SUPPLEMENT TO OCTOBER 29, 1999 SPLIT ROCK SITE CLOSURE REPORT

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On October 29, 1999, Western Nuclear, Inc. (WNI) submitted to the NRC a Site Closure Plan for the Split Rock Site that, pursuant to 42 USC §2114c, was structured, in part, as a proposed alternative for long-term protection of the public health and safety and of the environment from potential risks related to ground water impacted by byproduct material.

This alternative, if put into place, will provide the necessary *reasonable assurance* of protection of public health and safety and the environment and will satisfy all appropriate regulatory standards and requirements. This proposed alternative was developed from comprehensive site characterization studies, and from rigorous identification and screening of technical responses to the existence of byproduct material in ground water in the site vicinity. This alternative provides protection while rendering concentrations of site derived constituents to as low as reasonably achievable (ALARA).

Additionally this alternative incorporates several factors of conservatism which, when taken together, enhance the *reasonable assurance* that public health and safety and the environment will remain protected for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years as required by Criterion 6-1 of 10 CFR Part 40, Appendix A.[1]

FACTORS OF CONSERVATISM

The elements of the proposed alternative that employ conservative factors include the highly detailed characterization of geochemical conditions, which lends a high degree of confidence in the model predictions, the conservative over-estimates of mass in the transport system, which tend to over predict potential future concentrations, the highly conservative transport parameters assumed in the modeling, which tend to over predict constituent fate, the broad and durable and enforceable institutional controls included in the proposed alternative and the highly conservative assumptions used to estimate protective levels of constituents in ground water. These items are discussed below.

[1]Criterion 6(1) of 10 CFR Part 40 Appendix A states "In disposing of waste byproduct material, licensees shall close the waste disposal area in accordance with a design which provides ***reasonable assurance*** (emphasis added) of control over radiological hazards to (i) be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years."

Characterization and Modeling

A very comprehensive and robust numerical ground water transport model was developed to predict the potential future transport of site derived constituents. This model incorporated geochemical aspects of the site sources as well as site ground water flow conditions. The ground water flow component of the model was based on extensive geologic characterization, aquifer testing and model calibration with multiple operational time periods. The net result of these efforts is that the flow component of the transport model justifies placing a high degree of confidence in the model predictions.

The sources of site derived constituents to the ground water transport system were extensively evaluated prior to incorporation into the transport model. The sources include, not only long-term infiltration through, and seepage from, the reclaimed surface tailings, but also gradual re-release of constituents to the ground water from subsurface aquifer solids. These constituents became associated with the aquifer solids during the operational and standby periods (1957 through 1986) that were characterized by tailing seepage rates of over 1,000 gpm.

It should be noted that the state of practice at the time the mill was originally licensed was to design tailings impoundments to rely upon seepage as a form of tailings liquor management. This was a design principal employed in the early days of uranium mining that was approved by the Atomic Energy Commission (AEC) and its successor agency, the Nuclear Regulatory Commission (NRC). WNI's tailings facility was built in the late 1950's. The Uranium Mill Tailings Radiation Control Act was adopted by Congress in 1978, and 10 CFR Part 40, Appendix A, the regulation controlling WNI's site remediation effort, was not adopted until 1985.

The initial mass of uranium assumed in the transport model was conservatively over estimated with respect to the mass estimated from the measured ground water concentrations. This conservative factor over estimates the predicted concentration of site derived constituents in the ground water down gradient from the surface reclamation area. In particular, this factor over estimates the predicted concentration of site derived uranium in the ground water at the Red Mule area in the

future such that the predicted concentrations at the Red Mule area are higher than will likely be observed in that area.

In addition, it should be noted that the Red Mule area has already been identified as having naturally elevated background uranium concentrations (0.3 mg/L uranium; see Appendix F to the 10/29/99 Site Closure Plan). It is questionable if any significant increase in potential adverse health effects would result from the low concentrations of site derived constituents contributed to the naturally elevated uranium concentrations by future ground water transport. In any event, there is a reasonable assurance that site derived constituent concentrations will be below protective levels at this particular POE as required in Criterion 6.

Another conservative factor included in the modeling of the proposed alternative, as stated above, was the assumption that the constituent of most concern, uranium, currently having the largest source and greatest mobility would experience no retardation or attenuation beyond the valley mouths. However, site specific testing using site aquifer materials and site ground water has demonstrated that uranium transport is significantly attenuated (10/29/99 Site Closure Plan, Appendix F, Section 6.0; Appendix H, Attachment H.c).

