

REGULATORY AND RECLAMATION DESIGN PROCESS UPDATE:
JACKPILE URANIUM MINE RECLAMATION PROJECT¹

by

James H. Olsen, Jr., P.E., and Michael J. Bone, P.E.²

Abstract. The uniqueness of the Jackpile Reclamation Project and the changes in reclamation technology over the past few years prompted a reexamination of some of the design criteria specified by the Department of the Interior (DOI) in 1986. This reexamination allowed some flexibility in design to obtain optimum value for the effort expended yet still meet the overall goals of protecting human health and safety and long-term site stability, by identification and utilization of on-site conditions and previous work. A joint effort among the Pueblo of Laguna, the Bureau of Indian Affairs, the Laguna Construction Company, and Roy F. Weston, Inc. was undertaken to work within the "spirit" of the original Record of Decision criteria to demonstrate new project design and management approaches to the regulatory agencies.

Additional Key Words: slope length stability, New Mexico, value-engineering, slope benching, slope terracing, regulatory requirements, project management.

Introduction

The Jackpile-Paguate Uranium mine was, in the late 1970s, the largest surface/underground uranium mining complex in the world. The operation is located on the Laguna Indian Reservation in west-central New Mexico, approximately 40 miles west of

¹ Paper presented at the 1991 National Meeting of the American Society for Surface Mining and Reclamation, Durango, Colorado, May 14-17, 1991.

² James H. Olsen, Jr., P.E., Reclamation Project Manager, Pueblo of Laguna, Laguna, NM 87026, and Michael J. Bone, P.E., Engineering Section Manager, Roy F. Weston, Inc., Albuquerque, NM 87108.

Albuquerque. It was operated by the Anaconda Company (later a subsidiary of the Atlantic-Richfield Company) from 1953 to 1982.

When the operation was closed, the environmental impacts for reclaiming the site were identified and evaluated in an Environmental Impact Statement (EIS) prepared by the Department of the Interior (DOI) as a joint effort between the Bureau of Indian Affairs (BIA) and the Bureau of Land Management (BLM) on behalf of the Pueblo of Laguna (DOI 1986a). This step was taken since no specific reclamation requirements or environmental standards for uranium mines existed. The operation also predated any environmental assessment that may have been required in the 1970s and 1980s. Upon completion, a Record of Decision (ROD) was published (DOI 1986b), outlining the intent of

the reclamation effort and some of the specific requirements for achieving the various goals.

Engineering design work was done, job costs were estimated, and equipment purchases were made, with the Pueblo of Laguna assuming responsibility for the reclamation work on approximately 2,700 acres. The Jackpile Reclamation Project was formally mobilized and reclamation activities began on July 17, 1989. Early into the project, however, several of the key criteria and their applicability to the site were still in question. Given that the funds available to perform the work were limited for the Pueblo of Laguna, it was imperative that special care and attention be given to the associated value-engineering in order to be as cost-effective as practical and yet still meet the intentions and requirements of the ROD.

Background

The primary objective of the ROD resulting from the EIS process was to insure human health and safety. This was to be achieved by placement of low-grade ore into the pit bottoms and prevention elsewhere of its erosion into water and airways. This included covering the low-grade ore and ore-contaminated materials with specified thicknesses of shale and topsoil. The cover materials served the purposes of inhibiting radon gas and gamma radiation emissions as well as providing sufficient soil thickness to support vegetation comparable to the surrounding area.

Problem Areas

The numerous and extensive waste dumps on the site had been evaluated for stability, utilizing generally accepted slope stability techniques. To avoid the potential for catastrophic slope failure, it was decided to reduce the angle of repose from a 1.5h:1v slope (horizontal:vertical) to a 3h:1v slope. The presence of benches was also to be eliminated since the potential for ponding of water on the outside edges of these slope benches could cause piping and eventual failure.

