solids concentrations. Because the total dissolved solids at and below the tailings pile are from groundwater sources, salinity is probably diluted by less saline surface and ground water. However, complete mixing probably does not occur because at conductivities greater than 10,000 uS/cm water density becomes significantly greater than 1.0 g/cm³ and water of this density will seek the bottom of the water body (Hem 1970, Kunkle and Wilson 1984 in memorandum dated August 4, 1995 for the Recovery Program for Endangered Fishes of the Upper Colorado).

As can be seen in Table 9, total dissolved solids increase in the Colorado River below the tailings pile. Relative to river data collected, the average total dissolved solids content of the Atlas Seep continues to be high at 8,050 mg/l, where it is 14 times higher than upstream total dissolved solids concentrations. Furthermore, surface water concentrations of total dissolved solids increase to 1.6 times greater below the tailings pile. The Utah Department of Environmental Quality has informed the Nuclear Regulatory
Commission (letter dated April 26, 1996) that the high total dissolved solids found at the Atlas seep do not comply with the Colorado River Salinity Standards found in the Utah Standards of Quality for Waters of the State (UAC R37-2.4). These salinity standards have been adopted by Utah in cooperation with the other Colorado River Basin States, and the U.S. Environmental Protection Agency (Colorado River Basin Salinity Control Forum Policy, approved October 20, 1982). Said standards apply to industrial point source discharges of pollutants to the Colorado River. Under these standards, dischargers have a responsibility to comply with a "no-discharge" performance goal, to the extent practical, for salts and total dissolved solids.

In the case of existing industrial facilities, such as the Atlas tailings pile, the salinity standard allows a minimal discharge of salts when the facility can successfully demonstrate "...that it is not practical to prevent the discharge of all salt from an existing facility." Such a minimal discharge rate is then required to undergo technical justification, part of which includes a cost analysis for salt minimalization. However, such a technical justification and the "no-discharge" requirement may be waived on a case-by-case basis where the total salt or total dissolved solids load to the river is less than one ton (2,000 lbs) per day or 350 tons per year, whichever is less. To date, this requirement has not been waived for Atlas Corporations Moab site.

The Department of Environmental Quality letter of April 26, 1996, states that recent Department of Environmentalt Quality ground water quality information and available Atlas hydrogeological data suggests that the Atlas facility has discharged salts (total dissolved solids) to the Colorado River in excess of 2,000 lb/day. The Department of Environmental Quality further stated that the daily discharge could be as high as 15,523 lb/day and that it was the State's conclusion that the Atlas tailings pile should be required to meet the Colorado River Salinity Standards.

Given the above information and the known high levels of total dissolved solids at the Atlas site, the Service has concluded that adverse impacts, in the form of avoidance behavior, loss of habitat, as well as osmoregulatory problems, are and will continue to affect endangered fish from high total dissolved solids leaching from the Atlas tailings pile.

Gross Alpha. Gross alpha radiation is often used as a screening tool for radioactivity and includes all alpha emitters such as uranium 234, uranium 235, uranium 238, radium 226 and thorium 230. Each of these has been identified as present in the Atlas tailings water. A gross alpha standard of 15 pCi/l in surface water has been adopted by the State of Utah to protect
aquatic wildlife. Gross alpha levels in the Colorado River, while high above the Atlas tailings pile, increase by a magnitude of three (3) adjacent to the tailings pile, exceeding the standard. Average concentrations at the Atlas seep for five sampling events over a 7 month period were 444 pCi/l, but were reported as high as 900 pCi/l.

The toxicological effects of high gross alpha concentrations may occur both radiologically and chemically. High acute doses of ionizing radiation produce adverse biological affects at every organizational level: molecule, cell, tissue-organ, whole animal, population, community and ecosystem (Eisler 1994). Chronic effects of ionizing radiation include cell death, decreased life expectancy, increased frequency of malignant tumors, increased frequency of gene mutations, altered blood-brain barrier function, and reduced growth and altered behavior (Eisler 1994). It is generally acknowledged that among aquatic organisms older organisms are more resistant than the young to the affects of ionizing radiation. Eisler (1994) reported that developing eggs and young of some species of freshwater fishes are among the most sensitive tested aquatic organisms. Therefore, the larval and young-of-year endangered fish exposed to high gross alpha levels at and below the Atlas tailings pile may be adversely affected by the contaminated leachate in the river. Likewise, given that the leaching will continue after capping the tailings pile, high gross alpha concentrations may continue to adversely affect the endangered fish of the Colorado River.

Permanent Loss of Floodplain Habitat
The Nuclear Regulatory Commission has stated that 2 ha (5 acres) of the 100-year floodplain of the Colorado River would be lost as a result of leveling of the tailings pile slopes, and that additionally, a small floodplain area would be modified as a result of the relocation of Moab Wash. According to the Flood Hazard Boundary Map for Grand County, Utah (FEMA 1981), the lowest reaches of Moab Wash, several hundred meters, and possibly a small portion of the eastern base of the tailings pile are located on the 100-year floodplain of the Colorado River. However, currently, a long berm extends the length of the tailings pile, protecting the pile from high river flows. While the Nuclear Regulatory Commission has not discussed the berm in the proposed project description, it is assumed that the berm will remain, permanently isolating the Atlas site from the river at all but very high flows. The importance of floodplain habitats to the endangered Colorado River fishes is well documented (USFWS 1990b, USFWS 1996a). Both the razorback sucker and Colorado squawfish depend on flooded lowlands during various life stages. The loss of backwaters and floodplain habitats has been cited as one of the reasons for the decline of these fishes and is a limiting factor in their
recovery. Therefore, the permanent loss of Colorado River floodplain habitat will adversely impact the Colorado squawfish and razorback sucker.

Reconfiguration of Moab Wash
The reconfiguration of Moab Wash will result in increased sedimentation in the Colorado River during construction activities. Best management practices to control erosion will reduce the amount of material released, however, some temporary increase in sedimentation will result.

The relocation of the Wash will likely result in the elimination of the small backwater currently in the river at the mouth of the Wash. This could adversely impact the Colorado squawfish due to the importance of these backwaters to young-of-year fish. The limited backwaters in the vicinity of the tailings pile make the loss of one that much more critical. However, it is possible that another backwater would develop at the mouth of the newly relocated Wash.

The Final Technical Evaluation Report for the proposed action identifies that staff are concerned that during the 1,000-year design life, Moab Wash could migrate periodically and unpredictably and could move to a location adjacent to the reclaimed tailings impoundment (NRC 1997). If this occurs erosion of the tailings pile could result in a release of toxic material into the Colorado River, adversely impacting endangered fish. Due to this concern, the licensee has proposed to provide a large rock toe/apron along the toe of the embankment adjacent to Moab Wash. However, this has not been detailed as part of the proposed action in the biological assessment. Therefore, the Service must include the possibility of tailings impoundment erosion from Moab Wash in its impact analysis.

Southwestern Willow Flycatcher Habitat Loss
A small amount, 1.2 ha or 3 acres, of tamarisk wetland would be lost on the Atlas site. While southwestern willow flycatcher are not known to occupy this particular tamarisk wetland, they have been identified several miles downstream of the Atlas mill tailings site, and therefore, could be using this habitat. No definitive surveys have been conducted at this site. However, the final rule listing the southwestern willow flycatcher as an endangered species (60 FR 0694) identifies that habitat loss and modification is likely to have reduced populations of the flycatcher on the Colorado River. Habitat losses and fragmentation are limiting factors in southwestern willow flycatcher recovery. Therefore, any additional losses of possible habitat may affect the species by reducing the available nesting, breeding, and migrational habitat, and may result in further reductions in the population of southwestern willow flycatcher along the Colorado River.
Water Depletion

This biological opinion, in part, addresses an average annual depletion of approximately 154.3 acre-feet from the Upper Colorado River Basin for use in dust control, decontamination, construction, and other uses. Water depletions in the Upper Basin have been recognized as a major source of impact to Colorado squawfish, razorback sucker, humpback chub, and bonytail chub.

Impoundments and diversions have reduced peak discharges by 48 percent since 1942, while increasing base flows by 21 percent in some reaches. These depletions, along with a number of other factors, have resulted in such drastic reductions in the populations of the Colorado squawfish, humpback chub, bonytail chub, and razorback sucker that the Service has listed these species as endangered and has implemented programs to prevent them from becoming extinct. Continued water withdrawal has restricted the ability of the Colorado River system to produce flow conditions required by various life stages of the fishes.

Water depletions reduce the ability of the river to create and maintain critical habitat. Food supply, predation, and competition are important elements of the biological environment, one of the constituent elements of critical habitat. Food supply is a function of nutrient supply and productivity, which could be limited by reduction of high spring flows brought about by water depletions. Predation and competition from nonnative fish species have been identified as factors in the decline of the endangered fishes. Water depletions contribute to alterations in flow regimes that favor nonnative fishes.

Because of the above affects, the Service has determined and consistently maintained, since the inception of the Colorado River Fishes Recovery Program in 1988, that project depletion impacts are likely to jeopardize the continued existence of, and result in adverse modification and destruction of designated critical habitat for, Colorado squawfish, razorback sucker, bonytail chub and humpback chub. Any depletion to the system, regardless of how small, is considered to result in jeopardy to all four of the listed fishes while also resulting in adverse modification of any designated critical habitat within the project area. Designated critical habitat for Colorado squawfish and razorback sucker exists within the project area. Therefore, the proposed water depletion would also result in adverse modification of critical habitat for these two species.

Critical Habitat
Critical habitat has been designated for the Colorado squawfish and razorback sucker within the 100-year floodplain in portions of their historical range (59 FR 13374). Including that portion of the Colorado River affected by the Atlas tailings pile. Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. In considering the biological basis for designating critical habitat, the Service focused on the primary physical and biological elements that are essential to the conservation of the species without consideration of land or water ownership or management. The Service has identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. As discussed above, water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for recovery of the fishes. The depletion of 154.3 acre-feet will result in adverse modification of critical habitat for Colorado squawfish, razorback sucker, humpback chub and bonytail chub.

In addition, sufficient water quality is a characteristic of the primary constituent elements of critical habitat. Any contamination of that water that adversely affects fish, or causes avoidance of otherwise potential habitat, through leaching of the tailings pile or by other methods, adversely modifies designated critical habitat. As previously described, the proposed action will not limit or eliminate leaching of contaminants into designated critical habitat. Therefore, the proposed action will result in adverse modification of a minimum of 1 river mile of critical habitat for the Colorado squawfish and razorback sucker. This is the minimum length of river (the farthest downstream sampling point) showing increased contaminant levels in surface water. The actual surface water contaminant plume may extend well beyond this farthest downstream sampling locale.

In addition to water quantity and quality, physical habitat is a component of the constituent elements of designated critical habitat. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. The Nuclear Regulatory Commission has stated that 2 ha (5 acres) of the 100-year floodplain of the Colorado River would be lost as a result of leveling of the tailings pile slopes, and that additionally, a small floodplain area would be modified as a result of the
relocation of Moab Wash. The physical habitat at the mouth of Moab Wash would be adversely modified during relocation of the Wash under the proposed action while the leveling of the tailings pile slopes would result in the destruction of five (5) acres of designated critical habitat.

EFFECTS OF MOVING THE TAILINGS PILE OUT OF THE FLOODPLAIN

Contaminant Flux

As part of the modeling study conducted by Oak Ridge National Laboratory/Grand Junction (1998c), the Service requested an evaluation of the impact of tailings pile removal on contaminant flux discharging to the alluvial aquifer and the Colorado River. The source removal simulation assumed that after 51 years of contaminant release from the tailings pile, and subsequent transport to the alluvial aquifer, the source of contamination was completely removed by remedial action. After 41 years of contaminant transport (dating back to the initial operation of the uranium processing mill and inception of the tailings pile), an additional 10 years of continuous input of contaminants was simulated based on the assumption that tailings removal will require approximately 10 years to complete. During these 10 years contaminant flux rates were consistent with existing rates under a no source removal scenario. The model determined that after 35 years, contaminant concentrations near the river will be less than 10 percent of what was present in the initial tailings pile pore water. Additionally, the model determined that 35.5 years would be required to clean the aquifer. However, the report further states that this value, 35.5 years, is unrealistic because the simulation did not consider the effect of molecular diffusion of contaminants from permeable zones into adjacent low permeable zones and subsequent diffusion back to permeable zones as the concentration gradient reverses. The net result, therefore, is that there will be an increased amount of time before the aquifer completely cleans itself. Therefore, we can assume that 35.5 years is the minimum time required. This simulation did not take into account the actual concentrations of contaminants of concern and the length of time required to lower the concentrations to levels not harmful to the endangered fish. The time for this to occur would likely be less than the minimum 35.5 years.

Contaminant Pulse

Assuming that moving the tailings pile would result in a pulse of contaminants to the groundwater, and therefore greater jeopardy to the endangered fish. The Nuclear Regulatory Commission requested that the Oak Ridge National Laboratory/Grand Junction evaluate the impact of construction activities during tailings pile removal on contaminant discharge to the groundwater. The
additional source of water, according to the Nuclear Regulatory Commission, that could cause this pulse was attributed to dust suppression/control measures used during tailings pile excavation activities. To address the Nuclear Regulatory Commission's concern about a pulse of contaminated water discharging to the groundwater system if the tailings pile were moved, the Oak Ridge National Laboratory/Grand Junction discussed the dust suppression/control measures used by the Department of Energy with one of their hydrologists in Grand Junction. The determination was that the volume of water typically used for dust suppression during tailings pile excavation above the water table would not result in a "pulse" of contamination to the groundwater system if proper management of construction/excavation activities is provided. Water added for dust suppression during excavation would only penetrate a few centimeters into the tailings and evaporation losses would be significant. Further, low velocities associated with transport would be insufficient to move the moisture to any significant depths before the tailings were excavated. However, for excavation of tailings below the water table, the Department of Energy found that dissolution of contaminants may be increased by the remedial action. Since the Oak Ridge National Laboratory/Grand Junction (1998a) has previously determined that the tailings do not sit below the water table, this would not be a concern when moving the pile.

Alternate Concentration Limits

An additional benefit of moving the tailings pile, as opposed to reclamation in place, is that the site will be cleaned up to a higher standard and eventually the property would be suitable for other human uses. If the tailings pile is left in place alternative concentration limits would likely be allowed. This means that higher concentrations of contaminated leachate would be allowed into the river indefinitely. As previously discussed under the "Effects of the Proposed Action", while the Nuclear Regulatory Commission and State of Utah may allow for alternative concentration limits, these alternative concentration limits may not adequately protect endangered fish in the river.

Water Depletion

One concern raised by Atlas in their comments (dated August 6, 1997) on the initial Draft Biological Opinion with regard to moving the tailings pile has to do with the additional water depletion that would occur. Atlas identified that moving the tailings pile would result in a "doubling effect" requiring the use of considerably more water during the relocation process, perhaps two or three times as much. Dust suppression would be required at both the Moab
site and an alternate disposal site because moving the tailings would expose actual mill tailings. Furthermore, Atlas would have to decontaminate twice as much equipment at two sites, decontaminate railroad cars, and water the road to the alternate site. Furthermore, Atlas claims that since it will take three to six times longer to relocate the tailings, the additional depletion effect of requiring water for a longer period of time must be multiplied by the “doubling effect” to more accurately analyze depletion effects on endangered fish.

The depletion amount of 154.3 acre-feet identified for capping the pile in place was determined to be an average annual depletion amount. Therefore, while the “doubling effect” scenario is valid, and it may require three to six times longer to relocate the pile, the average annual water depletion required to relocate the tailings pile would still only amount to slightly over 300 acre-feet, annually. While all water depletions in the Upper Colorado River Basin have been determined to result in jeopardy and adverse modification of designated critical habitat for the Colorado squawfish, razorback sucker, humpback chub, and bonytail chub as identified above, the Colorado River Fishes Recovery Program has developed reasonable and prudent alternatives to deal with these depletions as identified under the “Reasonable and Prudent Alternative” section of this document. Furthermore, this water depletion would only occur for an estimated 10 year period and is insignificant when compared to the significant adverse impacts of allowing continued leaching of contaminated tailings water indefinitely.

Potential for Increased Turbidity in the Colorado River

In Atlas’s comments on the Draft Biological Opinion they identified that under the relocation of the tailings pile scenario surface runoff from the heavy construction activities on the banks of the Colorado River could significantly increase turbidity in the river, potentially impacting young-of-year Colorado squawfish. As the Nuclear Regulatory Commission points out in the Preliminary Final Environmental Impact Statement, “The Colorado River . . . naturally experiences large swings in suspended solids concentrations and turbidity.” The endangered fish have evolved in this high turbidity system. Any adverse impacts from increased turbidity due to construction activities would, therefore, be only minor at best. Furthermore, as the Preliminary Final Environmental Impact Statement further identifies, “even these minor impacts . . . could be further reduced through the proper use of runoff control measures, including careful grading practices, interception and retention of runoff in adequately sized settling basins, stabilization of soils promptly after disturbance, and use of sediment barriers such as silt fences. The Service assumes that if the proper use of runoff control measures
can eliminate any turbidity concerns of capping the pile in place, as identified by the Nuclear Regulatory Commission, the same control measures can eliminate any turbidity concerns of relocating the pile. Therefore, no increased turbidity from relocating the tailings pile as opposed to capping the pile in place would be expected and would not result in increased adverse impacts to endangered fish.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Endangered Species Act. Likewise, the future interrelated and interdependent action of development and implementation of the groundwater corrective action plan for the Atlas mill tailings site, would require separate consultation pursuant to section 7 of the Endangered Species Act.

