

NRC Staff Analysis of Proposed Colorado Alternative Standards for the Uravan, Colorado Uranium Mill

Summary:

The State of Colorado submitted and the NRC staff has evaluated a proposal for alternative soil standards for four areas at the Uravan uranium mill site (State of Colorado Radioactive Materials License (RML) 660-02) (ML092820404). The State of Colorado concluded that the licensee had conducted all practical actions to remediate the soil contamination. The NRC staff evaluation concludes that the proposed alternative standards are reasonable and provide a level of protection of public health and safety and the environment that is equivalent to, or more stringent than the standards in 10 CFR Part 40, Appendix A and the State of Colorado equivalent regulations found at *Colorado Rules and Regulations Pertaining to Radiation Control*, 6 Code of Colorado Regulations (CCR) 1007-18, Appendix A, Criteria 6 (CCR Part 18, Appendix A). The NRC staff has prepared this evaluation of the proposed alternative standards to support the Commission determination required in section 274o of the Atomic Energy Act (AEA), as amended (the Act) and codified in 10 CFR 150.31(d).

Background:

The Uravan site began operations in 1914 as a radium mill and later expanded operations to include extraction of other metals as well as uranium. Uravan was a licensed and operating mill at the time of passage of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) (November 1978) making it a Title II mill, even though some of the contamination is a result of practices going back to the earlier operations. NUREG-0706, *Final Generic Environmental Impact Statement on Uranium Milling*, makes specific mention of this situation and calls for active programs to address residual contamination during the operational phase. This site is part of the UMTRCA Title II program administered by the Colorado Department of Public Health and Environment (CDPHE). The Uravan mill ceased operations in 1984 and began decommissioning planning and implementation. The site was listed on the National Priorities List (NPL) in 1986. CDPHE is designated as the Lead Agency at this site under a Memorandum of Agreement signed with Environmental Protection Agency (EPA) Region VIII in 1986.

The site covers over 500 acres, most of which is in very steep, rugged terrain, the remainder of which is dominated by the San Miguel River Valley. Remedial activities have concluded and the final cap is in place over the disposal areas.

Portions of the site will title to the Department of Energy (DOE) for Legacy Management. Other portions of the site will be transferred to other Federal Agencies (e.g., Bureau of Land Management (BLM)) or to a land trust for institutional management. Also, a small portion of the site will be transferred to Montrose County. Montrose County Road Y-11 bisects the site.

CDPHE believes the licensee has remediated the site to the extent practical and has identified four discrete areas that are not in full compliance with the remediation standards. The licensee has proposed and CDPHE agrees that no further remediation is warranted for these areas.

This is the first site specific alternative standards to be proposed by an Agreement State (generic alternative standards were proposed and approved for Utah). There is a provision for alternative standards in the introduction to Appendix A of 6 CCR 1007-18 (equivalent to 10 CFR 40, Appendix A) which allows for "alternates to the requirements with Commission approval." This is based on language found in Section 274o of the Act, as amended. It states in part, "... a

State may adopt alternates to the requirements, including site-specific alternatives, if the Commission determines that such alternatives will achieve a level of stabilization and containment of the sites concerned, and a level of protection for public health, safety, and the environment from radiological and non-radiological hazards associated with such sites, which is equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose and any final standards promulgated by the Administrator of the EPA in accordance with section 275. Such alternative State requirements may take into account local or regional conditions, including geology, typography, hydrology, and meteorology.” This requirement was codified in 10 CFR 150.31(d).

The Office of Nuclear Materials Safety and Safeguards informed Region IV in 1988 with a memorandum titled, “Use of Title I Supplemental Standards for Title II,” that, if a request for alternative standards was to be considered, the application of the 40 CFR 192, Subpart C, Supplemental Standards, as guidance would be appropriate (ML111670171). The Uravan Consent Decree and Remedial Action Plan approved by the Federal Court in 1987 included the possible use of Applicable or Relevant and Appropriate Requirements (ARARs) which could include the Title I Supplemental Standards. If alternative standards are agreed to by NRC, the alternative standards could be used as part of the basis for the State and EPA to proceed with delisting the Uravan site from the NPL.