As the project began, during numerous field visits by the Pueblo Reclamation Project Manager, BIA Project Engineer, and the Laguna Construction Company management, questions were raised on the applicability of the ROD criteria in some cases. The exceptions noted were:

- 1) Many dumps had been reclaimed during the mid- to late-1970s and had been demonstrated to be stable and supporting excellent stands of vegetation. While some of the slopes on these dumps had spotty vegetation, additional remedial revegetation work was thought to be a more cost-effective alternative to upsetting already-established growth with slope reduction.
- 2) No slip circle-type slope failures had been observed on the site with many of the dumps remaining stable for more than 25 years. Problems with washouts had occurred in some cases, but these were the result of concentrated stormwater runoff due to improper water diversion, not instability of the dump material. Also, the heights of some dumps were shallow enough to indicate that the stability concerns may have been overstated for most cases.
- 3) The installation of a 3h:1v slope increases the slope length; and, in some of the larger dumps, the slope lengths would have been in excess of 1,200 ft. Consultation with other regulatory and reclamation personnel at several surface mine sites in New Mexico indicated that these long, uninterrupted slope lengths would fail from erosion since the runoff velocities would be high enough to remove the topdressing. In fact, it had been demonstrated both empirically and theoretically that slope lengths of over 200 ft would begin to have erosion problems. In other reclamation environments, the slope lengths resulting from the ROD criteria for the Jackpile Project would not have been allowed by other regulatory agencies. Using seed drills and other equipment on these relatively steep slopes also caused concerns for operational practicality and efficiency.
- 4) Reclamation technology and practice in New Mexico had seen changes from the accepted practice upon which the ROD (DOI 1986b) had been based. These changes,

including long slopes, use of contour furrowing, applications of fertilizer and seed mixtures, use of seed drilling, disturbance of previously reclaimed areas, and other items, led the project management group to undertake a reevaluation of these portions of the criteria.

It was not the intention of the project management group to perform a complete redesign of the project; but, it was felt that the final (and visual) success of the reclamation effort would rest heavily on the extent and stability of the revegetation work. Additionally, there was the need to blend the completed site with the natural surroundings. Ever-present were the needs to be as cost-effective as possible and to avoid creating more problems than the ones currently at hand, through duplication of effort by reworking stable sites. Thus, the approach taken by the group was one that would be in compliance with the spirit of the ROD goals and objectives while obtaining approval to utilize more current (and demonstrably better) techniques than those specified in the ROD.

Approach

In order to initiate the project in a timely fashion, the effort in the first year was directed to the more serious environmental concerns such as placing of the low-grade ore materials in the pit bottoms and clean up of ore-contaminated soils. Concurrently, efforts were undertaken to address the slope and revegetation issues, while the Laguna Construction Company (a Pueblo-owned enterprise) performed the other earthmoving tasks. This approach met with the approval of the BIA oversight personnel. It allowed for reevaluation of the remaining design issues while not impeding the progress of work on the more immediate problems. Only work for which the final plans and specifications had been approved by both the Pueblo of Laguna and the BIA was scheduled; while the final erosion control, special slope conditions, and revegetation specifications were deferred for further study.

In January 1990, the Pueblo of Laguna, BIA, BLM, Laguna Construction Company, and an engineering/ reclamation consulting team (Landmark Reclamation/Roy F. Weston,

Inc.) combined their efforts to finalize the remaining issues and settle on the remaining specifications which would govern the project through completion. Early in this effort, it became apparent that some of the items being proposed could be in direct conflict with the ROD. Significant changes to the ROD were felt to potentially cause two negative results:

- 1) resistance and conflict from the oversight agencies since the ROD should stand as it was written (i.e., other options had already been considered); and
- 2) reinitiating the entire evaluation process could trigger more expense and time, delaying the project and burdening an already-fixed monetary fund.

Initial meetings with BIA's upper management in the environmental and regulatory areas were conducted early in 1990 to explore the possibilities of what changes would be acceptable. As had been anticipated, the first concern from the upper management was the potential conflicts with the ROD. However, BIA did feel that certain items could be addressed as enhancements to the ROD, which could correct some unforeseen changes in reclamation practice and technology and would ultimately yield a better finished product. The ROD was felt to have some flexibility, if the overall goals and objectives could be met.

The group stressed that the proposed changes were in the spirit of the original intentions of the ROD, and the BIA's upper management agreed in principal to consider allowing some deviation if it could be demonstrated that the revision resulted in a better design. The Pueblo of Laguna was concerned that these design changes or enhancements had to be cost-effective and within the monetary limits already established, since the reclamation costs and first design had been predicated upon the ROD criteria. The reclamation fund managed by the Pueblo of Laguna was to be the only source of money to perform the work, so the cost/benefit of any changes had to be considered carefully.

