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Confederated Tribes and Bands
of the Yakama Nation

Established by the
Treaty of June 9, 1855

July 20, 2010

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RECEIVED
JUL 26 2010
EDMC

Jane Hedges, Program Manager
State of Washington Department of Ecology, Nuclear Waste Program
3100 Port of Benton
Richland, Washington 99354

Re: Review of Proposed Plan for Amendment of 100-NR-1/NR-2 OU Interim Action Record of Decision-DOE/RL-2009-54, Revision 0

Dear Ms. Olinger, Messrs. Brockman, Faulk, and Ms. Hedges,

The Yakama Nation ERWM Program appreciates the opportunity to review and provide comments on the *Proposed Plan for Amendment of 100-NR-1/NR-2 OU Interim Action Record of Decision-DOE/RL-2009-54, Revision 0.* 0088645

The Confederated Tribes and Bands of the Yakama Nation is a federally recognized sovereign pursuant of the Treaty of June 9, 1855 made with the United States of America (12Stat. 951). The U.S. Department of Energy's Hanford site was developed on land ceded by the Yakama Nation under the 1855 Treaty with the United States. The Yakama Nation retains reserved rights to this land under the Treaty.

The Yakama Nation ERWM Program supports use of technologies that reduce or eliminate the contamination of the Columbia River from source units on the Hanford Site. Initially, the approach presented in the *Proposed Plan for Amendment of 100-NR-1/NR-2 OU Interim Action Record of Decision-DOE/RL-2009-54, Revision 0* held promise of success. However, further expansion of this technology is not without some concerns. The Yakama Nation ERWM Program identified eight areas of significant concern.

1. Preferential Groundwater Pathways: Geologic cross-section figures (Figures 1-9 & 1-10) in the *Treatability Test Plan for Apatite Permeable Reactive Barrier Extension for the 100-NR-2*

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100-NR-1
100-NR-2

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Operable Unit-DOE/RL-2010-29, Draft A illustrate a far more complex hydro-geologic environment, which has been oversimplified; suggesting areas where Sr-90 has the potential to migrate under and/or between the injection wells through preferential pathways. This phenomenon is not localized, as evident in the BC Cribs area Columbia River's upwelling data.

It is our understanding that the injection wells have screened intervals that span both the Hanford and Ringold Formations. Containment of the injected solutions relied on river stage to provide appropriate confining pressure. Dilution measurements in adjacent injection wells do not account for the possibility of preferential flow through one geologic unit, or a smaller conduit in the subsurface that reaches the adjacent screen over a limited interval. In short, the measurements performed do not verify that the placement of chemical species necessary to form a continuous, consistent Apatite Permeable Reactive Barrier (PRB) has been achieved.

This concern has been further illustrated by the uneven levels of treatment that were observed in the Hanford and Ringold Formations during test injections (PNNL-17429, Section 7.0). During the 2009 high-concentration injection test, 50% of the wells used failed to meet injection specifications (based on measurements in adjacent wells) that would demonstrate formation of a continuous PRB (PNNL-SA-70033). Injection wells used during high-concentration solution injections experienced "excessive buildup" of precipitate in well filter pack, necessitating lower injection rates and resulting in decreased radial extent of treatment. Treatment of the overlap zone between wells, where coverage would be most severely compromised by the observed problems could not be verified since no monitoring equipment was installed at these locations except at the extreme ends of the test PRB (PNNL-SA-70033).

The Yakama Nation ERWM program requests post-injection verification soil sampling to demonstrate that apatite mineralization is occurring. The verification sampling should include areas between and on the perimeter of injection points and should include several vertical intervals so that samples represent the range of geologic and hydro-geologic properties.

2. Construction Integrity: Apatite Permeable Reactive Barrier (PRB): Uncertainty remains as to whether placement of the reactive species in the apatite PRB at the 100-N site is effective or reliable. During injection of both low- and high-concentration calcium-citrate and sodium-phosphate solutions, soil treatment was assumed successful based on the measured dilution of injected reagents at adjacent injection wells (PNNL-17429; PNNL-SA-70033). Important considerations related to the effectiveness and reliability of apatite treatment includes injection specifications, apatite flow, river stages, and annual flooding events.

Concerns regarding reagent placement are compounded by the complicated relationship between injection time, well location, river stage, and geologic unit. PNNL has reported instances of failure to achieve adequate formation treatment because of inappropriate river stage or different-than-expected behavior by the target geologic formation. These failures have resulted in loss of significant portions of the injection volume through the upper portions of the injection well screen into the more porous Hanford Formation media, and only limited treatment of the Ringold Formation (PNNL-17429). Inadequate treatment of the subsurface at any well within the PRB may result in potentially vulnerable or untreated segments along the river shoreline. Furthermore, annual spring flooding events change the aquifer's hydro-geologic gradient and may affect the stability of the barrier and the levels of Sr-90 concentration in the vadose zone and groundwater. This situation is analogous to the emerging problem of Uranium evident in the 300 Area groundwater.