The Moab area receives intensive seasonal recreational use that is increasing at over 13 percent yearly and is expected to continue. There may be additional demands for water placed on the water supply and new developments in and around the Colorado River floodplain. Additionally, recreational use of the Colorado River is expected to increase with increased visitors to the Moab area. The Service is unaware of any specific State, local or private actions which will occur in the area that could be included under the cumulative effects analysis.

CONCLUSION

Colorado River Fish. After reviewing the current status of the razorback sucker, Colorado squawfish, humpback chub, and bonytail chub, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, the Service has determined that sufficient protection, in the form of monitoring to detect and remediate adverse impacts to the endangered fish and their habitat in the Colorado River, has not been effected by the Nuclear Regulatory commission. nor does the reclamaton plan call for such monitoring. There is sufficient evidence to suggest significant adverse impacts are occurring, from contaminated leachate leaking into the Colorado River from the tailings pile, to the endangered fish and that the proposed capping of the tailings pile in place would not significantly reduce these impacts. Capping the pile in place would provide no greater protection to the endangered species than currently exists under baseline conditions.
Furthermore, an additional five (5) acres of designated critical habitat for the razorback sucker and Colorado squawfish would be destroyed with the proposed capping of the pile. Thus, the Service concludes that implementation of the proposed action is likely to jeopardize the continued existence of the Colorado squawfish, razorback sucker, humpback chub, and bonytail chub by depleting water from the Colorado River system and to jeopardize the continued existence of Colorado squawfish and razorback sucker by degrading water quality to the point that it jeopardizes the survival and recovery of the species and destroying five acres of designated critical habitat. Similarly, the potential to degrade water quality through the lack of monitoring and protection from influx of environmental contaminants is likely to adversely modify the designated critical habitat for Colorado squawfish and razorback sucker.

Southwestern Willow Flycatcher. It is the Service's biological opinion that implementation of the capping of the tailings pile in place and relocation of Moab Wash, as proposed, is not likely to jeopardize the continued existence of the southwestern willow flycatcher. However, while the actual importance of the Colorado River Valley near Moab, Utah is unknown, the limited available information indicates that all remaining potential habitat throughout the flycatchers range, is important to the continued survival of the species. Based on flycatchers census data and Lande's hypothesis, the effective population size for the southwestern willow flycatcher is probably critically low. The Service is concerned about the disturbance or loss of any potential breeding site because of the extremely low number of flycatcher territories remaining range wide (i.e., 400-500).

REASONABLE AND PRUDENT ALTERNATIVE

Regulations (50 CFR 402.02) implementing section 7 of the Endangered Species Act define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction, (3) are economically and technologically feasible, and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of the listed species or resulting in the destruction or adverse modification of critical habitat.

The Service's responsibility is to protect, now and long-term, listed fishes in the Colorado River near Moab, to protect designated critical habitat in the river and the 100-year floodplain, and to undertake appropriate actions to promote recovery of listed species. Based on the most recent Oak Ridge
National Laboratory studies undertaken pursuant to agreement with the Nuclear Regulatory Commission and furnished to the Service, the Service believes that the long term release of contaminants into the Colorado River will continue indefinitely absent any remedial action other than the proposed capping of the pile in place.

In modeling the rapid decline of the pile drainage rate, the Oak Ridge National Laboratory/Grand Junction (1998c) concluded that the bulk of the tailings water would drain after 100 years with 238 years required to reach steady state conditions (where inflow in the form of precipitation equals outflow or leaching). If the pile were to be removed, the source of contamination would be removed and “cleanup” of the groundwater could take place in an estimated 35 years (ORNL, 1998c). The Nuclear Regulatory Commission regulations (10 CFR part 40, Appendix A. criterion I) identify that, “Tailings should be disposed of in a manner that no active maintenance is required to preserve conditions of the site.”. The Service believes that affecting a groundwater cleanup for 238 years does not meet this requirement. Furthermore, the proposed action of capping the pile in place does not meet this requirement because it fails to account for the required Groundwater Corrective Action Plan or the second source of uranium contamination on the Atlas site that was identified during the Oak Ridge National Laboratory studies.

Capping the pile in place would also require an immediate commitment of $20 to $40 million in financial resources, thereby creating a strong disincentive to moving the pile, even if that were determined to be necessary in the future in order to eliminate long term exposure of listed fishes to leaching environmental contaminants. In all likelihood, the involved private and public entities would be reluctant to move the pile after having made the substantial investment to cap it in place, even if, at some time in the future, the capping proved ineffective. Also, if the pile were capped now, the cost of a future move would be increased due to the additional capping material that would have to be moved.

For these reasons, the Service believes that relocation of the tailings pile would, in the long term, be the best means to achieve optimal protection for listed fishes while meeting Nuclear Regulatory Commission requirements of no active maintenance. Also, with the pile removed, site cleanup will be effected to a higher standard and eventually the property would be suitable for other human uses (NRC 1996).

As a result of the exchanges between the Service, the Nuclear Regulatory Commission, and Atlas Corporation following issuance of the Draft Biological
Opinion on June 26, 1997, the Service recognizes that congressional action and legislation will be required to effect the removal of the pile to another location and the Service acknowledges that the Nuclear Regulatory Commission does not have the authority to require Atlas to undertake responsibility for relocating the pile. The only decision the Nuclear Regulatory Commission can make with regard to the pile is whether to approve the proposal to cap in place, approve the proposal with modifications, or deny the proposal to cap.

Accordingly, a reasonable and prudent alternative, consisting of three parts, has been developed to avoid the likelihood of jeopardy to the endangered Colorado River fishes from Atlas tailings pile contamination, from destruction of critical habitat, and from water depletion from the Colorado River. Because this biological opinion has found jeopardy and destruction and adverse modification of critical habitat, the Nuclear Regulatory Commission is required to notify the Service of its final decision on implementation of the reasonable and prudent alternative.

1. a.) To minimize and/or avoid jeopardy to the listed fishes from leachates seeping to the Colorado River from contaminated groundwater, the Nuclear Regulatory Commission shall require Atlas Corporation to immediately initiate whatever steps are necessary to comply with Nuclear Regulatory Commission and Utah Department of Environmental Quality regulations requiring implementation of a Groundwater Corrective Action Plan. This plan must be expedited so as to be completed within 2 years and be designed to reduce the leaching of contaminants into the Colorado River from the tailings pile. At this time, levels of known tailings contaminants must be reduced in the River, with no mixing zone allowed, to at or below surface water quality standards for the protection of aquatic life as identified in Utah Administrative Code 51-317 dated December 19, 1997. While several of these constituents are not specifically known to individually adversely affect the endangered fish at levels identified below the Atlas tailings pile, as previously identified under the “Effects of the Proposed Action”, the synergistic and/or additive effects of high concentrations of the known tailings contaminants may be adversely affecting Colorado squawfish and razorback sucker. The groundwater corrective action plan must be approved by the Service and the State of Utah.

b.) As previously stated, the Service has determined that leachate from the pile is resulting in take of listed fishes and that the level of take is impacting population numbers and recruitment and is sufficient to jeopardize the continued existence of the species. In order to more effectively determine cleanup levels required to remove jeopardy to
listed species, the Nuclear Regulatory Commission, in cooperation with
the Service, shall expeditiously arrange for bioassay studies to be
conducted by a mutually agreed upon third party such as the Columbia
Laboratory of the Biological Resources Division, U.S. Geological Survey.
These studies, to be completed within eighteen (18) months, shall be
conducted with various life stages of the endangered fish and/or
surrogate species and be tested with groundwater and nearshore river
surface water from areas potentially inhabited by endangered fish, at
and below the tailings pile. The bioassay studies must be approved by
the Service.

The Service recognizes that the current state of knowledge does not
support definitive comprehensive standards for all contaminants which
could be applied to protect listed species from take at this site (for
example, pH levels significantly affect the ammonia toxicity in the
river and the standard is subject to pH levels). It is clear that the
Colorado River at the Atlas tailings pile is a temporally and spatially
sensitive environment, and that additional information may be helpful to
finalize the Groundwater Corrective Action Plan. Bioassay studies will
be structured to give a rapid assessment of the cumulative effects of
the contaminant plume on endangered fish rather than focusing on
individual constituents. Such studies will also establish more
definitively to what level "take" is occurring, and provide more
specific information about the reduction in contaminant levels required
to eliminate harm to the endangered species. The Service recognizes
that design and construction of the Groundwater Corrective Action Plan
will take time, perhaps up to 2 years, and believes that bioassay
studies undertaken promptly will be of great value in designing the
Groundwater Corrective Action Plan to meet standards protective of
listed species.

Nuclear Regulatory Commission regulations allow for the establishment of
alternate concentration limits at the point of compliance when
background concentrations and/or acceptable hazard levels "may not be
practically achievable at a specific site." (10 CFR part 40, Appendix A,
criterion 5B(6)). Alternate concentration limits may not be strict
enough to avoid the Endangered Species Act section 9 (harm) standard
protective of endangered species. Alternate concentration limits must
not only protect human health but also must protect listed fishes. The
bioassay studies discussed above will determine if alternate
concentration limits can be allowed without harming endangered species.
Therefore, the Nuclear Regulatory Commission shall deny all requests for
alternate concentration limits, and exceptions thereto, at the site
unless prior concurrence is obtained from the Service that the alternate concentration limit or exception will not "harm" listed species.

2. The Service has found that the effects of the proposed action of capping the pile in place would result in jeopardy to the Colorado squawfish, razorback sucker, humpback chub and bonytail chub.

a. Using the NRC/Atlas design provided in the Biological Assessment and Preliminary Final EIS, capping the pile in place would require reconfiguration and reshaping of the tailings pile and would result in the permanent loss of an additional five acres of the 100-year floodplain of the Colorado River, thus, resulting in the destruction of designated critical habitat. To avoid this destruction of critical habitat, the pile cap shall be redesigned such that no additional critical habitat is adversely modified or destroyed.

If the pile cap cannot be redesigned to avoid the destruction of designated critical habitat, the Nuclear Regulatory Commission shall, in cooperation and with the approval of the Service, develop and implement a plan to replace, restore or enhance critical habitat for the Colorado squawfish and razorback sucker. This plan shall be developed and implemented within one calendar year from issuance of the Service's final biological opinion.

b. As identified by Oak Ridge National Laboratory/Grand Junction, capping the pile as proposed would not significantly eliminate, remove or reduce the length of time that contaminated leachate from the tailings pile continues to seep into the Colorado River (ORNL/GJ 1998a). Actions shall immediately be implemented to reduce current water levels contained within the tailings pile to levels that would, in 36 months from issuance of the Service's final biological opinion, preclude further drainage from the pile into the underground water table. Any water withdrawn from the pile must be disposed of in a manner that is acceptable to the Service and the State of Utah and that will not impact listed species and will meet both State of Utah and Federal water quality standards. Actions taken may include the use of vertical wick drains, vertical extraction wells, horizontal wells or other appropriate technologies.

c. In addition, the cap shall be redesigned so as to preclude any future infiltration of rain water into the pile. According to Oak Ridge National Laboratory, the current proposed cover permeability of 10^{-7} cm/sec for the cap will not limit rainwater infiltration. The Nuclear
Appendix H:
United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prarie Region

MAILING ADDRESS: Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION: 134 Union Blvd.
Lakewood, Colorado 80228-1807

MAR 11 1998

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Holonich:

In a letter to you dated March 11, 1998, Richard E. Blubaugh of Atlas Corporation proposed to consent to an extension of the Fish and Wildlife Service's deadline for issuing a revised draft biological opinion on Atlas's proposed surface reclamation plan for the Atlas Mill Tailings site in Moab, Utah. Atlas proposed the extension to allow the parties engaged in the section 7 consultation process further opportunities for cooperation and discussion. However, to grant this consent to an extension requires the Service to confirm that relocation of the tailings pile at Atlas' expense cannot be compelled by the Nuclear Regulatory Commission as a result of the Endangered Species Act section 7 consultation process on the surface reclamation plan.

The Service continues to believe that the soundest, most environmentally preferable, low-maintenance solution for the site and the Colorado River ecosystem continues to be relocation of the tailings pile and groundwater remediation in accordance with State and Nuclear Regulatory Commission water quality standards. Nevertheless, the Service acknowledges that the Nuclear Regulatory Commission lacks the legal authority to require Atlas to relocate the tailings pile to an alternate site, and that the Service, therefore, cannot recommend relocating the tailings pile as a reasonable and prudent alternative under the section 7 consultation process.

Sincerely,

[Signature]
Regional Director

cc: Gina Guy
David Gayer
Richard Blubaugh
Don Baur
Tony Thompson
Molly McUsic
Mr. Richard Blubaugh
Vice President of Environmental
and Government Affairs
Atlas Corporation
370 Seventeenth Street, Suite 3050
Denver, Colorado 80202

SUBJECT: RELOCATION OF ATLAS TAILINGS

Dear Mr. Blubaugh:

By letter to me dated March 11, 1998, you requested confirmation that relocation of Atlas Corporation's uranium mill tailings from its present site near Moab, Utah cannot be compelled by the U.S. Nuclear Regulatory Commission. We have addressed this issue in the past. In Carl J. Paperiello's August 12, 1997, letter to Terry Terrell of the U.S. Fish and Wildlife Service (FWS), we stated "NRC can order licensees to take specific actions, but only upon a finding of an imminent threat to public health and safety. Based on the current technical evidence, such a finding cannot be made with respect to the Atlas tailings." We have seen no compelling evidence since then that would support a finding of an imminent threat to public health and safety that warranted an NRC order to relocate the tailings. Non-imminent (long-term) threats to public health and safety are discussed in the Technical Evaluation Report (NUREG-1532) and the Draft Environmental Impact Statement (NUREG-1531).

I have also received a response, dated March 11, 1998, from Ralph Morgenweck, Director of the Mountain-Prairie Region of FWS in which he states, "...the Service acknowledges that the Nuclear Regulatory Commission lacks the legal authority to require Atlas to relocate the tailings pile to an alternate site, and that the Service, therefore, cannot recommend relocating the tailings pile as a reasonable and prudent alternative under the section 7 consultation process." A copy of Mr. Morgenweck's letter is enclosed.

Notwithstanding the views of the FWS, the NRC staff cannot make a final determination on the Atlas proposal to remediate the Moab tailings until all agency procedures, including possible Commission review, have been completed.
I trust that this responds to your request. If you have any questions, please contact me at (301) 415-7238 or Dr. Myron Fliegel, NRC's project manager, at (301) 415-6629.

Sincerely,

[Signature]

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards

Docket No.: 40-3453
License No.: SUA-917

Enclosure: As stated

cc: See attached list
Appendix I:
July 24, 1998

Mr. Scott Amey, Senior Research Associate  
Project On Government Oversight  
1900 L Street, NW  
Suite 314  
Washington, DC  20036-5027

SUBJECT:  RESPONSE TO JULY 15, 1998, LETTER

Dear Mr. Amey,

I am responding to your July 15, 1998, letter requesting additional information on the status of the Atlas Corporation's proposal to reclaim uranium mill tailings at its site in Moab, Utah. In your letter, you asked for information in three areas. These included the following: 1) a citation which lists the percentage of costs the Federal government will pay for the Atlas reclamation; 2) confirmation that the current surety value is $6.5 million; and 3) information concerning the U.S. Nuclear Regulatory Commission's (NRC's) 1982 decision to approve on-site reclamation.

With respect to your first request, the U.S. Department of Energy (DOE) has the responsibility, under Title X of the Energy Policy Act of 1992, to determine the percentage of cleanup costs for which the Federal government will reimburse a licensee. My understanding is that DOE determined, for each eligible site, the percentage of the tailings that were attributable to the uranium that the U.S. government purchased from that mill. For the Atlas mill, DOE determined that to be 56 percent. If you need more specific or detailed information on this subject, I suggest that you contact Mr. David Mathes at DOE. He can be reached at (301) 903-7222.

In response to your second question, the NRC license currently specifies that Atlas is required to maintain a surety for $6.5 million.