Discussion:

Four discrete areas of the site (about 40 acres total) could not meet the standard for background level of radium-226 in soil, found in the *Colorado Rules and Regulations Pertaining to Radiation Control*, 6 CCR 1007-18, Appendix A, Criteria 6. This standard is that the background level is not exceeded by more than 5 picocuries per gram of radium-226 averaged over the first 15 centimeters (cm) below the surface and 15 picocuries per gram of radium-226 averaged over 15 cm thick layers more than 15 cm below the surface. The four discrete areas are referred to as: the Mill Hillside Area; A-Plant North Area; River Ponds Area; and County Road Y-11. The areas were remediated as best as practical, and the specifics are described in the licensee’s report submitted to CDPHE (ML081150505). The licensee proposed to CDPHE that alternative standards be applied to these four areas of the Uravan site. The licensee’s proposal to CDPHE was to leave the remaining materials in place and conduct no further remediation.

CDPHE has accepted the licensee’s report and believes the areas were remediated to levels that are as low as reasonably achievable (ALARA), and are protective of public health. This is further demonstrated by applying criteria for supplemental standards in UMTRCA Title I standards in 40 CFR 192, Subpart C and through dose calculation for reasonable future use given the status of the areas after the termination of the specific license and long-term care of the site by DOE. The CDPHE recommended the application of contemporary dose limits for restricted release found in the License Termination Rule (LTR), which in Colorado are found at CCR 1007-04 §61.3, to this action. Since the LTR explicitly excludes uranium milling facilities and since the licensees proposed alternative standards were developed using the Title I supplemental standards specifically for uranium milling facilities, the NRC staff does not recommend pursuing the use of the LTR standard for this uranium recovery facility.

Challenges to worker safety prevented additional remediation along the cliff face that makes up a majority of the Mill Hillside Area under consideration for alternate standards. Remediation was performed as much as possible and was terminated when safety to workers became too

much of a risk, and costs to continue showed diminishing returns, along with concern that additional removal could cause mass wasting of the cliff face that would cause environmental harm to the riparian area and the San Miguel River. Two other areas, the River Ponds Area and the A-Plant North Area, were cleaned as much as possible prior to annual spring flooding that has since buried the areas under up to three feet of sediments (the San Miguel River is a free flowing river and does not have any dams to control flow). This riparian area now hosts fauna and wildlife that would not be best served if remediation were to continue. The final area, County Road Y-11, has contaminated materials present at depths greater than three feet, assuring that routine maintenance activities of the road can be conducted without creating worker exposure. County Road Y-11 will remain under institutional controls agreed to by the County, BLM, and DOE.

The alternative standards will still be protective even if the institutional controls fail in the distant future. This is based on two limited assumptions – the cliff face will not be developed for residential construction, and the San Miguel River will not be relocated. Both of these assumptions are realistic.

Since all four areas have been cleaned to levels that are considered ALARA, will be under permanent institutional controls, and meet the EPA supplemental standards requirements in 40 CFR 192, Subpart C, present safety or environmental challenges should additional cleanup be attempted with little corresponding reduction in dose, the staff believes the four areas are candidates for alternative standards.

The NRC staff evaluated Colorado's proposed alternate soil standards for the four discrete areas and the justification for the alternate soil standards for the Uravan Site in Montrose County, Colorado (CO RML 660-02). The individual areas are discussed in more detail in the specific area analyses below.

Conclusion:

The staff concluded that the State's proposal to leave the materials in place provides levels of protection to public health and safety and protection of the environment for each of the four areas that are equivalent or more stringent than the requirements contained in 10 CFR Part 40, Appendix A and the Colorado requirements in 6 CCR 1007-18, Appendix A.

Specific Analyses of Alternate Standards for Four Areas at the UMETCO Uravan Title II UMTRCA Site.

Mill Hillside Area

The alternative standard proposed by the State of Colorado is to leave the residual radioactive contamination at this location in place.

The area consists of steep/near vertical slopes that are the result of down cutting of the San Miguel River. The area is about 22 acres in size and extends from the mesa rim to the valley floor with an elevation change of approximately 500 feet.

The hillside was first used in the early 1900s for mining access and ore transport on a road cut that has been removed. In the mid-1930s, a vanadium plant was constructed on the hillside. In the 1940s, the vanadium plant was expanded to include uranium extraction. New process

works were constructed in the 1950s. After WWII, the original vanadium plant was shut down. Those mill structures were demolished and the foundations left in place.