The Yakama Nation ERWM Program requests the installation of separately screened wells to treat the Ringold Formation.

The Yakama Nation ERWM Program also recommends a dual approach to Sr-90 sequestration, employing construction of an impermeable barrier via injection of bentonite grout to augment the apatite barrier (the PRB).

3. PRB Effectiveness and Monitoring: To date, the DOE has reported that the PRB has been slow to incorporate strontium-90 under field conditions (DOE/RL-2008-46 Addendum 5). PNNL has indicated "long-term removal [of strontium] will need to be assessed with down gradient monitoring" over a period of years (PNNL-17429). The acknowledged need by PNNL for an extended period of monitoring to determine the PRB's performance, combined with the early failure to incorporate strontium-90 rapidly from site groundwater strongly suggests that a more thorough evaluation of this technology is warranted, including a more extended performance-monitoring period.

Flow reversals in the groundwater gradient that result from changes in river stage makes barrier assessment significantly more difficult than in areas where established gradients are maintained for extended periods. Despite the challenges associated with evaluating the PRB's effectiveness using existing monitoring wells and aquifer tubes, the proposed plan does not include installation of additional PRB-specific monitoring equipment in or around the test PRB prior to approval of its expansion.
Groundwater data collected from existing aquifer tubes, other down gradient monitoring locations or surrounding monitoring wells has not yet been presented that demonstrates the effectiveness of the test PRB.

Moreover, a detailed plan for PRB performance review has not been identified, or publicly released suggesting that no performance criteria have been identified against which the test PRB has been evaluated. The Proposed Plan states that "periodic groundwater monitoring will be performed to confirm the apatite PRB's effectiveness," but does not include details on locations or equipment or address the numerous difficulties associated with doing so outlined in this document, nor does it provide reference to a plan which does.

The Yakama Nation ERWM Program recommends revision of the Proposed Plan to include deeper boreholes/monitoring wells close to the river-shore and include monitoring locations up-stream and down-stream of the PRB. The sampling frequency should be sufficient to detect potential breakthrough under high water and low water conditions as they vary seasonally.

4. PRB Effectiveness and Monitoring: Presuming that barrier integrity issues can be adequately addressed, a full length PRB installed, and verified to be in accordance with design specifications, there are several potential problems associated with long-term effectiveness that should be addressed prior to its incorporation into the Final Record of Decision for the 100-N Area.

The apatite PRB is designed to contain the specific mass of apatite required to treat strontium-90 contaminated groundwater adequately as it flows from the plume towards the Columbia River. The mass of apatite is based on two variables (PNNL-17429):

- Mass-balance of apatite required to remove the projected mass of strontium that will reach the barrier and;
- Rate of strontium incorporation into barrier apatite; and
- Mobilization of Sr-90 during PRB construction.

If groundwater flow rates are too high, strontium-90 contamination will move through the treatment zone more quickly than it can be removed. Groundwater flow in the 100-N area is governed by the stage of the Columbia River, which may vary by as much as five meters in a given water year (USGS, 2009).

The Yakama Nation ERWM Program requests these highly variable groundwater elevation and resulting changes in groundwater flow direction and speed be incorporated into the barrier design.

Changes in regional climate or surface hydrology that may occur over the next 300 years cannot be predicted with a great deal of accuracy at this time. Such environmental changes may make required maintenance of the barrier much more extensive than is currently planned. Because the barrier construction specifications are calibrated to specific groundwater flow rates, significant changes in groundwater flow rates or long-term changes in river stage may require significant additional treatment or other changes in design that cannot be foreseen now.

No plans have been presented to continue to maintain and monitor the apatite PRB for its expected functional lifetime, which is governed by the time necessary to allow for remediation by radioactive decay (it should be noted that during this period the PRB will become increasingly radioactive). The preferred remedial alternative only includes a provision for one additional round of injections at a subset of wells within 5 years of PRB completion. Provisions or other types of maintenance on a long-term basis have not been identified.

The Yakama Nation ERWM Program requests DOE develop a detailed, long-term operation, and maintenance plan that describes inspection, maintenance, and contingency activities that will be used to maintain the PRB treatment effectiveness at high levels over a period of up to 300 years. The plan should include cost estimates for likely and contingent activities so that funding can be requested and obtained for these activities.

The fate of strontium that was mobilized during both high- and low-concentration PRB solution injections (performed from 2006 - 2008) should be determined and explained. Following both tests, increases in concentrations of strontium-90 in groundwater were observed in nearby aquifer tubes (PNNL-17429; PNNL-SA-70033; DOE/RL-2008-66). Some of these concentrations were as high as 75,000 picocuries per liter (pCi/L) (DOE/RL-2008-66). It is not prudent or acceptable to implement a remedy that results in releases of high concentrations of contaminants directly to the Columbia River.