Finally, NRC did complete an evaluation of Atlas' 1981 proposal to reclaim the tailings on site, approved the plan, and amended Atlas' license to reflect that. The license was later amended to require Atlas to provide additional information related to erosion protection of the tailings. In response, and because the maximum elevation of the tailings was to be lower than in the 1981 plan, Atlas prepared a revised reclamation plan for NRC review and approval. NRC conducted a review of the proposed changes, and in July 1993, issued a finding of no significant impact (FONSI). The FONSI was based on the differences between the previously approved and the revised plan; NRC concluded that the changes would not result in significant impact. This FONSI resulted in over 300 comments from 80 different individuals concerning the proposal for on-site reclamation. As a result of these comments, NRC decided to reevaluate the entire
revised plan, rather than just the changes from the previous plan, including the issue of on-site versus off-site disposal. This reevaluation included the preparation of an Environmental Impact Statement (EIS), and a technical review of all aspects of Atlas' proposed reclamation, to determine if the proposed plan was acceptable. In March 1997, NRC issued NUREG-1532, "Technical Evaluation Report for the Proposed Revised Reclamation Plan for the Atlas Corporation Moab Mill," documenting its technical evaluation, and is in the process of finalizing the EIS for this reevaluation.

I trust this letter responds to your questions.

Sincerely,

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
July 15, 1998

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Holonich:

As you know, the Project On Government Oversight (POGO) has been following the status of the Atlas Corporation’s Uranium mill site near Moab, Utah. Our current investigation is an attempt to clarify the ongoing debate between the many federal and State agencies.

I have a few questions that I hope that you can answer.

First, I have seen reports that the federal government, under provisions of the Energy Policy Act of 1992, is responsible for 56% of the cleanup cost at Moab. My research shows that this percentage is the federal government’s share for old AEC contracts. However, I have been unable to find a reference to the percentage in the Act and subsequently have been told that the percentage is contained in another regulation. To this point no one has been able to point me in the right direction to find the actual percentage. Do you know the actual citation that specifies the federal government’s percentage concerning Moab? I have been told that Moab is not listed specifically, but is combined with other uranium tailings sites.

Second, What is the current amount that Atlas has set aside in surety? My research shows that Atlas’ surety is about $6.5 million.

Finally, do you have any information concerning the NRC’s 1982 decision to approve Atlas’ plan to cap the Moab tailings in place. Is this true or false? What occurred that made the NRC postpone that decision?

Answers to these questions will be helpful in providing POGO with the opportunity to simplify the current confusion between the NRC, the FWS, and the many other entities that have been involved in Moab debate.

I thank you for your attention to this matter. If you have any questions, please contact me at (202) 466-5539.

Sincerely,

Scott Amey
Senior Research Associate
Appendix J:
June 26, 1997

Representative George Miller
United States House of Representatives
Committee on Resources
Washington, D.C. 20515

Re: Atlas Corporation’s Uranium Site Located in Moab, Utah
Rebuttal to Representative George Miller’s Letters to Vice President Gore and the Nuclear Regulatory Commission

Dear Representative Miller:

Please find enclosed a copy of Atlas Corporation’s rebuttal to the statements, misstatements, allegations and implications contained in your recent letters to the Vice President Gore and the Nuclear Regulatory Commission with respect to Atlas Corporation’s Uranium site located in Moab, Utah.

Should you have any questions concerning any of the information within the enclosed document, we would welcome the opportunity to discuss this at your convenience.

Sincerely,

Richard E. Blubaugh
sludges (including radioactive components) the disposal of which will have to be addressed. (p.88 of COMMENTS).

G. **The case of the Vitro site:** For example, although relocation of the tailings from the Vitro site in Salt Lake City was completed in 1989, the site has not yet been released for unrestricted use and groundwater cleanup studies are not scheduled to begin until 2002! (p.89 of COMMENTS).

The "slimes" problem: The advocates of the off-site reclamation option have failed to adequately consider the costs associated with handling and moving the fine tailings (slimes) found at the Atlas site. These materials retain their "toothpaste-like" consistency even after years of draining, and it will be necessary to utilize specialized equipment and care to implement their excavation, removal, transportation, placement, and covering. (pp. 119-120 of COMMENTS).

H. The NRC regulations require the agency to take economic costs into consideration when making licensing decisions. (FTER at 7-1).

I. MIM Holding Company and Independence Mining Company are not the "primary owners" of Atlas. Atlas is a publicly-traded corporation with many shareholders, including MIM Holding Company and Independence Mining. It is unlikely that these companies, or any individuals or other organizations who own Atlas' publicly-traded stocks, will volunteer to assist Atlas by paying to move the tailings pile as they have no legal liability for any such costs.

- **Miller criticizes the NRC's review of the facility and claims that the agency "is hiding behind its authorizing legislation and regulations."** (NRC)

A. Atlas is extremely concerned about the implications of this charge. For an elected official to suggest that an agency do something other than follow
Appendix K:
Decommissioning of U.S. Uranium Production Facilities

February 1995

Energy Information Administration
Office of Coal, Nuclear, Electric and Alternate Fuels
U.S. Department of Energy
Washington, DC 20585

This report was prepared by the Energy Information Administration, the independent statistical and analytical agency within the Department of Energy. The information contained herein should not be construed as advocating or reflecting any policy position of the Department of Energy or of any other organization.
5. Transporting materials and placing them in a burial site, usually in the tailings pile, some distance from the edge of the pile. Material is placed in the pile in layers, which may include solid wastes from remote nonconventional sites, with dirt compacted in and around the material. Since the tailings pile must have dried and compacted sufficiently to support heavy equipment, it might not be accessible for disposal of mill materials for years. Disposal at other locations, however, such as at other tailings piles or specially constructed pits, may be possible.

6. Cleanup of the mill site. Contaminated debris and soil are removed, as are roads and parking lots.

7. Ripping, regrading, resoiling, liming, fertilizing, and reseeding as necessary to reestablish vegetation. To enhance its long-term survival, the vegetation selected should be similar to native types.

Tailings Pile Reclamation

Mill tailings from the leaching and decantation processes consist of slurries of sands and clay-like particles called “slimes”; the tailings slurries are pumped to tailings piles for disposal. Generally, there are a number of tailings piles and evaporation ponds at each site. Each pile has different characteristics. Groundwater contamination comes mostly from the tailings pile. Depending on the siting and design of the pile, at some sites, the efforts to clean up groundwater to acceptable levels may be extensive.

The ultimate purpose of tailings pile reclamation is to return the site to the DOE or the appropriate State for
*For a definition of decantation, see the Glossary.
The steps involved in cleaning up the tailings piles (Figure 5) are as follows:

1. The edges of the piles are reshaped to minimize erosion hazards from surface runoff. This is done by recontouring the tailings piles or adding material to the base of the pile boundaries.

2. The pile slopes and edges are covered with radon barrier material and rock or other cover (usually a clay or silty material). For erosion protection, “rip rap” is the preferred material for a cover. To verify its suitability as a radon barrier, the covering material is tested for its radon diffusion and emanation characteristics as well as its permeability and other physical properties. A plastic and impermeable material is desirable.

3. Drainage in the vicinity is redirected away from the pile. This may require establishing new drainage routes, moving natural stream beds, and/or putting in diversions such as wing dams. The rock

Figure 5. Reclaiming a Tailings Pile

Source: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels.
For a definition of rip rap, see the Glossary.
and other materials used must be resistant to long-term weathering and erosion. Consideration must be given to the maximum possible magnitude of floodwater over the design life of the tailings pile, which is at least 200 years.

4. The pile is allowed to settle and dehydrate. This may take years if the pile is slow in releasing moisture. Generally, pools of liquid on the tailings piles receive additional water from rainfall. The slimy, clay-like nature of the fine materials from the milling process and the lack of capillary action inhibits moisture release and movement to the drying surface. The placement and design of the piles will also affect the length of this stage. Piles placed on porous material without sealing materials will drain through the bottom. Piles with synthetic or clay liners at the base will depend on drainage systems built into the pile or on evaporation. To hasten pile drying, additional moisture should be kept off the pile. New, lined evaporation ponds may be needed to dispose of liquids gathered during the reclamation process. Settlement of tailings must be monitored by establishing survey monuments on the pile and checking their movement, both vertically and laterally.

5. The entire pile is covered with a radon barrier. The material for this cover is usually the same as the material used to cover the edges and slopes of the piles. To verify its suitability, the material used in the new cover must be tested for such characteristics as acidity and radioactivity associated with disposal of heavy metal contaminants. The thickness (from 6 inches to several feet) required to meet standards varies with the nature of the tailings pile and with the material available for cover. Computer models estimate the thicknesses required for the various materials available to meet NRC standards for radiation and radon emanation. This barrier also serves to keep additional moisture off the pile, thus avoiding subsequent drainage into groundwater.

6. The final pile cover is a protection against erosion. It should not be added until the pile settlement is almost complete. Before the new cover is added, the integrity of the previously placed radon cover must be checked and corrected as necessary. The erosion cover may include various types of rocks and earth material, depending on what is available near the site. It may be soil if revegetation is planned, or rock if revegetation is not feasible. Soil amendments, such as lime, may be needed. The site must be monitored for erosion of the soil and growth of the vegetation.

7. The restricted part of the site may be enclosed by a fence.

8. A portion of the area of the tailings pile may be needed for final disposal of wastes at the site, particularly those wastes that may continue to accumulate from groundwater cleanup. It may be necessary to create and build a newly designed disposal area for final disposal of cleanup waste (such as the one being constructed at the Uravan mill site) to allow reclamation of the main tailings pile to proceed to completion.

9. The site is monitored to ensure that all aspects of the design and construction programs have worked as expected, that all standards have been met, and that no unexpected changes have occurred at the site. Until the site reclamation is completed and approved by the NRC, this work is the responsibility of the licensee. When the work is completed, title to the site and the responsibility for long-term surveillance, monitoring, and maintenance of the site are turned over to the DOE or the appropriate State.

Even if a decommissioning plan is approved by Federal or State agencies, it may be necessary to alter the plan over time to accommodate newer, more stringent regulations. For example, mined-out pits can make convenient dumps for mill tailings (Figure 6). If the mine is some distance away from the milling area, as is the case with most sites, haulage costs make this option uneconomical. The few conventional operations that have mined-out pits on site do not have this problem. Potentially, however, using the pits as disposal areas may present significant environmental problems. Seepage into the groundwater can be more difficult to control in a pit than on the surface. The most convenient options are not necessarily the most practical nor the least costly.

The important part of the tailings reclamation is to eliminate characteristics that could influence the magnitude and likelihood of failure for each potential failure mechanism (Table 2). One must give careful consideration to potential physical and chemical causes of failure affecting major failure elements (such as,

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10 For a definition of failure, see the Glossary.
Table 2. Causes of Potential Failure in Tailings Piles

<table>
<thead>
<tr>
<th>Cause of Failure</th>
<th>Cover</th>
<th>Liners</th>
<th>Embankment</th>
<th>Vegetation</th>
<th>Water Diversion Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential Settlement</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Gullying</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Water Sheet Erosion</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Wind Erosion</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Chemical Erosion</td>
<td>X</td>
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<td></td>
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<tr>
<td>Shrinkage</td>
<td></td>
<td></td>
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<tr>
<td>Subsidence of Subsoil</td>
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<td></td>
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<tr>
<td>Physical Penetration</td>
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<td></td>
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<tr>
<td>Slope Failure</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Flooding</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Weathering</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Climatic Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Obstruction</td>
<td></td>
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</tr>
</tbody>
</table>

*Gullying is activity of a deep ditch or channel cut in the tailings pile or embankment by running surface water after a downpour.

*Chemical erosion is an erosion of soil or embankment due to presence of acid generating chemical elements that interact with atmosphere or surface water.

Source: Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels.
Concluding Remarks

Decommissioning of U.S. Uranium Production Facilities is not the final word on the decommissioning process. As decommissioning work progresses at various sites, authors of future reports will benefit from a wider range of specific data. Also, it was not possible to address all of the decommissioning issues (such as environmental issues, or the relationship of decommissioning costs or revenues) in this study. This report concentrates on three key elements of the decommissioning process including the plan, activities, and costs.

The Decommissioning Plan

Current regulatory procedures are now well established and understood by the industry. Plans have been developed for all facilities. These plans have been reviewed and approved by the NRC or by the agreement States. As noted in the first chapter, however, the development of the current regulatory system was not without difficulties.

In the past, the absence of clear definition of the role of State agencies hampered regulatory control. As new laws are passed by the Congress and the States in an effort to further protect public health and the environment, the potential that State and Federal regulations will again overlap increases.

Decommissioning Activities

Experience gained by the uranium industry in decommissioning existing facilities can help to hold down costs for future sites. Regardless of how carefully a company may plan, unanticipated problems may arise when decommissioning activities are implemented. Problems might occur even after the company has completed all work described in the plan. Such unpredictable pitfalls include the following:

- Uncertain or changing criteria can hamper planning and impede an operation. For example, as State agencies re-evaluate and revise their regulations regarding mine land reclamation, the conventional uranium producer might discover that the existing plan is no longer sufficient.

- Changes in ownership of sites can lead to loss of corporate memory and thereby hamper implementing the plan. Some of the uranium processing facilities identified in this report have operated for decades. Therefore, it is reasonable to assume that some or all of the employees involved in drafting the original decommissioning plan at the time of the license application, have departed the company long before the plan was executed.

- Groundwater problems are often unpredictable. This is the one of the reasons why the tailings cover (cap) must be sufficient to prevent radon emanation and erosion of either the surface or edges of the tailings pile, and to direct drainage away from the pile. A tailings pile failure due to design defects or natural causes could allow contaminated fluid to seep into the groundwater or run off into nearby streams. The impact of unanticipated groundwater problems on costs can be substantial.

Decommissioning Costs

Decommissioning entails considerable costs for the uranium industry. The amount of surety in effect, covering costs for third parties to do the decommissioning work, totals approximately $335 million. Of this total, $237 million is for 26 conventional mills and $98 million is for 17 in situ leach facilities. With the site owner doing the work, actual costs would be lower.

The average decommissioning cost for conventional facilities with sufficient data for analysis is $14.1 million, of which over half is for tailings reclamation.29 The current generation of uranium mills is being phased out. Future operations would expect a lower rate of decommissioning costs through improved tailings pile design and groundwater restoration technology and practice.

29Costs vary from site to site, depending largely on the amount of tailings present, the design of the tailings pile, and the age of the facility.
For nonconventional facilities, the average is $7 million. Of this amount, 40 percent is for groundwater restoration. The averages for conventional and non-conventional facilities are derived from a wide data range. Decommissioning costs at some operations far exceed the average.

These costs, affecting the marginal cost of uranium production, are normally amortized over the life of the operation, and added into projected sales prices that would support developing a new plant. Therefore, decommissioning requirements would have some influence on prices, but they would not have a significant impact on future U.S. uranium production. Other costs (such as development and operating, acquisition and exploration costs) will be more influential in production decisions.

There are many uncertainties affecting the future of the U.S. uranium industry—costs, demands, future regulatory requirements. Uranium producers, however, believe there is at least one certainty: a significant increase in uranium prices would be needed to economically justify constructing new uranium production facilities in the United States.
Appendix A

Criteria of the NRC Performance Objectives on Mill Tailings Reclamation
Appendix A

Criteria of the NRC Performance Objectives on Mill Tailings Reclamation

The decommissioning plan for each uranium producing facility is adjusted to the site specific conditions, but the NRC Performance Objectives illustrate the complexity and similarity of the requirements for all sites.

NRC performance objectives for mill tailings, regulations that evolved from environmental impact studies, were established in 1977\textsuperscript{30} and are listed as follows:

**Siting and Design**\textsuperscript{31}

1. Locate tailings so that population exposures are reduced to the minimum.

2. Locate tailings so that disruption and dispersion by natural forces are eliminated or reduced.

3. Design tailings areas so that seepage of toxic materials into the groundwater system is eliminated or reduced.

**During Operation**

4. Prevent blowing of tailings to unrestricted areas.

**Post Reclamation**

5. Reduce direct gamma radiation from the impoundment area to essentially background.

6. Reduce radon emanation to about twice the emanation rate of surrounding environs.

7. Eliminate the need for an ongoing monitoring and maintenance program following successful reclamation.

8. Provide surety arrangements to assure that sufficient funds are available to complete the full reclamation plan.

The NRC regulations most relevant to mill site decommissioning and reclamation are set out in 10 CFR Part 40, particularly in Appendix A.

The Appendix notes that license applicants for uranium mills are required to provide specifications relating to milling operations and the disposition of tailings or wastes. The Appendix establishes the technical, financial, ownership, and long-term site surveillance criteria relating to the siting, operation, decontamination, decommissioning, and reclamation of mills and tailings or waste systems.\textsuperscript{32} It notes that licensees may propose alternatives to the requirements of the Appendix that may be acceptable if the alternative would result in an equivalent or higher level of stabilization and containment of the site in order to achieve equal or greater protection to the public health and the environment.

**Technical Criteria**

1. The goal is permanent isolation of tailings and contaminants by minimizing disturbance and dispersion by natural forces, without ongoing maintenance.

2. To avoid proliferation of waste disposal sites and reduce surveillance obligations, wastes from \textit{in situ} leaching operations, evaporation ponds, and small operations should be disposed of in existing large mill tailings sites.