Concrete foundations and contaminated soils were removed from the Mill Hillside in 1999, 2001, and 2002. A total of approximately 46,000 cubic yards of contaminated materials were removed from the Mill Hillside and some contaminated soils remain. In order to access and remove the remaining contaminated soils from the Mill Hillside area, approximately 27,600 cubic yards of materials would need to be excavated from the cliff face. Further excavation of the steep slopes of the Mill Hillside poses an unacceptable risk to workers and threatens to de-stabilize the naturally stable slope. Additional excavation would require the use of heavy equipment in some areas, hand excavation in others, as well as scaling crews (hanging on ropes of the cliff face) and vacuum trucks to access the materials. Some materials would have to be carried by hand to a location where they can be placed into containers. These remedial actions would be extremely hazardous, entail great risk to workers, and result in destabilization of the existing slope. The use of heavy equipment to excavate these areas might in itself further destabilize the slope. In addition, de-stabilized slopes could be subject to mass wasting or rapid erosion and cause degradation of the water quality in the San Miguel River. Public health or safety would be unavoidably endangered by any further remedial actions. The destabilization of the slopes that would be incurred from efforts to further satisfy the standard would cause significant environmental damage in comparison to any environmental and health benefits.

Field measurements indicated an average grid concentration of 22 picocuries per gram (pCi/g) or (0.81 kBq/kg) of Ra-226 with a maximum activity of 173 pCi/g (6.4 kBq/kg) for a single 10 by 10 meter grid. The highest readings were obtained from areas with slopes too steep to permit excavation during the remediation actions. Confirmatory soil samples indicated that the average Ra-226 value is 17.1 pCi/g, for the surface samples (0-15 cm), and 10.5 pCi/g, for the sub-surface samples (15-30 cm). Radionuclides other than Ra-226 and its decay products are not present in sufficient quantities that would pose a threat to public health or the environment.

The remediation of this area has resulted in residual radiological contamination levels that are considered ALARA. Since there is residual radioactive contamination remaining in the cliff area and the area can be described as environmentally stabilized, leaving the material in place under the proposed alternative standard would not cause environmental damage or harm to workers.

Dose estimates performed by the licensee indicate that the expected dose for a recreational scenario would be a few millirem per year. The alternative standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose.

The alternative standard (leaving the material in place) takes into account local or regional conditions, including geology, topology, hydrology, and meteorology. The remote cliff face is not reasonably accessible by humans. The Mill Hillside Area falls within the DOE long-term care site boundary and is to be maintained indefinitely. This area will be maintained under the DOE Legacy Management program.

Conclusion:

The Mill Hillside Area meets the alternative standard, which is to leave the residual radiological contamination in place.

Alternative standards have been applied to the Mill Hillside Area based on the following criteria:

- Risk to Workers or the Public (40 CFR 192.21(a))
Additional remedial activities in the Mill Hillside area would pose an unacceptable risk to worker safety due to the hazards associated with excavation of excessively steep slopes.
- Excessive Environmental Harm (40 CFR 192.21(b))
Additional remedial actions performed in the Mill Hillside Area could destabilize the slope, creating a risk for uncontrolled releases of sediment to the San Miguel River and long term instability of the cliff face.
- Absence of Other Residual Radioactive Material (40 CFR 192.21(h))
Previous remedial actions conducted on the site have reduced exposures to levels that are considered ALARA. The potential health risks associated with the residual radioactive contamination was determined to be negligible based on a reasonable use scenario.

The State of Colorado and the EPA have concurred that the application of the alternative standard is appropriate for the Mill Hillside Area. The DOE will assume long-term stewardship of the area and will assure that future land use activities are protective of public health and safety and the environment.

The staff concludes that with respect to Mill Hillside Area, the alternate standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose and any final standards promulgated by the EPA.

A-Plant North Area

The A-Plant North Area encompasses about two acres located on the northwestern part of the A-Plant area adjacent to the San Miguel River. The area includes riparian habitat in the flood plain of the San Miguel River. The area was a part of the A-Plant mill that produced uranium and vanadium, and also includes the former Joe Junior radium mill.

From 1994 through 1999, extensive decommissioning was performed at A-Plant mill. These activities included the demolition, removal, and disposal of 91 mill buildings and assorted pieces of mill processing equipment. Additionally, 480,000 cubic yards of contaminated soils were removed from the A-Plant. Almost the entire mill area was stripped to bedrock and reclaimed using uncontaminated soil. Further remediation in the northern part of the A-Plant Area was undertaken to remove additional contaminated soil in areas identified by post remediation surveys, which resulted in the removal of an additional 43,000 cubic yards of contaminated soils.