Laboratory batch sorption tests on clean aquifer soils and representative impacted ground water allowed calculation of site specific partitioning coefficient (K_d) values for uranium (Site Closure Plan, Appendix F, Section F.6.3.3.2.2, 10/29/99). These Kd values (concentration of uranium on aquifer solids divided by the concentration of uranium in the associated ground water) for Southwest Valley aquifer materials from locations SWEB-12-235, SWEB-12-395, SWEB-13-65, SWEB-13-455 and WN-43A-15 averaged 0.32, 0.30, 0.14, 0.20, and 0.34 L/Kg, respectively. These values are among the lowest values observed at the site from all testing and reflect the relatively high mobility of uranium in this environment. Retardation (R), or the amount by which constituent transport is slowed due to interaction with the aquifer materials, is calculated according to the following formula:

$$R = 1+(\rho_b/n) \times K_d$$

where ρ_b is the bulk density of the aquifer soil (1.65 g/cm^3) and n is the aquifer material porosity (0.15).

The calculated retardation values for the Southwest Valley aquifer materials range from 2.54 through 4.74 with an average retardation of 3.86. This average retardation value for uranium was applied to the existing transport model (Site Closure Plan, Appendix H, 10/29/99) with no other modifications. Contouring of these modeling runs are presented for the 200 year and 1,000 year time frame as Figures 1 and 2 to this discussion. These modeling predictions, using representative retardation values based on site-specific test results demonstrate that, at 200 years, uranium does not reach the Red Mule area (see Figure 1). Further, at 1,000 years, the uranium concentrations will be below background levels with the exception of a small portion of the Northwest corner of the Red Mule area, which will be at or slightly above the "protective level" of 0.1 mg/L (see Figure 2). It is demonstrated in discussions below that this value of 0.1 mg/L is overly conservative and slightly higher concentrations are protective.

Examination of the predicted uranium distribution at 200 years using the highly conservative assumption of no retardation (see Figure H-c-3 included herein, original presented in Attachment C to Appendix H, Site Closure Plan, 10/29/99) demonstrates that all COCs at the Red Mule area will be at background levels with the exception of a small portion of the Northwest corner of the Red Mule area which will be at or slightly above the "protective level" of 0.1 mg/L. The other two constituents of concern, nitrate (NO_3) and manganese (Mn) are assumed to transport conservatively and with no retardation under all modeling scenarios. Under these assumptions and by analogy based on their existing and potential future concentrations in the Southwest Valley, NO_3 and Mn will not exceed background levels for 200 years. Over a 1,000 year period NO_3 and Mn will essentially be at or slightly above "protective levels" (10 mg/L for NO_3 which is the EPA promulgated MCL and 0.7 mg/L for Mn – see Attachment I.a to Appendix I, Site Closure Plan, 10/29/99). These highly conservative potential future conditions would not pose a significant acute risk to residents. In conjunction with the proposed institutional controls, discussed below, and the proposed alternate drinking water supply, there is a reasonable assurance the public health, safety and the environment will continue to be protected in the future.

Institutional Controls

The implementation of institutional controls to eliminate the potential future exposure pathways for human consumption of ground water containing byproduct material is an integral part of the proposed alternative. The application of institutional controls provides an addition level of protection for the public by eliminating potential exposure pathways. The existing institutional controls, which cover more than 97% of the surface and subsurface disposal area, include land ownership in fee, restrictive covenants on ground water use, and acquisition of title to the subsurface estate of a portion of the land. WNI owns approximately 3,650 acres of the 5,195 acres of the proposed control area, slightly more than 70 percent of the total. These lands will be transferred to the long-term custodian. In addition, the US government owns approximately 700 acres within the proposed control area, or nearly 13.5 percent of the total. Future access to ground water from these lands will not exist (unless permitted by the long term custodian). Additionally, WNI has acquired severed title to the entire subsurface estate more than seven feet below ground surface for an additional 565 acres within the proposed long-term control area (nearly 11 percent of the total). Title to the subsurface estate over this area includes control over access to and use of ground water for any purpose. This title will be transferred to the long-term custodian. Therefore, actual ownership of any land which contains, or will contain, byproduct material in groundwater will be transferred to the long-term custodian (presumably the Department of Energy [DOE]) and encompass 94.5 percent of the proposed long-term control area.

Further, WNI has acquired restrictive covenants, or deed restrictions, from the owners of 127 acres (or nearly 2.5 percent of the total) forbidding the use of ground water obtained from under their land for human consumption. Restrictive covenants for approximately 82 acres of these 127 acres require the land owner and their successors to refrain from allowing any human use or consumption, or any domestic use of water, from any *new or existing* water wells in or upon the land. The restrictive covenants for the other 45 acres of these 127 acres enjoin the land owner from permitting, drilling, building, opening or utilizing any *new* water wells of any kind in or upon the land. These restrictive covenants run with the land and may be enforced by WNI and its successor owners of the reclaimed surface tailings area and its successor licensees (i.e., the long term custodian, presumably DOE).