The areas where changes were needed, as determined by the group, were: shortening

slope lengths by the installation of draining terraces, salvaging previously-reclaimed areas since they were stable and only needed remedial revegetation work, redesign of a proposed river rechannelization for which severe construction and cost constraints were anticipated, and dealing with an area where the sloping work would have resulted in encroaching on private land outside the Pueblo of Laguna boundary. In addition, the philosophy of reclamation needed to be reexamined. It was becoming apparent from other reclamation practice and experience that this type of work would not be a one-shot deal; i.e., it would require monitoring and some maintenance long after the heavy construction/earthmoving was completed. It was a goal to eliminate long-term maintenance; but, realistically, close scrutiny and fixing of problems early in the monitoring period would be necessary and would contribute to the long-term success of the effort.

Engineering Work

Engineering work included a reevaluation of the slope length issue (Bone and Olsen 1990). The engineering work yielded results that showed that the slope lengths had to be reduced to insure long-term resistance to erosive forces. Flatter slopes had been examined; i.e., going to slopes less than the 3h:1v criteria, but this was soon rejected since the volume of material to be handled to achieve this slope was prohibitive. In addition, it became apparent that slope length was the critical item and not necessarily the slope angle itself. The recommended method to reduce slope length was the installation of draining terraces that were designed to handle anticipated precipitation events. Where feasible, the terraces were designed to drain against resistant features (highwalls and rock outcrops) and eliminate the costs of rock-lined drainage structures.

An outgrowth of the slope length analysis was the development of criteria for benching on slopes. These criteria showed that reducing a slope to less than the critical height would eliminate the need for sloping down to the 3h:1v requirement. This approach eliminated the need to disturb previously-reclaimed areas (since they were,

in most cases, shallow dumps); it also provided some flexibility on reclamation of the dumps adjacent to the river, which had been scheduled for rechannelization. The cost of removing dump material to construct the bench and meet the critical height requirement was about 40% of the rechannelization cost, and the existing channel could remain undisturbed. The property line encroachment problem would also be resolved with this technique.

Support for the findings was received by the BIA management, and the requested authorization to utilize these techniques was given in June 1990.

Conclusions

Several key items that may have application to future efforts of this kind were identified:

- 1) A cooperative effort among all involved parties yielded a high level of confidence in achieving the intended goals of the reclamation work; areas where the letter of the law was (perhaps) in conflict with the spirit were addressed with open-minded approaches, and a fair consideration was given to the new approaches (engineering and construction) that were felt to increase the chances for success and still be cost-effective.
- 2) Engineering and reclamation practices continue to evolve as more is learned about such work. Reclamation is as much an art as a science. Site-specific conditions are judged to sometimes preclude rigid adherence to certain techniques; realistic goals should be set with the realization that flexibility and judgement are needed to deal with changing or unforeseen conditions. As long as the goals can be achieved, alternative methodologies should be allowed and even encouraged.
- 3) The uniqueness of the Jackpile project has afforded an opportunity to add to the knowledge in both technical and regulatory areas. The size of the project, its arid environment, and the approach in evaluating the environmental impacts have resulted in the establishment of important precedents for future work of this kind.

4) The approach taken by this group is also finding use in the arena of nuclear waste disposal technology. The National Research Council's Board on Radioactive Waste Management is taking the flexible approach in order to incorporate new and changing technologies. "Rather than being wedded to specific architectural details defined in advance, designs and procedures could be modified to meet performance requirements at any step of the construction and operations processes based on new information gathered during prior stages and from other projects," says the Board (NSPE 1990).

Literature Cited

- Bone, Michael J., P.E., and J. H. Olsen, Jr., P.E. 1990. "Developing Waste Pile Slope Design Criteria for Steep Slope Planes: Jackpile Uranium Mine."
- DOI. 1986a. "Final Jackpile-Paguate Uranium Mine Reclamation Project Environmental Impact Statement." U.S. Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs, Albuquerque New Mexico.
- DOI. 1986b. "Jackpile-Paguate Uranium Mine Reclamation Project Record of Decision." U.S. Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs, Albuquerque, New Mexico.
- NSPE. 1990. *Engineering Times*. Volume 12, No. 9, p. 16. National Society of Professional Engineers.