The licensee estimated that approximately 10,000 cubic yards of soils with elevated residual radioactivity remain within a small riparian area (approximately two acres) in the flood plain of the San Miguel River. Field measurements indicate an average grid concentration of 5.37 pCi/g Ra-226 with a maximum activity of 28.38 pCi/g Ra-226 for a single 10 by 10 meter grid. Radionuclides other than Ra-226 and its decay products are not present in sufficient quantities that would pose a threat to public health or the environment.

This area has been remediated to levels that are considered ALARA. Dose estimates performed by the licensee indicate that the expected dose for a recreational scenario would be a few millirem per year. The alternative standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose.

The A-Plant North Area falls within the DOE long-term care site boundary and is to be maintained indefinitely. This area will be maintained under the DOE Legacy Management program.

Conclusion:

The A-Plant North Area shall be subject to the alternative standard, which is to leave the residual radiological contamination in place.

Alternative standards have been applied to the A-Plant North based on the following criteria:

- **Excessive Environmental Harm (40 CFR 192.21(b))**
Additional remedial actions performed in the flood plain would require heavy engineering to divert the flow of the San Miguel River. These actions would cause significant environmental damage, in comparison with limited health and environmental benefits that would result from satisfying the standard, since remediation of the area would require the destruction of sensitive riparian/wetlands areas. The area can currently be described as stabilized and contained due to the fact that the soils are stabilized by vegetation and are subject to additional sedimentation by future flooding.
- **Absence of Other Residual Radioactive Material (40 CFR 192.21(h))**
Previous remedial actions conducted on the site have reduced exposures to levels that are considered ALARA. The potential health risks associated with the residual radioactive contamination was determined to be negligible.

The State of Colorado and the EPA have concurred that the application of the alternative standard is appropriate for the A-Plant North Area. The DOE will assume long-term stewardship of the area and will assure that future land use activities are protective of public health and safety and the environment.

The staff concludes that for the A-Plant North area, the alternate standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose and any final standards promulgated by the EPA.

River Ponds Area

The River Ponds were constructed of mill tailings along the main channel of the San Miguel River. There were seven ponds, two on the northeast bank of the river and five on the southwest bank. These ponds were directly north of the A-Plant area and were used in the uranium and vanadium recovery operations including the former Joe Junior radium mill. The area routinely floods during spring runoff and contains diverse wildlife habitat.

During the mid-1990s, excavation was conducted during winter low-flows in the river and extended into natural soils beneath the tailings material. Excavation ceased when river water flooded the excavation areas. Approximately 332,500 cubic yards of material were excavated from the River Ponds area. Riprap dikes or groins two to three feet high were constructed across the excavated areas to the limits of the river channel. These groins protected the area against future erosion and promoted alleviation in the former River Ponds area.

Gamma exposure rates from 20 to 60 $\mu\text{R/hr}$ indicated local hot spots in the cleanup area prior to final excavation and river alleviation. Final verification surveys were not possible because the excavation was flooded before a survey could be conducted. Areas of residual contamination were subsequently covered by 2 to 3 feet of recent alluvial sediment and stabilized by riparian vegetation.

During the seasonal low-water period of the San Miguel River in 2007 (~15 years post remediation), a random walking survey was conducted in the north and south river ponds areas. Field measurements indicate an average grid concentration of 4.7 pCi/g Ra-226 with a maximum activity of 6.8 pCi/g Ra-226 for a single 10 by 10 meter grid. Radionuclides other than Ra-226 and its decay products are not present in sufficient quantities that would pose a threat to public health or the environment.

Monitoring of water in the San Miguel River has been conducted quarterly since 1987 at stations above and below the River Ponds. Monitoring results indicate that the River Ponds area does not contribute any significant contaminants to the San Miguel River and that there are no impacts from residual materials from the area. Because current exposure rates are within background ranges there is no incremental health risk to the general public or future site workers from residual radiological materials within the River Ponds area.

This area has been remediated to levels that are considered ALARA. Dose estimates performed by the licensee indicate that the expected dose for a recreational scenario would be a few millirem per year. The alternative standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose.

The A-Plant North Area falls within the DOE long-term care site boundary and is to be maintained indefinitely. This area will be maintained under the DOE Legacy Management program.

Conclusion:

The River Ponds area shall be subject to the alternative standard, which is to leave the residual radiological contamination in place.