3. Prime option for disposal of tailings is below grade, in mines or specially excavated pits. Where not practicable, above grade disposal programs must provide reasonably equivalent isolation of the tailings.

4. The following site and design criteria are mandatory:


\textsuperscript{31}The tailings pile characteristics are described in Table A1.

\textsuperscript{32}The constituents present in tailings pond water are described in Table A2.
Table A1. Typical Characteristics of Uranium Mill Tailings

<table>
<thead>
<tr>
<th>Tailings Component</th>
<th>Particle Size (µm)</th>
<th>Chemical Composition</th>
<th>Radioactivity Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sands</td>
<td>75 to 500</td>
<td>SiO₂ with &lt; 1% complex silicates of Al, Fe, Mg, Ca, Na, K, Se, Mn, Ni, Mo, Zn, U, and V; also metallic oxides</td>
<td>0.004 to 0.01% U₃O₈&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acid leaching&lt;sup&gt;b&lt;/sup&gt;</td>
<td>26 to 100 pCi &lt;sup&gt;226&lt;/sup&gt;Ra/g</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>70 to 600 pCi &lt;sup&gt;230&lt;/sup&gt;Th/g</td>
</tr>
<tr>
<td>Slimes</td>
<td>45 to 75</td>
<td>Small amounts of SiO₂ but mostly very complex clay-like silicates of Na, Ca, Mn, Mg, Al, and Fe; also metallic oxides</td>
<td>U₃O₈ and &lt;sup&gt;226&lt;/sup&gt;Ra are almost twice the concentration present in the sands</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acid leaching&lt;sup&gt;b&lt;/sup&gt;</td>
<td>150 to 400 pCi &lt;sup&gt;226&lt;/sup&gt;Ra/g</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>70 to 600 pCi &lt;sup&gt;230&lt;/sup&gt;Th/g</td>
</tr>
<tr>
<td>Liquids</td>
<td>(c)</td>
<td>Acid leaching: pH 1.2 to 2.0; Na&lt;sup&gt;+&lt;/sup&gt;, NH₄&lt;sup&gt;+&lt;/sup&gt;, SO₄&lt;sup&gt;2-&lt;/sup&gt;, Cl&lt;sup&gt;-&lt;/sup&gt;, and PO₄&lt;sup&gt;3-&lt;/sup&gt;; dissolved solids up to 1%</td>
<td>Alkaline leaching</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200 pCi &lt;sup&gt;226&lt;/sup&gt;Ra/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acid leaching</td>
<td>0.001 to 0.01% U</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 to 7,500 pCi &lt;sup&gt;226&lt;/sup&gt;Ra/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2,000 to 22,000 pCi &lt;sup&gt;230&lt;/sup&gt;Th/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alkaline leaching</td>
<td>essentially no &lt;sup&gt;230&lt;/sup&gt;Th (insoluble)</td>
</tr>
</tbody>
</table>

<sup>a</sup>The U₃O₈ content is higher for acid leaching than for alkaline leaching.
<sup>b</sup>Separate analyses of sands and slimes from the alkaline leaching process are not available. However, total <sup>226</sup>Ra and <sup>230</sup>Th contents of up to 600 pCi/g (of each) have been reported for the combined sands and slimes.
<sup>c</sup>Particle size does not apply. Up to 70 percent of the liquid may be recycled. Recycle potential is greater in the alkaline process.


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a. Rainfall catchment areas must be minimized to decrease erosion potential.

b. Topographic features must provide wind protection.

c. Embankment and cover slopes must be relatively flat after final stabilization. Slopes should not be steeper than 5H to 1V and preferably should be about 10H to 1V.

d. A self-sustaining vegetative or rock cover must be established to reduce wind and water erosion to negligible levels. Impoundment cover must be contoured to avoid concentrated surface runoff. Areas that might be affected by surface runoff must be protected by rock cover (rip rap). Surrounding terrain must be evaluated to assure that no potential erosion processes cause damage to the impoundment.

e. The impoundment must not be located near a fault that could cause an earthquake that the impoundment could not withstand.

f. Where feasible, the impoundment should be designed to promote deposition and to avoid erosion.

5. This criterion concerns groundwater and supplements EPA Standards of 40 CFR Part 192.

The following information should be provided by applicants: characteristics of waste solutions; characteristics of underlying soils and geologic formations and their hydraulic gradient and conductivity; quality, capacity, and uses of groundwater at the site and lining or compaction of soils underlying core storage areas to minimize radionuclide penetration.

a. Groundwater protection programs should consider the following:

- Installation of bottom liners made of synthetic material with leak detectors or of suitable clay
Table A2. Constituents of Tailings Pond Water

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Acid Mill</th>
<th>Alkaline Mill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Suspended Solid (mg/l)</td>
<td>435</td>
<td>44.0</td>
</tr>
<tr>
<td>Total Dissolved Solid (mg/l)</td>
<td>39,043</td>
<td>25,400</td>
</tr>
<tr>
<td>Conductivity (μhos)</td>
<td>40,788</td>
<td>28,840</td>
</tr>
<tr>
<td>pH</td>
<td>1.33</td>
<td>10.32</td>
</tr>
<tr>
<td>Arsenic (mg/l)</td>
<td>1.870</td>
<td>5.020</td>
</tr>
<tr>
<td>Barium (mg/l)</td>
<td>0.372</td>
<td>0.100</td>
</tr>
<tr>
<td>Selenium (mg/l)</td>
<td>0.450</td>
<td>27.88</td>
</tr>
<tr>
<td>Molybdenum (mg/l)</td>
<td>1.659</td>
<td>104.5</td>
</tr>
<tr>
<td>Ammonia (mg/l)</td>
<td>3.32</td>
<td>17.8</td>
</tr>
<tr>
<td>Sodium (mg/l)</td>
<td>549.7</td>
<td>9,292</td>
</tr>
<tr>
<td>Chlorine (mg/l)</td>
<td>296.8</td>
<td>1,418</td>
</tr>
<tr>
<td>Sulfate (mg/l)</td>
<td>28,876</td>
<td>8,412</td>
</tr>
<tr>
<td>Calcium (mg/l)</td>
<td>544.0</td>
<td>60.0</td>
</tr>
<tr>
<td>Potassium (mg/l)</td>
<td>82.3</td>
<td>35.1</td>
</tr>
<tr>
<td>Bicarbonate (mg/l)</td>
<td>--</td>
<td>2,388</td>
</tr>
<tr>
<td>Nitrate/nitrite (mg/l)</td>
<td>2.03</td>
<td>10.72</td>
</tr>
<tr>
<td>Magnesium (mg/l)</td>
<td>1,205</td>
<td>813</td>
</tr>
<tr>
<td>Vanadium (mg/l)</td>
<td>56,630</td>
<td>1.18</td>
</tr>
<tr>
<td>Zinc (mg/l)</td>
<td>8.25</td>
<td>&lt; 0.25</td>
</tr>
<tr>
<td>Aluminum (mg/l)</td>
<td>1,220</td>
<td>&lt; 0.25</td>
</tr>
<tr>
<td>Lead (mg/l)</td>
<td>0.875</td>
<td>0.007</td>
</tr>
<tr>
<td>Cadmium (mg/l)</td>
<td>0.014</td>
<td>0.001</td>
</tr>
<tr>
<td>Gross α (pCi/l)</td>
<td>43,000±2,000</td>
<td>3,400±400</td>
</tr>
<tr>
<td>Radium-226 (pCi/l)</td>
<td>27±8</td>
<td>56±17</td>
</tr>
<tr>
<td>Radium-228 (pCi/l)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Lead-210 (pCi/l)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Uranium (mg/l)</td>
<td>11.4</td>
<td>4.17</td>
</tr>
</tbody>
</table>

a Samples from West Borrow Pit decant, United Nuclear Corporation mill tailings, Church Rock, New Mexico.
b Samples from sump for tailings water drainage, United Nuclear-Homestake Partners, Milan, New Mexico.

Note: Samples, unfiltered, taken in November 1979.

- Mill process designs that recycle solutions and conserve water to reduce the amount of liquids added to the impoundment
- Dewatering of tailings by process devices and drainage systems
- Neutralization of chemicals to promote immobilization of toxic substances
- Where groundwater impacts occur due to seepage, action must be taken to reduce seepage and restore groundwater quality.

b. The groundwater restoration plan should establish groundwater protection standards. It should specify maximum concentrations of certain listed constituents at points selected to provide prompt indication of contamination on the down gradient edge of the tailings disposal areas. The listed constituents include metals such as arsenic, lead, and mercury, insecticides and herbicides, as well as radium and alpha radiation. Standards will have to be set for other hazardous substances that are expected to be in the groundwater, or which have been detected in the uppermost aquifer.

6. After the final disposal, tailings or wastes must have an earth cover designed to control radiological hazards for a minimum of 200 years, and for 1,000 years to the extent reasonably achievable. Licensees must also limit radon-222 releases to 20 picocuries per square meter per second, averaged over the disposal area. Radon release limitation requirements apply to any portion of the disposal site unless radium concentrations do not exceed 5 picocuries per gram in the first 15 centimeters (cm) below the surface and do not exceed 15 picocuries in layers more than 15 cm below the surface. Direct gamma exposure should be reduced to background levels.

7. At least 1 year before major site construction, a monitoring program must be conducted to provide baseline data on the mill site and its environs. A monitoring program must be conducted throughout the construction and operation phase to assure compliance and to evaluate impacts.

8. Operations must be conducted so that airborne effluent releases are as low as reasonably achievable. Primary control is through emission control. Where necessary, institutional controls such as extending the site boundary may be employed. To control dust from tailings, portions not covered by standing liquids must be wetted or chemically stabilized. Consideration should be given to phased covering and reclamation of tailings. Operations should be conducted to provide reasonable assurance that the annual dose equivalent does not exceed 25 millirems to the whole body to any member of the public. Daily inspections of the waste retention system must be made by qualified personnel and any failures or potential problems reported to the NRC.

9. Financial surety arrangements must be made to assure that sufficient funds will be available for the decontamination and decommissioning of the mill and site and for the reclamation of any tail-
ings or waste disposal areas. The amount of the funds must be based on NRC-approved plans and cost estimates. The decommissioning plan must bring the site to a status that will allow unrestricted use of the mill site and reclamation of the tailings and waste areas in accordance with the Technical Criteria of Appendix A, described above. The surety amount must include funds for long-term surveillance and control, described in 10, below. The cost estimates must be based on the costs of having an independent contractor perform the work. The surety amount will be reviewed annually to consider inflation, changes in plans, work performed, and other conditions influencing costs. Financial surety arrangements may include surety bonds, cash deposits, certificates of deposit, deposits of government securities, and irreversible letters or lines of credit. Parent company guarantees may also be used.

10. A minimum charge of $250,000 (in 1978 dollars) to cover the cost of long-term surveillance of mill and tailings sites must be paid prior to termination of the license. This charge may be higher if a particular site is found to have significantly greater requirements. Prior to payment, the charge will be adjusted for inflation annually using the Consumer Price Index.

11. Prior to license termination, title to the land used for disposal shall pass, without cost, to the United States government, or to the State, including land needed to ensure long-term stability.

12. Final disposition of tailings and wastes should not require ongoing maintenance to preserve isolation. Inspections of the site shall be made at least annually to confirm the integrity of the pile and to determine the need for maintenance work. The NRC may require more frequent inspections at particular sites.

13. EPA identifies approximately 375 hazardous substances for which standards must be set if anticipated or detected in groundwater.

To assist the industry in conforming to the regulations, additional guidance has been provided by the NRC. This includes:

1. Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Material

2. Recommended Outline for Site Specific Reclamation and Stabilization Cost Estimates

3. Design of Erosion Protection Covers for Uranium Mill Tailings Sites

4. Standard Format and Content of Decommissioning Plans for Licensees Under 10 CFR Parts 30, 40, and 70 (Regulatory Guide 3.64)


The EPA has overall responsibility for establishing environmental standards and guidelines. Applicable EPA standards are contained in part in 40 CFR Part 192, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,” particularly in Subpart D. The standards in Subpart D became effective December 6, 1983. However, these facilities are regulated in accordance with NRC and “agreement” State regulations under 10 CFR Part 40, “Domestic Licensing of Source Material.”

\(^{33}\)For a definition of source material, see the Glossary.
Appendix L:
Mr. Scott Amey  
Senior Research Associate  
Project on Government Oversight  
1900 L Street, NW  
Suite 314  
Washington, DC  20036-5027  

SUBJECT: QUESTIONS RELATED TO NRC'S COMMENTS ON THE REVISED DRAFT BIOLOGICAL OPINION ON ATLAS  

June 5, 1998  

Dear Mr. Amey:  

In your May 27, 1998, letter to me you asked several series of questions related to the U.S. Nuclear Regulatory Commission's (NRC's) comments on the U.S. Fish and Wildlife Service's (FWS') Revised Draft Biological Opinion related to the proposed reclamation of Atlas Corporation's uranium mill tailings pile near Moab, Utah. Your questions and our responses follow.  

*Will the Atlas ground-water Corrective Action Plan (CAP) be revisited? When does NRC plan to revisit the CAP? What does revisit mean?*  

The NRC continues to work with FWS and Atlas on the need to revisit the CAP. All three organizations agree that a revisit of the CAP is necessary to see if there are ways to accelerate the cleanup of ground-water contamination currently found at the site. Presently, Atlas is under an NRC-accepted CAP that requires dewatering of the tailings, and relies on natural flushing for the ground water to eventually reach applicable standards. This approach was accepted by the NRC in the early 1990s based on an engineering analysis that showed that active remediation, such as pumping of the ground water, was not feasible at this site.  

Notwithstanding the fact that Atlas has an NRC-accepted ground-water cleanup program, both NRC and FWS would like to have Atlas look at ways to accelerate clean up of the current contamination. When NRC talks about revisiting the CAP, it essentially means that Atlas should look at ways of accelerating the cleanup of the current contamination in the ground water. This acceleration can be through a number of means, including faster dewatering of the tailings, possible use of new pump and treat technologies, and the application of chemical or biodegradable processes. NRC would review the revised CAP once it is submitted by Atlas; therefore, the NRC's review schedule is dependent on Atlas. Based on discussions with Atlas, NRC understands that Atlas plans to submit a revised plan in about six months.
Does NRC have any intention of allowing alternate concentration limits (ACLs) at the Atlas site? Who would approve ACLs? Would ACLs have a ceiling, or are they open?

The use of ACLs at a site is allowed under NRC regulations in 10 CFR Part 40, Appendix A, Criterion 5(B)5, which conform to U.S. Environmental Protection Agency (EPA) regulations in 40 CFR Part 192. The standards specified in criterion 5(B)5 are either background concentrations found at the site; maximum concentration limits (MCL) established by EPA, and applicable to the constituents listed in Criterion 5C; or ACLs. Because the use of ACLs are permitted by regulations, if it chooses, Atlas may apply for an ACL for any constituent covered in either Criterion 5C or the Atlas license. In addition, if NRC were to add other constituents not currently regulated, such as ammonia, the only standards that NRC could apply would be either background or an ACL, since there are not MCLs for such constituents in Criterion 5C.

Acceptance of an ACL is the sole regulatory responsibility of NRC. However, in developing any ACL for the site, NRC would need to consult with the FWS to assess what impact that ACL would have on any endangered species in the Colorado River. In conducting these consultations, FWS would provide NRC with a surface-water standard for protection of endangered species in the Colorado River. NRC would then use this standard as a benchmark for determining if the Atlas proposed ACL was acceptable.

Although there is no ceiling on any ACL Atlas chooses to develop, the surface-water standard provided by FWS as part of the Section 7, Endangered Species Act consultation will limit the value of any ACL. In addition, as part of its review process in determining the acceptability of an ACL application, NRC requires that licensees demonstrate that the ACL being proposed, whether for radiological or non-radiological constituents, is as low as reasonably achievable (ALARA). Thus, this ALARA approach also helps ensure that ACLs are established at a minimal value. Finally, the State of Utah has concurrent jurisdiction over the non-radiological aspects of ground-water cleanup, and can establish more stringent standards for those constituents.

Did Oak Ridge National Laboratory (ORNL) work on the NRC's Draft Environmental Impact Statement (DEIS)? Does the ORNL office in Grand Junction have some level of expertise in tailings reclamation? Why was ORNL's Tennessee office chosen to perform the DEIS over the Grand Junction office?

The NRC did use the ORNL Tennessee office to assist in the preparation of the DEIS. The ORNL Tennessee office was chosen to work on the DEIS because it had the expertise necessary to support the preparation of the DEIS. The qualification of the ORNL Grand Junction staff has not been raised as an issue by the NRC staff. The concerns raised by NRC in its February 13, 1998, letter to FWS, and in the comments on the revised biological opinion, center around the assumptions and boundary and initial conditions, used in the ORNL Grand Junction modeling and in the interpretation of the results. In addition, the NRC staff questioned how the ORNL Grand Junction modeling correlated with historical conditions observed at the site.
I trust that this responds to your request. If you have any questions, please contact me or Myron Fliegel, the NRC project manager for the Atlas site. I can be reached at (301) 415-7238 and Dr. Fliegel at (301) 415-6629.