The Yakama Nation ERWM Program requests clarification on the estimated period of elevated concentration entering the Columbia River.

The Yakama Nation ERWM Program requests DOE assemble and review and interpret data from prior tests to understand the nature and extent of the problem; develop injection procedures that will minimize mobilization of strontium in the laboratory with subsequent field-testing to verify the process is not problematic.

Furthermore, the Yakama Nation ERWM Program recommends the retention of the 100-N Area Pump and Treat System as viable, redundant backup system as there is no current contingency plan should the PRB fail. Retention of the pump and treat system is supportive of the current policy DOE is pursuing with installation of the Central Plateau pump and treat system.

5. Site Characterization & Risk Assessment Process: DOE considers results of past Qualitative Risk Assessments (QRA) as "still relevant for remedial action alternatives" presented in this Proposed Plan. While these QRAs may have provided a screening level evaluation adequate in the mid-1990s for immediate identification of high-priority sites for interim remedial actions, they are now quite outdated for the purposes of evaluating current remedies. These QRAs, as well as the River Corridor Baseline Risk Assessment, are inadequate for considering site risks because they rely only on current conditions, limited contaminants, and limited exposure pathways.

Sampling data used for past risk assessments have been limited to residual contamination at previously remediated waste sites. To capture the complete risk profile, additional characterization data (particularly of sub-surface contamination), transport of contaminants through the environment, future concentrations, all exposure pathway possibilities (including future Tribal and resident population exposure scenarios), and cumulative effects must be considered.

The Yakama Nation ERWM Program requests incorporation of Tribal residential use scenarios and resulting impacts from future site conditions (e.g., potential comingling of total petroleum hydrocarbons (TPHs) into the Sr-90 plume) into the calculation of site risks.

6. CERCLA Process: It is stated in DOE/RL-2010-29, Draft A, *Treatability Test Plan for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit,* that this Proposed Plan was based on agreement by DOE and Ecology (DOE/RL-2006-20), that the long-term strategy for groundwater Sr-90 remediation at the 100-N Area should include apatite sequestration as the primary treatment technology to be tested. It is stated in the Proposed Plan, an associated documents, (DOE/RL-2010-29, Draft A, & PI Fact Sheet) that the decision to deploy apatite sequestration at additional locations will be made via an Ecology-approved plan, or through an addendum to DOE/RL-2001-27 (*Remedial Design Report/Remedial Action Work Plan for the 100-NR-2 Operable Unit, Rev 0).*

The Yakama Nation ERWM Program requests clarification of the regulatory pathway which allows for application/utilization of this Proposed Plan and the amendment of an Interim Action Record of Decision for any purpose other than at the specific site locations identified herein.

While the successful use of apatite PRBs at abandoned mine sites to treat acid tailings discharge has been demonstrated (Yancey and Bruhn, 2006), placement of the reactive species was assured by using traditional open cut methods and the flow of contaminated water was both relatively consistent and well defined. The unique method of placement for the calcium- and phosphate-species at the test PRB site, combined with variable groundwater gradients, chemistry and elevations introduce *additional uncertainty* regarding the PRB's ability to perform in a manner similar to apatite barriers installed using more traditional methods.
Selection of the apatite PRB as a remedial alternative has not been performed in accordance with EPA guidelines and the CERCLA process. DOE has not yet completed a remedial investigation for the Operable Unit in accordance with EPA's CERCLA RI/FS guidance. This investigation is intended in part to determine the full nature and extent of contamination at the 100-N Area, including the source terms for strontium contamination of groundwater.

Estimates of Sr-90 inventory as stated in DOE/RL-2009-54, Draft B (submitted to Ecology 12/16/2009; 10-AMCP-0032) differ significantly from values presented in this version of the

Proposed Plan. This suggests there is an uncertainty of the remaining Sr-90 in the vadose zone and present in the underlying aquifer.

The Yakama Nation ERWM Program is concerned that premature expansion or additional deployment of the PRB may result in implementing a compromised design due to inadequate characterization of strontium source terms. The Yakama Nation ERWM Program requests clarification on this issue.

In the selection of remedy alternative during the Final Record of Decision process, the Yakama Nation ERWM Program requests DOE employ an independent expert to oversee additional characterization and data collection efforts (including modeling of contaminant transport).

7. Public Participation and Tribal Involvement: A detailed plan for PRB performance review has not been identified, or publicly released suggesting that no performance criteria have been identified against which the test PRB has been evaluated. The Proposed Plan states that "periodic groundwater monitoring will be performed to confirm the apatite PRB's effectiveness," but does not include details on locations or equipment or address the numerous difficulties associated with doing so outlined in this document, nor does it provide reference to a plan which does.