Alternative standards have been applied to the River Ponds area based on the following criteria:

- Excessive Environmental Harm (40 CFR 192.21(b))
The area is a habitat for both aquatic and terrestrial species, including both small and large game species. Additional remedial actions performed in the River Ponds area would require stripping the area of all riparian vegetation and excavating two to three feet of clean alluvial sediments. Excavation of contaminated soils would necessitate the

removal of all riparian vegetation from the banks of the San Miguel River. These actions would cause significant environmental damage, in comparison with limited health and environmental benefits that would result from satisfying the standard, since remediation of the area would require the destruction of sensitive riparian/wetlands areas. The area can currently be described as stabilized due to the fact that the soils are stabilized by vegetation and are subject to additional sedimentation by future flooding.

- Absence of Other Residual Radioactive Material (40 CFR 192.21(h))
Previous remedial actions conducted on the site have reduced exposures to levels that are considered ALARA. The potential health risks associated with the residual radioactive contamination was determined to be negligible.

The State of Colorado and the EPA have concurred that the application of the alternative standard is appropriate for the River Ponds area. The DOE will assume long-term stewardship of the area and will assure that future land use activities are protective of public health and safety and the environment.

The staff believes that for the River Ponds area, the alternative standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose and any final standards promulgated by the EPA.

County Road Y-11

The County Road Y-11 Area is located in Montrose County along the southwestern side of the San Miguel River. The County Road Y-11 Area consists of a 5,800-foot section of road between the County Road Y-11 Bridge and the Old Iron Bridge. County Road Y-11 is composed of natural earthen materials that were used in construction of the road, including NORM in the form of overburden and waste rock; some tailings were also used in the right of way for the road. The roadway is relatively flat and follows the gentle down gradient direction of the San Miguel River.

Removal activities were initiated in 1998 as a part of the cleanup of the Town Dump area and additional contaminated soils were excavated in 2006. A total of approximately 8,200 cubic yards of contaminated materials were removed from the roadway. These previous remedial activities have been conducted to assure that routine maintenance along the roadway can be conducted without creating exposures to workers.

Radioactively contaminated soils may exist at depth (>3 feet) beneath the roadway. Exposure readings along the roadway after reclamation activities were completed are within background ranges and pose no additional or incremental risk to human health for people traveling on the road. Field measurements indicate an average grid concentration of 4.6 pCi/g Ra-226 with a maximum activity of 20.2 pCi/g Ra-226 for a single 10 by 10 meter grid. Radionuclides other than Ra-226 and its decay products are not present in sufficient quantities that would pose a threat to public health or the environment.

County Road Y-11 is currently owned by Montrose County. Institutional controls agreed to by Montrose County, BLM, and DOE will control future integrity of the road. The public will have access and use of the county road.

This area has been remediated to levels that are considered ALARA. Dose estimates performed by the licensee indicate that the expected dose for several different exposure scenarios would be a few millirem per year. The alternative standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose.

Conclusion:

The County Road Y-11 area shall be subject to the alternative standard, which is to leave the residual radiological contamination in place.

Alternative standards have been applied to the County Road Y-11 area based on the following criteria:

- **Unreasonably High Costs vs. Benefits (40 CFR 192.21(c))**
The residual radioactive materials costs of land cleanup would be high relative to the long-term benefits. The residual radioactive materials do not pose a clear present or future hazard. Because the area is located along a county maintained roadway, the county does not want to expend funds for limited reduction in dose. Institutional controls agreed to by Montrose County, BLM, and DOE will control future integrity of the road since the road bisects the land to be transferred to DOE for long-term care.
- **Absence of Other Residual Radioactive Material (40 CFR 192.21(h))**
Previous remedial actions conducted on the site have reduced exposures to levels that are considered ALARA. The potential health risks associated with the residual radioactive contamination was determined to be negligible. The area can currently be described as stabilized and contained due to the fact that the accessible contaminated soils were removed.

The State of Colorado and the EPA have concurred that the application of the alternative standard is appropriate for the County Road Y-11 area. DOE will monitor County Road Y-11 as part of their long-term stewardship activities.

The staff concludes that for the County Road Y-11 area, the alternate standard achieves a level of protection for public health, safety, and the environment from hazards that are equivalent to, to the extent practicable, or more stringent than the level which would be achieved by standards and requirements adopted and enforced by the Commission for the same purpose and any final standards promulgated by the EPA.