Sincerely,

[Signature]

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
Appendix M:
Final
Technical Evaluation Report
for the Proposed Revised
Reclamation Plan for the Atlas
Corporation Moab Mill

Source Material License No. SUA 917
Docket No. 40-3453
Atlas Corporation

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

March 1997
7.0 APPENDIX A ASSESSMENT

Appendix A to 10 CFR 40 establishes technical, financial, ownership, and long-term site surveillance criteria relating to the siting, operation, decontamination, decommissioning, and reclamation of uranium milling facilities. Each site-specific licensing decision is to be based on the criteria in the appendix, taking into account the public health and safety and the environment. Decisions based on the criteria in the appendix must take into account the risk to the public health and safety and the environment with due consideration to the economic costs involved. Decisions as to the ability of the design to meet "reasonably achievable" criteria must take into consideration the state of technology as well as the economics of improvements in relation to the resulting benefits.

Appendix A provides flexibility in the NRC regulatory program in several ways. It allows licensees to propose alternatives to the specific requirements contained in the appendix. It also requires that licensing decisions take into consideration the economic costs involved (this requirement originates in the Atomic Energy Act of 1954, as amended). One of the reasons for this flexibility was the recognition that some of the regulations in Appendix A could not be applied to existing sites with the same level of conservatism as they could be applied for proposed new sites. The Generic Environmental Impact Statement on Uranium Milling, NUREG-0706 (1980) explicitly discussed this. As a result, the criteria in Appendix A that identify goals, as opposed to specific numerical requirements, are applied to existing sites with the recognition that the goal may not be met to the extent that it would for a new proposed site.

The following Appendix A criteria were considered for the proposed licensing decision to amend Source Material License SUA-917 in accordance with the reclamation plan submittals. Criterion 2, 8, and 11 are not applicable for review and approval of a reclamation plan and were therefore not considered.

Criterion 1

Criterion 1 addresses the general goal of siting and designing facilities to provide for the permanent isolation of tailings and associated contaminates by minimizing disturbance and dispersion by natural forces without the need for ongoing maintenance. As discussed above, it is recognized that the general goal in Criterion 1 may not be met at the existing Atlas site to the extent that it would for a new site. The following site features must be considered when judging the adequacy of an existing site:

1. Remoteness from populated areas:

   The Moab Mill is located on the west bank of the Colorado River, 3 miles northwest of the center of the City of Moab, in Grand County, Utah. There is a private residence adjacent to the restricted area to the northeast. The 1990 census reports a population of 4050 for the city of Moab. This shows a decrease in population from the 1980 census which reported a population of 5333 for Moab. The population of Grand County has also decreased from a population of 8200 in 1980 to 6800 according
to the Utah Department of Employment Security. Review of data from the
licensee indicates that the population within a 10 km radius of the mill
has been declining since 1970. (See Draft Environmental Impact
Statement, October 1995.)

Adjacent lands and waters are used for a variety of activities. State
Highway 279 and U.S. Highway 191, both adjacent to the site, are major
transportation routes for industry and tourism. Outdoor recreational
use of the area is heavy; Arches National Park is across U.S. 191, with
the visitor center less than 2 miles northwest of the site.

Population projections for these areas are difficult to make. There may
be significant population increases in the immediate future due to the
development of outdoor recreational facilities and the proximity of
National and State parks. It is doubtful, however, that there will be
any increase in the immediate proximity of the disposal area. The
Nature Conservatory has purchased the wet-lands between the City of Moab
and the Colorado River, prohibiting development in this area. Any
development to the east of the disposal area, on the west bank of the
Colorado River, would be in the flood plain for Moab Wash and the
Colorado River. The licensee will be required to include the entire
reconfigured Moab Wash in the final fenced restricted area which will
help ensure that there are no future developments in the immediate
vicinity of the disposal area.

While the proposed location of the Atlas tailings is not as remote from
populated areas as most tailings piles, there are at least two tailings
piles that were reclaimed in more densely populated areas. Tailings
from the former Vitro rare metals plant site were reclaimed on site
within the city of Canonsburg, Pennsylvania. The 1980 census figures
(the most recent when the decision was made) showed a population of 7938
within 1 mile of the site. The population within 1 mile from the
reclaimed tailings at Shiprock, New Mexico was 2197.

2. Hydrologic and other natural conditions as they contribute to continued
immobilization and isolation of contaminants from ground-water sources:

The reclaimed disposal area will be capped with a cover system which
will minimize infiltration. The review of ground-water conditions at
the site to assure compliance with 10 CFR 40, Appendix A, is currently
being done under other licensing actions. The licensee is currently
implementing a CAP to return ground-water quality to established
standards. The CAP was submitted on March 31, 1989, and was fully
operational prior to July 1, 1990. The CAP is being revised as a result
of information collected since it was initiated.

3. Potential for minimizing erosion, disturbance, and dispersion by natural
forces over the long-term:

The potential for wind and water erosion will be minimized by several
design features. The tailings will be re-contoured and covered by an
erosion protection cover. A drainage system will be constructed to
divert precipitation away from the tailings. The tailings cover and
diversion channels will be protected from flooding and erosion by engineered rock riprap. The cover and channels have been designed in accordance with the guidance suggested by the staff (NRC, 1990). The staff considers that erosion protection which meets that guidance will provide adequate protection against erosion and dispersion by natural forces over the long term.

4. The tailings will be disposed of in a manner that will not require active maintenance to preserve conditions at the site:

The staff considers that the erosion protection will not require active maintenance over the 1000-year design life, for the following reasons: 1) the riprap has been designed to protect the tailings from rainfall and flooding events which have very low probabilities of occurrence over a 1000-year period, resulting in no damage to the layers from those rare events; 2) the rock proposed for the riprap layers will be durable and is not expected to deteriorate significantly over the 1000-year design life; and 3) during construction the rock layers will be placed in accordance with appropriate engineering and testing practices, minimizing the potential for damage, dispersion, and segregation of the rock.

As discussed in Sections 2 and 3, the staff also considers that the site should not require active maintenance to mitigate the effects of geologic, including seismic, disturbances.

Criterion 3

Criterion 3 sets below-grade disposal as the prime option for tailings disposal.

Relocation of the tailings to another site so that all the contaminated material could be placed below grade is technically feasible; however, if the other criteria are met, the benefits of below grade disposal at another location, over stabilizing the tailings in place would be small with respect to this criterion. Since the existing site is adequate and the design of the disposal cell meets the closure criteria, the cost of disposing the contaminated materials below grade by relocating the disposal area would be much greater than the benefit realized, making relocation economically impracticable.

If below-grade disposal is not practicable, the disposal plan must provide reasonably equivalent isolation of the tailings from natural erosional forces. This is addressed in Criteria 4, 6, and 12.

Criterion 4

Criterion 4 sets specific technical criteria for disposal of tailings.

Criterion 4(a) requires that upstream rainfall catchment areas be minimized to decrease erosion potential and the size of the floods which could erode or wash out sections of the tailings disposal area.
The site is located in an area which is flooded by offsite floods from Moab Wash and the Colorado River. However, as discussed in the Section 4, the site is protected from direct onsite precipitation and flooding by engineered riprap layers for the top and side slopes; the tailings disposal cell will need this protection regardless of where it is located. The riprap for the side slopes and drainage ditches is large enough to resist flooding from the minimal flow velocities of floods occurring from a PMF on the Colorado River. A large rock apron has been designed to provide protection against the potential migration of Moab Wash and the Colorado River. The staff therefore concludes that the erosion potential at the site has been acceptably minimized, since any flooding at the site will be mitigated by the erosion protection, and the forces associated with offsite floods are minimal.

Criterion 4(b) states that topographic features should provide good wind protection.

The staff considers that the site will be adequately protected from wind erosion by placement of an engineered riprap layer that protects the tailings from surface water erosion. Studies performed for the NRC have shown that an engineered riprap layer designed to protect against water erosion will be capable of providing adequate protection against wind erosion.

Criterion 4(c) states that cover slopes must be relatively flat after stabilization to minimize erosion potential and to provide conservative factors of safety assuring long-term stability. In general, slopes should not be steeper that 5H:1V.

The side and relatively flat top slopes of the covers will be protected from erosion by engineered riprap layers designed to provide long-term stability (see Section 4.3). In order to reduce the length of the slopes and, therefore, to minimize intrusion onto the Colorado River floodplain, the side slopes will be 10H:3V. The erosion potential of the covers will be minimized by the design of the rock to be sufficiently large to resist flooding and erosion, based on the slope selected. The staff concludes that the slopes, with their corresponding rock designs, will be sufficiently stable to meet the erosion aspects of this criterion.

Criterion 4(d) requires a full self-sustaining vegetative cover be established or a rock cover employed to reduce erosion to negligible levels. The rock cover design must include consideration of such factors as the shape, size, composition, and gradation of the rock particles; rock cover thickness and zoning of particle size; and steepness of underlying slopes. The rock must be good quality.

Due to the arid nature of the site, the licensee made no attempt to substantially self-sustaining vegetation over a 1000-year period. The contaminated tailings will be protected from flooding and erosion by an engineered rock riprap layer. The riprap has been designed in accordance with the guidance suggested by the NRC staff (NRC, 1990). As discussed in Section 4, the staff considers that erosion protection
which meets that guidance will provide adequate protection against erosion and dispersion by natural forces over the long term. Adequate protection is provided by: (1) selection of proper rainfall and flooding events; (2) selection of appropriate parameters for determining flood discharges; (3) computation of flood discharges using appropriate and/or conservative methods; (4) computation of appropriate flood levels and flood forces associated with the design discharge; (5) use of appropriate methods for determining erosion protection needed to resist the forces produced by the design discharge; (6) selection of a rock type for the riprap layer that will be durable and capable of providing the necessary erosion protection for a long period of time; and (7) placement of a riprap layer in accordance with accepted engineering practice and in accordance with appropriate testing and quality assurance controls.

Criterion 4(e) requires that the impoundment not be located near a capable fault that could cause a maximum credible earthquake larger than that which the impoundment could reasonably be expected to withstand.

There are no capable faults near the site that could generate earthquakes larger than the design basis earthquake. Faults of the Moab fault system, which occur under and adjacent to the site, are not capable faults.

Criteria 5, 7, and 13

Criteria 5, 7, and 13 concern groundwater protection. As previously discussed, groundwater is being addressed under separate licensing actions. However, groundwater protection standards at the site will be in accordance with these criteria.

Criterion 6

Criterion 6 sets forth performance criteria for the disposal of tailings.

Criterion 6(1) requires that waste disposal areas be closed in accordance with a design which provides reasonable assurance that average releases of radon-222 and radon-220 to the atmosphere will be limited to 20 picocuries per square meter per second (pCi/m²/s). The design is to be effective for 1000 years to the extent reasonably achievable and, in any case, for at least 200 years.

The evaluation of the radon barrier utilized the RADON computer code (NRC, 1989b) and acceptable parameters to estimate radon emanation from the pile. The design is supported by adequate construction specifications, settlement monitoring, and quality control programs. Therefore, the staff concludes that the cover design will limit radon releases to atmosphere to 20 pCi/m²/s.

The design basis events for erosion protection features protecting the radon barrier are the PMP and the PMF events. Both of these events are considered to be the most severe that are reasonably possible and thus provide reasonable assurance of not being exceeded during the 1000-year
design life. The erosion protection features should assure that excessive erosion does not occur during the design life.

The design basis for seismic stability is an acceleration of 0.18g, calculated by the licensee, in its probabilistic seismic hazard analysis, as having a return period of 10,000 years. The pile slopes are designed to withstand a seismic coefficient of 0.25, which translates into an acceleration of 0.38g. Therefore, there is reasonable assurance of pile stability under reasonably expected seismic loading for 1000 years. The design basis for subsidence is uniform or differential subsidence of the bedrock surface beneath the site, of 1 meter in 1000 years. The pile is capable of accommodating 2 meters of bedrock subsidence without damage to the cover system. The design will also accommodate other geologic hazards, such as migrating sand, and rock and debris falls, that can be reasonably expected to threaten pile stability over the next 1000 years.

Criteria 6(2) and 6(3) require the licensee to verify by testing, as soon as reasonably achievable after placement of the final radon barrier, or portions of the final radon barrier, the effectiveness of the radon barrier in limiting radon releases. Criterion 6(4) requires the licensee to report the results of the verification within 90 days of completion and to maintain the pertinent data and calculations.

The licensee will be required to verify the effectiveness of the radon barrier by using the procedures described in 40 CFR part 61, appendix B, Method 115, or another method, if approved by NRC, and to report the results to NRC.

Criterion 6(5) precludes the use of materials containing elevated levels of radium in near surface cover materials.

With the exception of sandy soil from Moab Wash, all cover materials will be obtained from uncontaminated borrow areas well away from the site, and should not contain elevated levels of uranium. The licensee will be required to confirm, by testing, that cover material obtained from Moab Wash does not contain elevated levels of radium.

Criterion 6(6) imposes the long-term design requirements of Criterion 6 to all portions of the disposal site that contain a concentration of radium in land, averaged over areas of 100 square meters, which exceed the background level by 5 picocuries per gram (pCi/g) averaged over the first 15 centimeters below the surface and 15 pCi/g averaged over each 15 centimeter layer more than 15 centimeters below the surface.

The cleanup of contaminated areas is required by License Conditions Nos. 21 and 39 of Source Material License SUA-917. The cleanup will result in no areas outside the disposal cell exceeding the limit.

Criterion 6(7) requires that the licensee control, minimize, or eliminate post-closure escape of nonradiological hazardous constituents.

The radon barrier design includes a low permeability clay layer which
will also serve to limit infiltration into the disposal cell. As a result, seepage of nonradiological hazardous constituents from the disposal cell will be minimized to the extent necessary to prevent threats to human health and the environment.

Criterion 6A

Criterion 6A requires the final radon barrier to be completed as expeditiously as practicable considering technological feasibility and that completion dates for the radon barrier and interim milestones be established in the license.

Milestones for the completion of the radon barrier are identified in License Condition No. 55 of Source Material License SUA-917.

Criteria 9 and 10

Criteria 9 and 10 require that a financial surety arrangement be established to assure that sufficient funds are available to carry out the decontamination and decommissioning of the facility and the reclamation of the disposal area, and to cover the payment of the charge for long-term surveillance and control by the long-term custodian of the site.

The licensee’s currently approved surety instrument, a performance bond issued by the Acstar Insurance Company of New Britain, Connecticut in favor of the NRC, is in the amount of $6,500,000 for the purpose of complying with Criteria 9 and 10. The licensee also maintains a Standby Trust arrangement for the benefit of NRC, with Norwest Bank of Colorado N.A.

Within 3 months of approval of the reclamation plan for the disposal area, Atlas is required to submit a revised cost estimate. If estimated costs in the newly approved plan exceed the amount covered in the existing financial surety, the licensee is required to have a new surety instrument in place within 3 months of NRC approval of the new cost estimate. (License Condition No. 42 of Source Material License SUA-917.)

Criterion 12

Criterion 12 requires that the final disposition of tailings or wastes at milling sites should be such that ongoing active maintenance is not necessary to preserve isolation.

As discussed in Section 4, the staff considers that the erosion protection should not require active maintenance over the 1000-year design life, for the following reasons: (1) the riprap has been designed to protect the tailings from rainfall and flooding events which have low probabilities of occurrence over a 1000-year period, resulting in no damage to the layers from those rare events; (2) the rock proposed for the riprap layers is designed to be durable and is not expected to deteriorate significantly over the 1000-year design life; and (3) during construction, the rock layers will be placed in accordance with appropriate engineering and testing practices, minimizing the potential
for damage, dispersion, and segregation of the rock.

As discussed in Sections 2 and 3, the staff also considers that the site should not require active maintenance to mitigate the effects of geologic, including seismic, disturbances.
Criterion 4(c) – flatness of slopes: The top slopes are relatively flat. Testing by Atlas, in accordance with approved construction specifications, will assure that appropriate compaction of the cover is achieved. The NRC staff has reviewed slope dynamics to assure stability.

Criterion 4(d) – self-sustaining vegetative cover or rock cover: Comment noted.

Criterion 4(e) – seismic design: Staff agrees that there is uncertainty in seismic analysis, however, because of the conservative manner in which it performed its evaluation, the staff is confident that the design meets the stability criteria. As discussed in sections 2 and 3, the staff’s evaluation of the structural stability of the pile considered all potential earthquake sources.

7.4.4 Revisions to the TER

Criterion 4(b) has been revised to remove reference to local topography.

7.5 Groundwater Criteria

7.5.1 Commenters

U.S. Department of the Interior (56-23)
Grand County Council by Jenner & Block (59-77)

7.5.2 Summary of Issues

The Department of the Interior expressed concern about groundwater quality and contaminants leaching into the Colorado River. Grand County states that, as in the Title I program, Atlas should be required to prove now how it will address groundwater contamination.