Accordingly, these restrictive covenants eliminate any potential future exposure pathway to site derived constituents from this acreage.

Land ownership, the ultimate intitutional control, combined with enforceable restrictive covenants, eliminate any potential future human pathway to site derived constituents in the ground water for over 97 percent of the proposed long-term control area and, consequently, provide *reasonable assurance* that any associated potential hazards to the public health and safety or the environment associated with these constituents are eliminated.

The remaining 3% of the proposed long term control area is called the "Red Mule" area (approximately 150 acres). WNI has not acquired ownership or restrictive covenants over this small portion of the proposed long-term control area. According to information recently obtained from the Freemont County Assessors Office, there are 14 parcels of separate ownership in the Red Mule area. Three of these parcels are vacant, one has a free standing home, one has a log cabin, several have old mobile or manufactured homes, one has a Quonset hut and two of the parcels have sheds. In addition, 11 existing domestic wells in this area have been identified though only 6 wells are in active use.

As part of the proposed alternative, WNI has developed a program to supply a perpetual alternate source of domestic water, including drinking water, to this small area should it ever be required. This alternate water supply will remove any need for residents of the Red Mule area to use ground water for domestic or drinking water purposes. Other uses of ground water in this area will not pose any substantial potential future hazard to public health and safety and the environment. Additionally, only through the application of all the overlapping conservative factors in the predictive transport modeling estimation of potential risk factors could there be any possibility of future risks to the Red Mule area. As a result, it is highly unlikely that any potential future incremental risk from uranium in drinking water will be realized.

In addition to providing the alternate drinking water supply, notification in the local (Fremont County) public land records will be provided regarding the fact that a small portion of the subsurface

of the proposed long-term control area beneath the Red Mule area is being used for the disposal of byproduct material and is subject to either an NRC general or specific license[2]. This notification, of a type contemplated by the regulations in Criterion 11(C) of 10 CFR Part 40 Appendix A, provides an additional component of the required *reasonable assurance* that there will be no significant potential exposure from site derived uranium to the public in the Red Mule area, the only area of the WNI site not subject to direct control. This is particularly true in light of the final mandatory component of the required *reasonable assurance*—the existence of a licensed, long term, governmental custodian that will be responsible for warning any residents of Red Mule about the import of the deed notations, if the site derived constituents ever get there, and who will be responsible for notifying and for providing the residents with an alternate water supply. Additionally, until the alternate supply is needed, no individual land owner in the control area would be exposed to any site derived constituents.

Conservatism In Development Of "Protective" Concentrations

The maximum predicted future concentrations of site derived constituents have been conservatively over estimated in the transport model. Of the six site derived constituents identified as constituents of concern (U, Ra-226+228, Mn, Mo, NH_3, NO3; COC; see Appendix I to the 10/29/99 Site Closure Plan), only U, Mn, and NO_3 have the potential to be transported as far as the Red Mule area (see Appendix H to the 10/29/99 Site Closure Plan). Moreover, these conservatively predicted maximum future concentrations are near the identified "protective" concentrations. Several factors of conservatism were incorporated into the development of these "protective" concentrations.

[2]42 USC §2113 provides: "*IN EXERCISING THE AUTHORITY OF THIS PARAGRAPH*, the Commission *SHALL* take into consideration the status of the ownership of such land and interests therein and the ability of the licensee to transfer title and custody thereof to the United States or a State." (Emphasis added.)

Criterion 11(C) of 10 CFR Part 40 Appendix A states that, in certain circumstances, rather than acquiring the land, the licensee may "provide notification in the public land records of the fact that the land is being used for the disposal of radioactive material and is subject to either an NRC general or specific license prohibiting the disruption and disturbance of the tailings. . . . *FOR LICENSES ISSUED BEFORE NOVEMBER 8, 1981*, the Commission *MAY* take into account the status of the ownership of such lands, and interests therein, and the ability of the licensee to transfer title and custody thereof to the United States or a State." (Emphasis added.)

The following discusses various conservative assumptions used in development of the "protective" concentrations.

One principal conservative assumption for all constituents is that the local ground water will supply all drinking water 350 days each year for 30 years. This is not likely to be the case for residents in this area.