7.5.3 Staff Analysis of Comments

As stated in the TER, groundwater protection will be addressed in a separate licensing action. Contrary to Grand County’s assertion, in the Title I program, the Department of Energy separated and postponed consideration of groundwater contamination from surface remediation of tailings.

7.5.4 Revisions to the TER

No revisions were made to the TER as a result of these comments.

7.6 Criterion 6

7.6.1 Commenters

Richard L. Christie (23-25)
Grand County Council by Jenner & Block (59-78)
Appendix N:
ATLAS CORPORATION

1997 REPORT TO SHAREHOLDERS
13. DISCONTINUED OPERATIONS

During 1997, as a result of continuing delays in the regulatory approval process and due to an anticipated increase in the scope of the final reclamation plan expected to be approved by the NRC in 1998 (Note 14), the Company recorded a charge of $3,000,000 representing an increase to its uranium reclamation liability. In addition, the Company recorded a charge of $217,000 related to the clean up at its former asbestos mine located near Coalinga, California (Note 14) and also recorded a gain of $349,000 related to coinsurance experience primarily related to the operations of the Company’s Atlas Building Systems Division, which was sold in 1989.

During fiscal year 1995 the Company recognized income of $621,000 from discontinued operations, including a gain of $846,000 recorded upon the receipt of a payment from the Department of Energy under Title X of the Energy Policy Act (Note 14) in connection with the reclamation of the Company’s uranium mine and mill site in Moab, Utah. The gain was partially offset by a loss of $225,000 due to cost overruns at the Company’s Coalinga, California asbestos mine and mill reclamation project (Note 14).

The items above are included in the consolidated statements of operations under the heading "Income from discontinued operations". The following table summarizes the operating income (loss) of the discontinued businesses:

<table>
<thead>
<tr>
<th>Period ended (In thousands)</th>
<th>Asbestos Mining &amp; Milling</th>
<th>Uranium Reclamation Costs</th>
<th>Service &amp; Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 31, 1997</td>
<td>$ (217)</td>
<td>$ (3,000)</td>
<td>$ 349</td>
<td>$ (2,868)</td>
</tr>
<tr>
<td>December 31, 1996</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
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<tr>
<td>December 31, 1995</td>
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</tr>
<tr>
<td>June 30, 1995</td>
<td>$ (225)</td>
<td>$</td>
<td>$ 846</td>
<td>$ 621</td>
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</tbody>
</table>

14. COMMITMENTS AND CONTINGENCIES

Uranium Mill Site, Moab Utah

The Company is obligated to decommission and reclaim its uranium mill site located near Moab, Utah. The Company discontinued its uranium operations and permanently shut down its uranium mill and mines in 1987, and estimated shut down expenses and reclamation costs were accrued. Title X of "The Comprehensive National Energy Policy Act" ("Title X"), enacted in October 1992, provides for the reimbursement of past and future reclamation expenses related to uranium sites operated under Atomic Energy Commission contracts. The Company’s uranium reclamation costs are reduced by this Government cost sharing program since 56% of its tailings were generated under government contracts. The total estimated reclamation liability ($21,935,000) and current and future Title X receivables ($15,865,000) are shown separately in the accompanying 1997 consolidated balance sheets leaving a net liability to the Company of $6,070,000.
Appendix O:
Mr. Joseph J. Holonich, Chief
High-Level Waste and Uranium
Recovery Projects Branch
Mail Stop TWFN 7-J9
Division of Waste Management
Office of Nuclear Material
Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Holonich:

The Department of the Interior has reviewed the Draft Environmental Impact Statement and the draft technical evaluation report for the Reclamation of the
Atlas Mill Tailings Pile Site, Moab, Grand County, Utah, and has prepared the
enclosed comments (enclosure 1). Minutes of a recent interagency meeting are
enclosed for your information (enclosure 2).

Many questions surrounding the environmental impacts of the Nuclear Regulatory
Commission (NRC) proposal remain unanswered. The documents do not adequately
address issues raised during the scoping process, nor do they answer critical
questions raised during development of preliminary drafts. We recommend that the
NRC not release a final EIS until identified inadequacies can be rectified.
Should the final EIS not satisfactorily address the issues and concerns raised
in our comments, the concerned bureaus may recommend to the Department that this
matter be referred to the Council on Environmental Quality.

We appreciate the opportunity to review the Draft Environmental Impact Statement
and the draft technical evaluation report.

Sincerely,

Willie R. Taylor
Director, Office of Environmental
Policy and Compliance

Enclosures
Comments of the Department of the Interior
on the Draft Environmental Impact Statement for the
Reclamation of the Atlas Mill Tailings Pile Site, Moab,
Grand County, Utah

General Comments

The Draft Environmental Impact Statement (DEIS) addresses a wide range of complex
issues associated with the reclamation of uranium mill tailings at the Atlas
site. However, many other important issues previously raised by the Department
have not been adequately addressed. Important issues previously brought to your
attention but still not resolved include overall risk to Colorado River
resources, and air pollution risks to employees at Arches National Park
Headquarters. We remain concerned about the undocumented degree of potential
impacts to the Scott M. Matheson Wetland Preserve, located across the river from
the Atlas site.

On March 14, 1996, the Times Independent newspaper in Moab reported that Atlas
had dropped all Castle Valley sites as possible sources of borrow material. This
action by Atlas renders impossible any meaningful assessment of environmental
impacts from mining and transporting of borrow materials, and further calls into
question the adequacy of this DEIS.

Relationship of Draft Environmental Impact Statement and Draft Technical
Evaluation Report

A major concern is related to the overall presentation of information in the DEIS
and the Draft Technical Evaluation Report (DTER). It is imperative that
information be integrated between these two documents. For example, many
analyses and results are presented in the DTER; however, much of this information
is not presented, or even cited, in the DEIS. As such, the DEIS contains major
omissions with respect to the presentation of critical information and related
analyses. (Sections of the DEIS where such omissions occur are noted in the
Specific Comments provided below.) Furthermore, in order to carry out an
adequate assessment of environmental impacts related to the reclamation of
uranium mill tailings at the Atlas site, the "open issues" outlined by NRC in the
DTER must be satisfactorily addressed and then incorporated into the analyses
contained in the final statement (FEIS). It is our understanding that the
licensee is in the process of resolving these open issues. The FEIS should not
be issued until these open issues are addressed so that the findings may be
incorporated into the FEIS.

As a related concern, page xvii of the DEIS states that the DTER "focuses on
engineering aspects of the Atlas proposal and its compliance with Appendix A to
10 CFR Park 40, whereas this DEIS focuses on the environmental aspects." Based
on a review of the 13 Appendix A Technical Criteria in 10 CFR 40 (Appendix C,
page C-1 of the DEIS) and the outstanding "open issues" (Table 1-1, DTER, pages
1-5 - 1-7), it is very obvious that while the DTER focuses on "engineering
aspects," these aspects have definite environmental implications for the project.
For example, the "open issues" described in Table 1-1 of the DTER include the
presence or absence of faulting, the potential for subsidence, seismic design,
slopes of the disposal cell, liquefaction potential for the site, erosion
protection, groundwater flow directions, and compliance with groundwater
protection standards for the site. As stated above, these issues have a
definitive bearing on the short-term and/or long-term environmental consequences
of the reclamation plan and, as such, must be fully considered in the DEIS.
These comments, therefore, address information from both the DEIS and the DTER.
We understand that the licensee may propose alternatives to the criteria in Appendix A to 10 CFR Part 40. However, as the DEIS states in Section 1.4, page 1-5, any proposed criteria must be equivalent to or better than that required by the existing criteria in Appendix A.

The DEIS has not proven that the on-site reclamation design standards proposed by the licensee are "equivalent to or better than" the Appendix A criteria 1(a), 1(b), 3, 4(c), 4(e), 5(a), 5(e), 5(h), 5(I), 5(k), and 13.

The on-site reclamation plan as explained in the DEIS and DTER violates the 11 criteria listed above and can not be expected to reasonably achieve compliance with these specific criteria. For example, throughout the DEIS, there are statements that contaminants will continue to leach into the ground water and the Colorado River (Sections 2.1.6., 2.4, 4.4.5.1, 4.6.1.5, 4.12, and Table 2.4-1 in two places). There is no evidence from which to draw the conclusion that the hydrologic and other natural conditions of the licensee's proposal will promote immobilization and isolation of contaminants. This is also true of the other 11 criteria listed above.

Based on our review of the DEIS and DTER, we have two major general concerns with the technical analyses contained in these documents. One general concern is physical in nature and relates to the geomorphic stability of the site (see Specific Comments below). The other general concern is chemical in nature and stems from the fact that, to our knowledge, no chemical analyses have been performed on the solids in the tailings (see Characteristics of the Tailings, pages 2-6 to 2-9, DEIS). Furthermore, the true chemical variability within the natural system (and specifically the site) does not appear to have been adequately characterized.

Characterization of Tailings Solids

As stated in previous letters (including the letter from Arches National Park Superintendent Noel Poe to Mike Fliegel of the NRC, dated 9-8-95) from the Park Service to the NRC, we still have concerns related to potential impacts of toxic chemicals. In brief, we continue to be concerned about: the lack of a minimal data set with respect to number of samples from different media; the number of contaminants not considered in spite of our suggestions to the contrary; the lack of a chemical characterization of the concentrations of contaminants in solids in various areas and levels of the tailings material; the absence of analyses regarding respirable particulates; the absence of quantitative information of the number and chemistry of seeps from the site into the Colorado River; and the lack of a credible geochemical or biological analysis of the mixing zone where the leachate enters the Colorado River. Further chemical sampling in different media is warranted to address these issues.

The lack of information on the chemical composition of the pile and contaminated site soils is crucial. Without knowing what is contained in the tailings material, predictions of gradual or catastrophic impacts to river or other surrounding environment are impossible. Without this information, the sweeping statements in the DEIS about the potential results of failure of part or all of the tailings pile into the Colorado River or the air pollution resulting from remediation disturbance are premature and unsupported. If the contents of the pile or site soils are not clearly established, it is unclear how predictions can be made regarding the potential water pollution effects of failure of the pile or parts of the pile into the river or the potential air pollution effects of construction activities involving the pile or contaminated site soils. When commenting on this question, Atlas response has generally been limited to statements that the pile contains "uranium mill tailings," or references to the
chemical analyses performed on tailings leachate. On one occasion, an Atlas representative cited records that had been kept on mill output as describing the content of the pile. None of these responses directly answers the question of the characterization and concentrations of contaminants in tailings solids, and their spatial distribution within the pile.

Water Pollution Risks

The overall message of the DEIS seems to be that the risks are small outside of the immediate mixing zone in the vicinity of the pile. This conclusion is premature for the following reasons:

1) Not all the parameters of concern or sites suggested by this Department have been monitored, as is further documented in our detailed comments below.

2) The impacts of contaminated sediments upon aquatic organisms downstream from the pile are potentially very important but hardly discussed at all in the DEIS. The discussions in Appendix F are spotty and incomplete.

3) The radiological contaminants moving from the pile into the river have been incompletely studied, and some of the radioactive isotopes are of particular concern due to potential human impacts via the following pathways:

A) Fish flesh consumption,

B) Drinking water sources downstream, and

C) Direct human contact with the river and its sediments.

Risks from these pathways were not well analyzed in the DEIS, and no fish fillet samples from the mixing zone area have been analyzed for radiological contamination despite previous requests that this be done. If a catastrophic failure of the tailings pile occurred, radiological wastes would be distributed along sand bars and other bank habitats heavily used by river rafters. The potential risks were not adequately covered in the DEIS.

4) Concerning non-radiological hazardous substances coming from the pile and accumulating in fish downstream of the pile, the vanadium, selenium, and mercury accumulations cited in the DEIS are of particular concern related to potential cumulative effects on endangered fish and other aquatic resources. A 1995 paper by Steven Hamilton published in the Journal Ecotoxicology and Safety (volume 30, page 134-142), concluded that vanadium and zinc tied for metals most toxic to three endangered Colorado River system fish, and that a form of selenium (selenite) was the next most toxic. Mercury is a special concern because of bioaccumulation aspects. Cumulative impacts and combined (additive or synergistic) effects of the many combinations of contaminants coming from the pile need to be carefully evaluated. We believe they have not yet been fully considered. The DEIS should indicate that all pollutant loads must be permitted under the Clean Water Act and monitored to meet water quality standards. In the case of the Atlas pile, there are special reasons (endangered fish presence and heavy human contact and large drinking water sources downstream) not to allow considerable unregulated amounts of pollution to continue to flow into the Colorado River as is suggested for the Preferred Alternative in the DEIS.

5) Potential hazards to humans or aquatic biota utilizing Lake Powell are not fully documented. Although it is true that many metallic contaminants will end up in sediments near the inflows to Lake Powell, it is not necessarily true that these hazardous contaminants will never be re-mobilized to cause problems in Lake Powell. There are several important potential sources of remobilization and transformation of contaminants in Lake Powell inflow sediments:
A) There are enough carbon sources in these sediments to promote microbially-activated reducing subsurface environments. Metals can be reduced to more mobile and dangerous forms. Also typical of such environments is bioturbation of sediments by worms and fish, as well as biomethylation by bacteria. In such shallow, fluctuating-water environments, algae often mobilize and transform metals to different forms. Via such mechanisms, toxic metals can be mobilized and changed to forms which are more biologically hazardous.

B) As the level of Lake Powell falls (which it does on a regular basis), previously deposited sediments are exposed and eroded by the river channel as it moves around meandering its way downstream. This re-suspends metals which were previously trapped in the sediments. Some of these metals may now be in the more mobile and biologically active forms, as discussed above.

Air Pollution Risks

Recent conversations with the Director and other experts at the Lovelace Biomedical and Environmental Research Institute, a Department of Energy (DOE) laboratory in Albuquerque, confirm that the sections of the DEIS discussing air pollution risks are inadequate. Any risk to staff at Arches National Park would more likely be due to risk from hazardous respirable particles than from radon, and without knowing what is in the pile, it is impossible to ascertain which hazardous substances are involved or the degree of the risk to employees of the National Park Service (NPS). The main emphasis of the DEIS risk assessment on air was modeling of radon combined with some general statements concerning particulates. This oversimplified approach is inadequate. For example, if the amount of arsenic in the pile and in other contaminated site soils to be disturbed is unknown, how can we possibly know if respirable particles of arsenic will be a risk to employees at Arches headquarters one mile downwind? The same is true of other respirable particles which might be hazardous due to toxics other than arsenic. If radon is not the true potential hazard a mile away but various types of respirable particles are the true hazard, we must know what is the in pile and contaminated site soils which will be disturbed before we can adequately assess the true air pollution hazard.

Consistency with Other Reclamation Efforts

Another general concern which we have is with respect to the consistency of the reclamation of the subject tailings relative to the reclamation of other uranium mill tailings adjacent to or near the Colorado River or its tributaries. More specifically, DOE has, at a number of sites, relocated uranium mill tailings away from the Colorado River and its tributaries to upland engineered sites. Presumably, these relocation activities were based on findings that permanent sites adjacent to or near these drainages were not appropriate in terms of long-term protection of the environment and/or human health concerns. The FEIS should address this consistency issue and clearly state why the Atlas site is different from these other sites, thus justifying leaving uranium mill tailings at the current Atlas site immediately adjacent to the Colorado River.

Estimated Costs

The DEIS states that Atlas estimates the cost of on-site reclamation to be $11 to $17 million (Summary, page xxii [Section 5.1, page 5-1 states $13 to $16 million]). This is the same price range as Atlas provided for the 1993 Environmental Assessment (EA).

Because the reclamation design has changed considerably since the design offered by the 1993 EA, we are concerned that the costs have changed as well. Following is a list of some of the major design differences that became obvious in reviewing Section 2.1.2.1:
several times more cover material is specified;
- the amount and size of rip rap have increased significantly;
- rip rap will be hand placed (DTER Section 4.5.4.3);
- several lifts of compacted clay applied under time limits;
- more rock aprons and toes (DTER pages 4-13 to 4-19);
- and slope angles requiring more material and more labor.

These design changes in combination with the cost of living increases would appear to indicate that the 1996 estimate for reclamation in place would be significantly more expensive than the 1993 estimate.

We recognize that NRC's standard procedures does not require the licensee to provide a line item by line item cost estimate until the licensee's reclamation plan is approved. However, an accurate estimate of the cost of reclaiming the tailings pile is absolutely necessary for comparison between alternatives since the DEIS concludes that moving the tailings to the Plateau Site is a more costly but better environmental solution. (See Section 2.4.)

We suggest that this is an issue of controversy sufficient for NRC to depart from standard procedures or policy. Prior to approving a license amendment, NRC should ask Atlas to complete a line item by line item estimate of the cost for reclaiming in place. This listing must include detailed costs on obtaining and transporting of cover and rip rap material, for reclaiming borrow areas, for road construction or highway repair due to transportation impacts (as evidenced by the $50 million dollar highway rehabilitation statement in Section 4.7.5.2, page 4-61), for drilling monitoring wells, and for obtaining Alternative Concentration Limits (ACLs) or other ground and surface water requirements, etc.

Specific Comments - DEIS

Page xvii, Paragraph 3.a.: It is stated in the DEIS that "Reclamation of tailings should be consistent with NRC policy and regulations and prior NRC actions involving tailings reclamation ..." The reclamation plan should also consider prior DOE actions involving tailings reclamation (particularly in the Colorado River basin). Two of the larger Uranium Mill Tailings Remedial Action (UMTRA) projects, of the 24 that DOE has been involved with since 1978, are the Grand Junction and Rifle sites in Colorado. Both of these sites were originally located along the Colorado River, and both tailings piles were eventually moved to locations at which standards could be achieved.

Page xviii, Paragraph 3.b: Based on Scoping, a major category of concern was that "The chemical and physical composition of the tailings should be well described." As noted in our general comments, the chemical composition of the solids in the pile are still not described in the DEIS. There are no descriptions of concentrations of contaminants in the pile solids in the DEIS. Both Atlas and NRC have previously confirmed that no such data exist. We have consistently taken the position that it is impossible to properly characterize risks to the Colorado River or air pollution risks to humans in the vicinity without first knowing what is in the pile. Without this information, related conclusions contained in the DEIS are unsubstantiated.

Page xix, Paragraph b: The DEIS states that "The increase in contamination should be too slight to have any appreciable long-term impact on land uses along the river." Since the chemical content of the solids in the pile is not known (as noted above), the basis for this conclusion is unclear. More information should be provided to substantiate this conclusion.

Page xix, Paragraph a: We do not believe that there is enough background or mixing zone data to conclude that leachate from the tailings to the Colorado River would have a "small, generally undetectable impact on surface water quality." This overall conclusion near the front of the DEIS is not consistent with the statements in section 4.6.1.5: that pile-source ammonia and gross alpha
Appendix P:
March 12, 1999

NRC ISSUES FINAL ENVIRONMENTAL STATEMENT
ON URANIUM MILL TAILINGS PILE IN UTAH

A proposal by the Atlas Corporation to leave its uranium mill tailings pile permanently in place near Moab, Utah, was found environmentally acceptable by the Nuclear Regulatory Commission if the company meets a number of specific requirements from the NRC and the Fish and Wildlife Service (FWS) and if it can show that ammonia levels in the Colorado River will be reduced to levels specified by the FWS.

The finding was contained in a Final Environmental Impact Statement (FEIS) issued by the NRC.

The tailings pile resulted from operations of a uranium mill at the Moab site from 1956 until 1984. The facility has been owned by Atlas since 1962. Uranium is no longer processed at the site, and the mill has been dismantled except for one building.

The Atlas proposal includes (1) re-grading the tailings to enhance draining off the pile and (2) installing an earth and rock cover system over the pile. This cover system is intended to minimize radon escape, infiltration of rain water into the tailings (thus minimizing infiltration of tailings contaminants into the groundwater), and tailings erosion potentially caused by surface runoff from rain or flooding of the Colorado River.

The NRC issued a draft environmental impact statement on the proposed on-site disposal for public comment in January 1996 and held public meetings in Moab in April 1994, February 1996 and September 1998 to discuss the proposal. Copies of public comments and NRC responses to them are included as appendices to the FEIS.

As required by the Endangered Species Act, the agency also consulted with the FWS concerning the proposed on-site tailings stabilization. In a Final Biological Opinion, FWS concluded that the proposal would jeopardize the continued existence of four endangered fish species. To avoid the likelihood of this jeopardy, the FWS developed reasonable and prudent alternatives that are focused on expediting cleanup of the groundwater and that identify the ammonia concentrations in the Colorado River that are needed to avoid future jeopardy to endangered fish. If the NRC approves the Atlas proposal, it will require the company to meet the conditions specified in the FWS opinion.
Significant additional NRC requirements that would be imposed if the agency approves the Atlas plant would include analyses to show that ammonia concentrations in the Colorado River will be reduced to the levels identified by the FWS and more expeditious cleanup of the groundwater. Other requirements would include minimization of dust emissions; submission of a spill prevention plan and an erosion control plan for NRC approval; interception and storage of contaminant-laden runoff through use of adequate drainage control, retention and treatment ponds, silt fences, and other means as necessary; and avoidance of major earthmoving operations during periods of high thunderstorm potential when feasible.

The NRC also issued a final technical evaluation report in March 1997 on the safety aspects of the company's proposal to dispose of the mill tailings on site.

When printed copies of the FEIS are available (expected within several weeks), copies will be sent to the Environmental Protection Agency (EPA). The NRC can make no decision on the pending Atlas request for a license amendment to permit stabilization of tailings on site until 30 days after publication by EPA of a Federal Register notice stating that the FEIS has been filed with EPA.

A copy of the "Final Environmental Impact Statement Related to Reclamation of the Uranium Mill Tailings at the Atlas Site, Moab, Utah," document number NUREG-1531, will be sent to the Grand County Public Library, 25 South 100 East, Moab. A copy will also be available for review and copying at the NRC Public Document Room, 2120 L Street, N.W., Washington, D.C. 20555; telephone 202/634-3273.

Copies of the document will be available for purchase from the Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328.

In addition, portions of the FEIS will be available on the NRC Internet web site at http://www.nrc.gov/OPA/reports.
Moab FEIS - Abstract and Summary

ABSTRACT

This Final Environmental Impact Statement (FEIS) has been prepared by the Nuclear Regulatory Commission (NRC), Office of Nuclear Material Safety and Safeguards, to address potential environmental impacts associated with a request by Atlas Corporation to amend its existing NRC License No. SUA-917 to reclaim in place an existing uranium mill tailings pile near Moab, Utah. The proposed reclamation would allow Atlas to (1) reclaim the tailings pile for permanent disposal and long-term custodial care by a government agency in its current location on the Moab site, and (2) prepare the 162-ha (400-acre) Moab site for site closure. The FEIS describes and evaluates (1) the purpose of and need for the proposed action, (2) alternatives considered, (3) potentially affected environmental resources, (4) environmental consequences of the proposed action, and (5) costs and benefits associated with reclamation alternatives.

The National Park Service (NPS), U.S. Department of the Interior, was a cooperating agency in the preparation of this FEIS. In this role, the NPS provided information to the preparers of the FEIS, submitted comments on preliminary drafts of the EIS, and assisted in defining proposed sampling protocols for the collection of additional information on water quality and aquatic biota. The NPS does not necessarily agree with the analysis and conclusions in this FEIS.

A Draft Environmental Impact Statement (DEIS) on the proposed reclamation was published for public and agency comment in January 1996. A public meeting was held in Moab on February 28, 1996, to receive comments on the DEIS. The comment period closed on April 29, 1996. This FEIS incorporates revisions in response to comments received. A summary of the comments on the DEIS and responses to comments are presented in Appendix A. The comment letters received are reproduced in Appendix J.

After an extensive consultation process under Section 7 of the Endangered Species Act, in July 1998 the U.S. Fish and Wildlife Service (FWS) issued their Final Biological Opinion on the impacts of the proposed project to endangered and threatened species. The Final Biological Opinion concluded that the proposed project would jeopardize the continued existence of four endangered fish species due to continued leaching of contaminants into the Colorado River, water depletion impacts, and/or destruction or adverse modification of designated habitat. The FWS included reasonable and prudent alternatives to avoid the likelihood of jeopardy to the endangered fishes and to avoid destruction or adverse modification of their critical habitat, as well as reasonable and prudent measures to minimize the incidental take of southwestern willow flycatcher, razorback sucker, and Colorado squawfish. These requirements would be included in any license amendment approved by NRC on the proposed reclamation plan.

The analysis of impacts presented in the FEIS indicates that the Atlas proposed on-site reclamation with recommended mitigation will significantly reduce the impact of contaminants entering the Colorado River, but a rigorous determination of whether the proposed action will meet the FWS ammonia concentration requirements specified in the Final Biological Opinion cannot be made without additional data and analyses by the applicant. All other environmental aspects of the proposed action are acceptable. The FEIS compares the proposed on-site reclamation to an alternative of moving the tailings to an alternative site on Klondike Flat. NRC staff's analysis finds that no aspect of the relocation
alternative would have a potentially significant, adverse, long-term environmental or socioeconomic impact. Some of the short-term impacts, including radiation doses associated with moving the tailings, would be greater for the relocation alternative. Thus, the short-term impacts and the significantly higher economic cost of moving the tailings are the major disadvantages of the relocation alternative.

SUMMARY AND CONCLUSIONS

This Final Environmental Impact Statement (FEIS) has been prepared under the direction of the staff of the U.S. Nuclear Regulatory Commission (NRC) and issued by the Commission's Office of Nuclear Material Safety and Safeguards (NMSS). The National Park Service (NPS), U.S. Department of the Interior has been a cooperating agency in the preparation of this FEIS. In this role, the NPS provided information to the preparers of the FEIS, submitted comments on preliminary drafts of the report, and assisted in defining proposed sampling protocols for the collection of additional information on water quality and aquatic biota. The NPS does not necessarily agree with the analysis and conclusions in this FEIS.

1. This action is administrative, involving a licensing decision in response to a license amendment request from Atlas Corporation, Denver, Colorado. Atlas proposes to reclaim an existing uranium mill tailings pile on the Atlas site near Moab, Utah, and has requested NRC to amend its existing License No. SUA-917 to allow this proposed reclamation. The Atlas mill ceased operations in 1984 and has been dismantled except for one building. The stabilization of the 9.52-million-metric-ton (10.5-million-ton) uranium mill tailings pile for long-term disposal is evaluated in this FEIS. The proposed license amendment would allow Atlas to (1) reclaim the 52.6-ha (130-acre) tailings pile for permanent disposal and long-term custodial care by a government agency in its current location on the Moab site, and (2) prepare the 162-ha (400-acre) Moab site for site closure.

Under the Atlas proposal, the side slopes of the pile would be reduced to 30 percent [i.e., 0.9 m (3 ft) vertical per 3 m (10 ft) horizontal] or less to minimize effects of erosion and possible earthquakes. Also, an earth and rock cover system would be installed over the pile and around its sides and base to minimize radon escape, infiltration of rainwater into the tailings, infiltration of tailings contaminants into groundwater, and tailings erosion potentially caused by surface runoff and flooding of the Colorado River and a nearby ephemeral stream known as Moab Wash. Earth and cover materials would likely be obtained from several borrow sites, including a site for crushed bedrock near Potash to the southwest of the Atlas site, an area for rounded cobble in Spanish Valley southeast of Moab, and an area for clay on Klondike Flat northwest of Moab near the Canyonlands Airport.

Alternatives considered in this FEIS include (1) moving the tailings by rail for disposal at the Plateau site, about 29 km (18 miles) northwest of Moab; (2) the no-action alternative under which Atlas would cease all operations involving environmental control of the tailings and NRC would make no licensing decision; (3) alternative modes of tailings transport, including conventional truck, off-road truck and private haul road, and slurry pipeline; and (4) other alternative disposal sites, including the Box Canyon site, the Rio Algom site, the Envirocare site, and the Emery County Development Corporation site. The FEIS compares the Atlas proposal with an alternative of tailings disposal at the Plateau site, which was identified during scoping as one of the best alternate sites identified to date. Because the no-action alternative would not comply with NRC and other environmental regulations and would not be environmentally acceptable, it is not analyzed in detail.

2. A Draft Environmental Impact Statement (DEIS) was published and made available for public and agency review and comment in January 1996. A public meeting to receive comments on the DEIS was held in Moab on February 28, 1996. The comment period closed on April 29, 1996. Comments received have been reviewed by NRC staff and revisions have been made in this FEIS in response to comments.
1. PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

1.1.1 The Federal Proposed Action

This Final Environmental Impact Statement (FEIS) has been prepared in support of a Federal licensing decision to be made by the U.S. Nuclear Regulatory Commission (NRC), in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended. The decision is whether or not to approve Atlas Corporation's request for a license amendment on its proposed reclamation plan for on-site stabilization of uranium mill tailings at the Atlas site near Moab, Utah. The decision will be made after consideration of the analysis presented in this FEIS, which provides an environmental evaluation of the Atlas proposal and alternatives to that proposal. Atlas' proposed reclamation plan is referred to in this FEIS as the Atlas proposal. The NRC is the lead agency in preparing this FEIS, and the National Park Service (NPS) is a cooperating agency. The NPS does not necessarily agree with all analyses and conclusions presented in this FEIS.

A final Technical Evaluation Report (TER) evaluating the technical adequacy of Atlas' proposed design for tailings pile reclamation was published by NRC in March 1997 (NRC 1997). The TER evaluated engineering aspects of the Atlas proposal, while this FEIS assesses environmental impacts.

A Draft Environmental Impact Statement (DEIS; NRC 1996a) and a draft TER (NRC 1996b) were published and distributed for public comment in January 1996. A public meeting on the DEIS was held by NRC in Moab on February 28, 1996. Extensive comments on the DEIS were made at this meeting and in writing during the comment period that ended on April 30, 1996. Written comments are presented in Volume 2 (Appendix J) of this FEIS, and a summary of the comments and NRC responses to them are provided in Appendix A.

Subsequent to publication of the DEIS and in response to comments from the Department of the Interior (DOI) expressing concern about the data available for assessing impacts to endangered species, NRC prepared a Supplement to the Biological Assessment (Appendix B) containing updated data and analysis and submitted it to the U.S. Fish and Wildlife Service (FWS) in February 1997. As part of the consultation process under Section 7 of the Endangered Species Act, the FWS prepared a Draft Biological Opinion and a Revised Draft Biological Opinion that were reviewed and commented on by NRC and Atlas. The consultation process was completed in July 1998, when the FWS issued its Final Biological Opinion (Appendix C) which found that the proposed action would jeopardize the continued existence of four endangered fish species. The Final Biological Opinion included reasonable and prudent alternatives and measures to avoid jeopardy, which NRC will include as conditions of the license amendment should it be approved.
piles at low rates. Tailings leachates are slowly diffusing downward into groundwater, some of which moves horizontally and enters the Colorado River. Radioactive radon gas slowly escapes the tailings pile and enters the air. To minimize environmental contamination, Atlas has conducted a number of environmental control and corrective action programs, including placement of an interim cover on the tailings to prevent movement of contaminated windblown materials from the pile. Additional environmental protection measures are needed, however, for long-term tailings stabilization and disposal.

The purpose of the tailings-reclamation action (either the Atlas proposal or an alternative) considered in this FEIS is to minimize the potential for environmental and public health impacts posed by the existing tailings pile. This purpose can be satisfied only by appropriate reclamation of the tailings pile, either at the Moab site or an alternate site.

1.3 HISTORY AND CURRENT STATUS OF THE MOAB MILL FACILITY AND OPERATIONS

The Atlas Moab Mill is located on the west bank of the Colorado River about 5 km (3 miles) northwest of Moab. The property and facilities were originally owned by the Uranium Reduction Company that was acquired by Atlas Corporation in 1962. Atlas owns approximately 160 ha (400 acres) including the approximately 80 ha (200 acres) on which the mill and tailings are located. Atlas activities at the Moab Mill site are covered by the NRC Source Material License SUA-917, which was renewed in 1988. The mill ceased ore milling operations in 1984. The principal Atlas and NRC documents supporting the source material license are listed in Appendix E.

Initial tailings pond construction was completed in 1956, and, with the exception of brief periods, tailings were disposed in the pond continuously from initial start-up in October 1956 until the mill ceased operations and was placed on standby status in 1984. The tailings pile has been maintained since that date under various conditions of the Atlas Source Material License. The pile has five embankments that were raised to their present elevation of 1237 m (4058 ft) above mean sea level (amsl) after the 1979 license renewal. A 5.5-m (18-ft) raise in embankment elevation to a projected final elevation of 1242 m (4076 ft) was reviewed and approved under License Amendment No. 7 dated June 30, 1982. However, the embankment raise was never initiated, because the added capacity was not needed when the mill subsequently entered a long-term shutdown status.

During early operations, Atlas utilized an acid leach process for uranium milling. At that time, lime was added to the mill tailings to help neutralize the tailings. In 1961, an alkaline leach process was initiated. In 1967, a new acid leach circuit was installed and, for a period of time, both the acid circuit and an alkaline circuit were operated. Up to this point, as much as 4921 L/m (1300 gpm) had been taken from the Colorado River under Atlas’ Water Rights, used in the process, treated, and then discharged back into the Colorado River (Atlas 1973). Around 1974, Atlas began modifying various process circuits to reduce the total amount of water used in the milling and processing operations to eliminate the direct discharge of waste water into the Colorado River. After these modifications, which
Purpose of and Need for Action

included recycling process waters, approximately 492 L/m (130 gpm) of river water were used for the mill. At this reduced rate, evaporation and seepage from the tailings pile were adequate to handle the waste water stream and there was no need to directly discharge waste water into the Colorado River (Atlas 1973). From 1982 through 1984, only an acid leach process was used with no neutralization of process water because of the process water recycling practices.