Nitrate (NO_3)

The maximum predicted future concentrations of NO_3 at the Red Mule area are on the order of 30 mg/L to 50 mg/L. The Maximum Contaminant Level (MCL) developed by the US Environmental Protection Agency (EPA) which is considered to be the "protective" concentration, is 10 mg/L. However, this "protective" concentration is based on a sensitive population of infants less than 3 months old fed formula made from water containing elevated levels of NO_3. At the conservatively predicted future concentrations at the Red Mule area, adult human exposure would be below identified adverse risk levels. The literature indicates that NO_3 concentrations up to 500 mg/L have no observed adverse health effects when consumed by adults or older children on a long-term basis. Again, the long term custodian could warn any residents regarding use of ground water in infant formula.

Maganese (Mn)

The current average Mn concentration at the mouth of the Southwest Valley is approximately 5 mg/L, though point concentrations at a few locations have been observed to be higher. Maximum Mn concentrations at the Red Mule area, if Mn ever is transported that far, would be expected to be on the order of 0.5 to 1 mg/L. The EPA has not promulgated an MCL value for Mn, although the published EPA reference dose (RfD) for all exposure to Mn is 0.14mg/kg-day. Given a typical human of 70 Kg this RfD translates to 9.8 mg of Mn per day as a safe chronic level of Mn consumption. The EPA assumes that Mn is ingested both through food sources and non-food sources such as water and soil. The EPA also assumes that 3 times more Mn is adsorbed into the body from these non-food sources than from food source although it acknowledges that there are no

data to support this assumption. Therefore, the EPA applies a safety factor of 3 to the consumption of Mn from the non-food source of drinking water consumption.

EPA Region III has developed a risk based concentration (RBC) for Mn in tap water, which is a screening level guidance value only. This RBC value for Mn is 0.73 mg/L and includes the 3 fold factor of safety for Mn from non-food sources. Without this unsupported factor of conservatism but still following the conservative EPA risk calculation methods, the RBC value becomes 2.2 mg/L as a safe concentration of Mn in drinking water for the long-term even considering additional manganese consumption through food. This value is below the range of probable maximum Mn concentrations at the Red Mule area in the future.

Uranium (U)

The maximum predicted future concentrations of U at the Red Mule area are on the order of 0.3 mg/L to 0.8 mg/L. Currently, the EPA has not promulgated an MCL value for U. Additionally, the Wyoming State drinking water standard for U, which the State presumably considers protective, is 5 mg/L and naturally occurring U concentrations in the Red Mule area ground water are 0.3 mg/L.

The EPA calculation of a "safe level" for uranium exposure starts with the lowest observed adverse effect level (LOAEL) reference dose (RfD) value of 2.8 mg/kg-day (or 196 mg/day for a 70 Kg adult) and then employs a factor of safety of 1000. (As a point of comparison, the Swiss Office of Public Health has proposed a No Effect value for humans of 1mg/kg-day, an exposure level 333 times higher than the EPA RfD.) Without the application of this huge factor of conservatism, the "safe" drinking water concentration would be approximately 100 mg/L. The highly conservatively predicted future concentrations of U at the Red Mule area are still several times lower than the "safe level using a factor of conservatism of 50, an reasonable and ample margin of safety. Therefore, an individual's exposure to uranium, should the individual choose not to use the alternate drinking water supply, would be below identified adverse risk levels.

CONCLUSION

Taken together, the extensive characterization, conservatism in the predictive modeling, the implementation of broad enforceable institutional controls, the supply of a perpetual alternate drinking water source, notification in the land records that the lands are being used for byproduct material disposal, and the conservatism inherent in the "protective" concentrations, individually and collectively, demonstrate that the proposed alternative posses the requisite "reasonable assurance" of protection for public health and safety and the environment as required by 10 CFR Part 40, Criterion 5(D)[3].

The ground water component of the Site Closure Plan, submitted to the NRC on 10/29/99, through the detailed and carefully considered review of site conditions and alternatives has identified the best alternative. It is protective and reduces impacts to public health and safety and the environment to as low as reasonably achievable. The detail and conservatism designed into this alternative provides the requisite "reasonable assurance" of protection to public health and safety and the environment for 1,000 years, to the extent reasonable achievable, and, in any case, for at least 200 years (10 CFR Part 40, Criterion 6-1[4]).

[3] Criterion 5(D) of 10 CFR Part 40 Appendix A states "The Commission will determine when the licensee may terminate corrective action measures based on data from the ground-water monitoring program and other information that provide reasonable assurance that the ground water protection standard will not be exceeded."
[4] Criterion 6(1) of 10 CFR Part 40 Appendix A states "In disposing of waste byproduct material, licensees shall close the waste disposal area in accordance with a design which provides reasonable assurance of control over radiological hazards to (i) be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years."