The NRC required Atlas to initiate a groundwater detection monitoring program and a compliance monitoring program in 1988, in accordance with the revisions to Appendix A of 10 CFR Part 40. As a result of these monitoring programs, Atlas was required to develop and initiate a groundwater corrective action plan (CAP) designed to bring the identified groundwater contamination to within standards established in the license and NRC's regulations.

Two site-specific conditions discovered during previous hydrogeological characterization efforts restricted the number and type of groundwater corrective action measures that could be applied at the site. The occurrence of brine in the lower portion of the alluvial aquifer presented limitations on the amount of groundwater pumping that could be accomplished in the shallower portions of the aquifer, without drawing the brine into the groundwater collection wells. In addition, the fine-grained nature of the shallower portion of the alluvium presented limitations to effective recovery of contaminated ground water. These two circumstances led NRC to approve a CAP that focused on reducing the seepage from the tailings by removing the free water surface and dewatering the tailings. A CAP that included an enhanced evaporation system, a toe drain system, and a series of dewatering wells in the tailings was approved in July 1989. The dewatering wells were approved as a pilot project, with the stipulation that Atlas would need to propose additional dewatering measures, such as wick drains in the tailings, if the dewatering wells proved ineffective.

The CAP was modified in 1993 to discontinue the enhanced evaporation system, because the free water surface was reduced to the point that it could not be pumped and the toe drains were deleted from the license because they had ceased collecting water. The license was also amended at a later time to allow the disposal of radioactive contaminated solid waste in the south sump pit of the toe drain system. The dewatering wells remained in operation, but have shown a decrease in effectiveness through time. Approximately 6,515,000 L (1,721,000 gals) of tailings water were removed from the tailings through the dewatering wells in 1992, and approximately 2,419,000 L (639,237 gal) in 1998, demonstrating a reduction in the system's effectiveness because of the corresponding reduction in pressure head levels in the pile.

NRC notified Atlas (NRC 1996c) that a revised CAP would be needed to address groundwater contamination in the alluvial aquifer. NRC considers the revision of the CAP as a separate, independent licensing action from the reclamation approval, because the cleanup of contaminated groundwater must be addressed whether the tailings are reclaimed on site or relocated. Also, the feasibility of engineering remedies that could be applied to groundwater cleanup would not be impacted by the location of the tailings, since the constraints limiting groundwater cleanup are aquifer characteristics unique to the site. The revised CAP will address what can be done to cleanup
contamination currently in the groundwater and must be developed regardless of whether the tailings are reclaimed on site or moved to an alternate site.

The CAP and monitoring programs are mandatory by licence conditions 17 and 55, which describe the groundwater program for the site. The groundwater program includes the establishment of groundwater quality standards, point-of-compliance wells, a background well, sampling frequency, groundwater sampling points, and selected constituents for which the groundwater was to be analyzed. The projected date for completion of all groundwater corrective actions, as specified in license condition 55 is December 1998, but this date was not achieved and will need to be changed after Atlas submits the revised CAP.

In the DEIS, the NRC did not conduct a detailed analysis of the groundwater system. Instead, the DEIS presents an assessment of the impacts on the Colorado River from existing contamination in the aquifer at the site. This assessment was based on actual data measured by the State of Utah in the groundwater seep located in the mouth of Moab Wash. No credit was given for completion of the currently required groundwater program, or the cleanup of groundwater to established Federal standards. Because of this, the DEIS presented a conservative, bounding assessment of the environmental impacts. The DEIS reached the conclusion that the impacts to the Colorado River from the existing groundwater contamination were acceptable. Once the tailings were capped, and the seepage of contamination significantly reduced, the groundwater contaminant levels would lessen, and situation in the Colorado River would improve.

Since the publication of the DEIS, there continues to be a concern that NRC is not addressing the cleanup of current groundwater contamination. As discussed above, there is currently an NRC required groundwater cleanup program in the Atlas license. However, because that program has not been effective in cleaning up the current level of groundwater contamination, the NRC has required Atlas to revise the current groundwater corrective action program and identify ways to accelerate cleanup of current day contamination. As also discussed above, that cleanup must be undertaken regardless of whether the tailings are reclaimed on site, or are relocated to an alternate site. Thus any revision to the groundwater cleanup program is independent of the decision concerning on-site reclamation of the tailings.

The action that is the subject of this FEIS (tailings reclamation) considers, among other things, the ability of the Atlas proposal to keep groundwater within standards over the next 1000 years. This is accomplished by separately examining the effects the proposed action would have on the groundwater system, without applying additional groundwater corrective action measures. The application of active groundwater cleanup measures are limited in time and could not be relied upon to keep the groundwater within standards for the 1000 year design life. The Atlas proposal must show that groundwater would ultimately achieve and remain within standards. If a proposed action would rely on a short-term groundwater corrective action to achieve standards, but could not show that the groundwater continued to meet the standards over the reclamation design life, then the action could not be approved.
Purpose of and Need for Action

The application of groundwater cleanup measures are viewed as a means accelerating the time needed to achieve compliance with the groundwater standards, if the Atlas proposal can demonstrate that groundwater constituent concentrations would not rise above standards once the standards were met. Accelerating the time for groundwater to achieve standards is applied independently of the engineering construction of the approved reclamation design.

Atlas has conducted cleanup of windblown tailings and other contaminated soils in several areas on the site. These areas were along the west side of State Route (S.R.) 279, between the tailings pile and the highway, an area northwest of the tailings pile, and an area of about 3 ha (7 acres) southeast of the tailings pile. Cleanup involved excavating the windblown tailings and contaminated soils and placing them on the tailings pile. Additional cleanup of on-site and off-site contaminated windblown materials will be conducted as part of the reclamation activities.

1.4 FEDERAL AND STATE AUTHORITIES, REGULATIONS, AND PERMITS

Title II of UMTRCA, as amended, authorizes the NRC to enforce decontamination, decommissioning, and reclamation standards on new licenses or relicensing actions for uranium mill and mill tailings sites. NRC regulations in Appendix A to 10 CFR Part 40 establish criteria for the technical aspects, finance, ownership, and long-term site surveillance relating to the siting, operation, decontamination, decommissioning, and reclamation of uranium milling facilities. Each site-specific licensing decision is to be based on the criteria, taking into account public health and safety and the environment. A detailed discussion of the applicability of these criteria to the Atlas proposal is provided in Appendix A of the final TER (NRC 1997).

Appendix A to 10 CFR Part 40 provides flexibility in the NRC regulatory program in several ways. It allows licensees to propose alternatives to the specific requirements contained in the appendix as long as an equivalent level of protection of public health is provided. It also requires that licensing decisions take into consideration the economic costs involved (this requirement originates in the Atomic Energy Act of 1954, as amended). One of the reasons for this flexibility was the recognition that some of the regulations in Appendix A could not be applied to existing sites in the same manner as applied to proposed sites. The Generic Environmental Impact Statement on Uranium Milling, NUREG-0706 (1980), explicitly discussed this. As a result, the criteria in Appendix A to 10 CFR Part 40 that identify goals, as opposed to specific numerical requirements, are applied to existing sites with the recognition that the goal may not be met to the extent that it would for a new proposed site.

In the case of the Atlas proposal for tailings reclamation at the Moab site, NRC staff reviewed the licensee's proposed design and cover materials for the reclaimed tailings pile to independently determine whether the licensee has acceptably demonstrated that its proposal would meet the applicable criteria. Results of that review are documented in the final TER (NRC 1997). Regulations state that NRC will approve a reclamation plan proposed by a licensee if the NRC evaluation documented in the final TER demonstrates compliance with the Appendix A criteria and if the environmental impacts are appropriately considered, in conformance with 10 CFR Part 51, and found to be acceptable.
Appendix Q:
UNITED STATES BANKRUPTCY COURT
FOR THE DISTRICT OF COLORADO

IN RE:
ATLAS CORPORATION, a Delaware corporation
EI#: 15-5503312

ATLAS GOLD MINING INC., a Nevada Corp.
EI#: 84-1023843

ATLAS PRECIOUS METALS INC., a Nevada
Corp., EI#: 87-0400332

Debtors.

Case No. 98-23331 DEC
Chapter 11

Case No. 99-10889 DEC
Chapter 11

Case No. 99-10890 SBB
Chapter 11

(Jointly Administered Under
Case No. 98-23331 DEC)

NOTICE PURSUANT TO LOCAL RULE 202 OF ATLAS
CORPORATION'S AMENDED MOTION FOR ORDER ABANDONING MOAB
URANIUM TAILINGS SITE PURSUANT TO 11 U.S.C. SECTION 554(a)

Notice is hereby given that the Atlas Corporation ("Atlas") has filed an Amended Motion for Order Abandoning Moab Uranium Tailings Site Pursuant to 11 U.S.C. § 554(a). Atlas is the fee owner of a closed uranium processing mill and adjoining property consisting of approximately 400 acres in Moab, Utah (the "Mill Property"). Unless the United States Nuclear Regulatory Commission approves the amendment of Atlas' Materials License to maintain and remediate the Mill Property and the proposed remediation plan, there is no value or equity which can be realized by the estate for distribution to creditors from the Mill Property and it is burdensome to the estate. This Amended Motion does not seek abandonment of any water rights arising from the Colorado River. It is in the best interests of the estate to abandon the Mill Property pursuant to 11 U.S.C. Section 554(a). In support of the Amended Motion, Atlas incorporates the factual and legal arguments in its Objection to the Nuclear Regulatory Commission's Claim for Administrative Expense, filed with the Court on February 25, 1999.

A copy of the pleading is available for inspection in the Bankruptcy Court Clerk's Office, or upon request from the undersigned attorney.

Pursuant to Rule 202 of the Local Rules of Bankruptcy Procedure, if you desire to oppose this action you must file a written objection and request for a hearing with the Court on or before March 22, 1999, and serve a copy thereof on the undersigned. Objections and requests for hearing shall clearly specify the grounds upon which they are based, including the citation of supporting legal authority, if any. General objections will not be considered by the Court.

In the absence of a timely and substantiated objection and request for hearing by an interested party, the Court may approve or grant the aforementioned application without any further notice to creditors.


By
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ATTORNEYS FOR DEBTOR

[Signature]

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Atlas Corporation, by and through its counsel Sender & Wasserman, P.C. and for its Amended Motion for Order Abandoning Moab Uranium Tailings Site Pursuant to 11 U.S.C. § 554(a) states as follows:


2. Atlas is the fee owner of a closed uranium processing mill and adjoining property consisting of approximately 400 acres in Moab, Utah (the "Mill Property").

3. Unless the United States Nuclear Regulatory Commission approves the amendment of Atlas' Materials License to maintain and remediate the Mill Property and the proposed remediation plan, there is no value or equity which can be realized by the estate for distribution to creditors from the Mill Property and it is burdensome to the estate. This Amended Motion does not seek abandonment of any water rights arising from the Colorado River.

4. It is in the best interests of the estate to abandon the Mill Property pursuant to 11 U.S.C. Section 554(a).
5. In support of the instant Motion, Atlas hereby incorporates the factual and legal arguments in its Objection to the Nuclear Regulatory Commission’s Claim for Administrative Expense, filed with this Court on February 25, 1999.

WHEREFORE, Atlas Corporation prays that this Court enter its Order authorizing it to abandon the above-described real property fee interest, and for such other and further relief as to this Court may seem just and proper.

DATED this __ day of February, 1999.

Respectfully submitted

SENDER & WASSERMAN, P.C.

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ATTORNEYS FOR ATLAS CORPORATION
IN RE:

ATLAS CORPORATION, a Delaware corporation
EIN: 15-5503312

ATLAS GOLD MINING INC., a Nevada Corp.
EIN: 84-1023843

ATLAS PRECIOUS METALS INC., a Nevada Corp., EIN: 87-0400332

Debtors.

Case No. 98-23331 DEC
Chapter 11

Case No. 99-10889 DEC
Chapter 11

Case No. 99-10889 BDR
Chapter 11

(Jointly Administered Under Case No. 98-23331)

NOTICE PURSUANT TO LOCAL RULE 202 OF ATLAS CORPORATION'S AMENDED MOTION FOR ORDER REJECTING MATERIALS LICENSE FOR MOAB URANIUM TAILINGS SITE PURSUANT TO 11 U.S.C. SECTION 365(a)

Notice is hereby given that the Atlas Corporation ("Atlas") has filed an Amended Motion for Order Rejecting Materials for Moab Uranium Tailings Site Pursuant to 11 U.S.C. § 365(a). Atlas is the fee owner of a closed uranium processing mill and adjoining property in Moab, Utah. Atlas maintains the property pursuant to a Materials License (the "License") granted by the United States Nuclear Regulatory Commission (the "NRC"). Pursuant to Section 365, Atlas requests authority to reject the License. Atlas is contemporaneously filing with this Amended Motion an Amended Motion to Abandon the Moab Uranium Tailings Site. Keeping the License would require use of funds which are otherwise necessary to Atlas' reorganization and the use of which to maintain the License will not be in the best interest of the estate or the creditors. There is no benefit to the estate from maintaining the License. Atlas does not believe that there is any equity or value in the License. The License requires that Atlas perform certain duties with respect to the supervising, maintenance, and reclamation of the uranium mill tailings site, and the NRC supervises and approves Atlas' plans and activities at the site. As a consequence, the License constitutes an executory contract as that phrase is used in § 365 and has been construed by the courts. Atlas' rejection of the License in no way affects its rights to funds from the Department of Energy for reimbursement of remediation funds under Pub. L. 102-486, Title X, § 1001, Oct. 24, 1992, 106 Stat. 2946, codified at 42 U.S.C. § 2296a. In support of the instant Motion, Atlas incorporates the factual and legal arguments in its Objection to the Nuclear Regulatory Commission's Claim for Administrative Expense, filed with the Court on February 25, 1999.

A copy of the pleading is available for inspection in the Bankruptcy Court Clerk's Office, or upon request from the undersigned attorney.

Pursuant to Rule 202 of the Local Rules of Bankruptcy Procedure, if you desire to oppose this action you must file a written objection and request for a hearing with the Court on or before March 16, 1999, and serve a copy thereof on the undersigned. Objections and requests for hearing shall clearly specify the grounds upon which they are based, including the citation of supporting legal authority, if any. General objections will not be considered by the Court.

In the absence of a timely and substantiated objection and request for hearing by an interested party, the Court may approve or grant the aforementioned application without any further notice to creditors.


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ATTORNEYS FOR DEBTOR

Case No. 98-23331 DEC
Chapter 11

Case No. 99-10889 DEC
Chapter 11

Case No. 99-10889 BDR
Chapter 11
ATLAS CORPORATION’S AMENDED MOTION FOR ORDER REJECTING
MATERIALS LICENSE FOR MOAB URANIUM TAILINGS
SITE PURSUANT TO 11 U.S.C. SECTION 365(a)

Atlas Corporation, by and through its counsel Sender & Wasserman, P.C. and for its
Amended Motion for Order Rejecting Materials License for Moab Uranium Tailings Site
Pursuant to 11 U.S.C. § 365(a) states as follows:

1. Atlas Corporation ("Atlas") filed its petition for relief under Chapter 11 of the
filed their petitions for relief under Chapter 11 of the Bankruptcy Code on January 26, 1999.
Since the date of the filing of their petitions, the Debtors have been operating as Debtors in
Possession.

2. Atlas is the fee owner of a closed uranium processing mill and adjoining property
in Moab, Utah.

3. Atlas maintains the property pursuant to a Materials License (the "License")
granted by the United States Nuclear Regulatory Commission (the "NRC"). A copy of the
License is attached hereto as Exhibit A.

4. Pursuant to Section 365, Atlas requests authority to reject the License. Atlas is
contemporaneously filing with this Motion a Motion to Abandon the Moab Uranium Tailings.
Keeping the License would require use of funds which are otherwise necessary to Atlas’
reorganization and the use of which to maintain the License will not be in the best interest of the
estate or the creditors. There is no benefit to the estate from maintaining the License. Atlas does not believe that there is any equity or value in the License.

5. The License requires that Atlas perform certain duties with respect to the supervising, maintenance, and reclamation of the uranium mill tailings site, and the NRC supervises and approves Atlas' plans and activities at the site. As a consequence, the License constitutes an executory contract as that phrase is used in § 365 and has been construed by the courts.


7. In support of the instant Motion, Atlas hereby incorporates the factual and legal arguments in its Objection to the Nuclear Regulatory Commission's Claim for Administrative Expense, filed with this Court on February 25, 1999.

WHEREFORE, Atlas Corporation prays that this Court enter its Order authorizing it to reject the License, and for such other and further relief as to this Court may seem just and proper.

DATED this \underline{X} day of February, 1999.

Respectfully submitted

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