Evaluation of alternative technologies for remediation of strontium-contaminated groundwater was performed by the Innovative Treatment and Remediation Demonstration Program in 2001 (ITRD, 2001). Additional evaluation of this technology was released in 2004 in the form of the letter report *Evaluation of Strontium-90 Treatment Technologies for the 100-NR-2 Groundwater Operable Unit Letter Report* (not publicly available).

PNNL has indicated that sediment core samples were to be collected from the test PRB in November, 2009. The results from this sampling and analysis are not yet available. Other limited data from sediment core sampling performed as part of a surface infiltration test are also not readily available at this time (results are reportedly available in PNNL-18303, see References).

The Yakama Nation ERWM Program requests DEO make the relevant PNNL reports and/or future documents (e.g., design plans, monitoring plans) available to the Yakama Nation and the public. Remedial design revisions should carefully consider our concerns and requests described above.

8. Additional Related Concerns:

- As identified in our June 2010 comment response letter for our review of *the Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 5: 100-N Decision Unit, DOE/RL-2008-46-ADD5, Draft B, and Sampling and Analysis Plan for the 100-N Decision Unit Remedial Investigation/Feasibility Study, DOE/RL-2009-42, Draft B,* the Yakama Nation ERWM Program detailed its concerns about the apatite barrier that are not addressed in the RI/FS or the SAP, and which remain unresolved in this Proposed Plan.

The Yakama Nation ERWM Program requests clarification on when we can expect a timely response to our comments on these documents.

- Yakama Nation Comment Responses for DOE/RL-2009-54, Draft B, Proposed Plan for Amendment of 100-NR-1/NR-2 Interim Action Record of Decision: *See attach file.*

- Yakama Nation Comment Responses for DOE/RL-2010-29, Draft A, Treatability Test Plan for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit: *See attach file.*
- Yakama Nation ERWM Program comment on the Use and Effectiveness of Phytoremediation: *See attach file.*

The Yakama Nation ERWM Program's review comments are enclosed. The Yakama Nation ERWM Program looks forward to official responses from you and dialog on these concerns and comments. If you have any questions, please contact Russell Jim at (509) 945-6741, or Dave Rowland at (509) 582-3466 or (509) 945-4488.

Sincerely,

Russell Jim, Manager
Yakama Nation
ERWM Program

Enclosures:

1) Yakama Nation ERWM Program Comment Responses for DOE/RL-2009-54, Draft B, Proposed Plan for Amendment of 100-NR-1/NR-2 Interim Action Record of Decision.
2) Yakama Nation ERWM Program Comment Responses for DOE/RL-2010-29, Draft A, Treatability Test Plan for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit.
3) Yakama Nation ERWM Program comment on the Use and Effectiveness of Phytoremediation

cc: Paula Call, U. S. Department of Energy
Ken Niles, Oregon Department of Energy
Gabriel Bohnee, NPT
Stuart Harris, CTUIR
Wade Riggsbee, Yakama Nation ERWM
Dave Rowland, Yakama Nation ERWM
Jean Vanni, Yakama Nation ERWM
Administrative Record

Yakama Nation ERWM Program Comment Responses for DOE/RL-2009-54, Draft B, Proposed Plan for Amendment of 100-NR-1/NR-2 Interim Action Record of Decision:

The Yakama Nation ERWM Program has additional concerns regarding application of this technology and requests additional information and clarification on the following:

- References: DOE/RL-2010-29, Draft A, *Treatability Test for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit* was not listed. It should have been as it provides more a detailed and important explanation of the Sr-90 sequestration process missing from the Proposed Plan.
- Pg. 3: It is unclear to the reader which documents are being referenced within the body of the text. ***The Yakama Nation ERWM Program recommends inclusion of associated document numbers or the referenced document numbers need the full title.***
- Pg. 5: It is unclear to the reader as to the regulatory status of the waste source units identified as "liquid waste disposal facilities (116-N-1 & 116-N-3 LWDFs). ***It is our understanding these units are Resource Conservation and Recovery Act (RCRA) Treatment, Storage and Disposal Operable Units and should be identified as such.***
- Pg. 5, Contaminated Media: ***The Yakama Nation ERWM Program requests DOE provide a reference document that identifies the additional radiological and chemical contaminants detected in the groundwater and in upwelling samples collected along the Columbia River shoreline.***
- Pg. 6, Causes of the current contamination at the site: It is unclear what is meant by statement "The discharges to the LWDFs contained radioactive waste products and undocumented quantities of dangerous waste streams, including corrosive liquids, metals-laden wastes, and other laboratory chemicals *as allowed by* the Resource Conservation and Recovery Act (RCRA) Part A." These types of contaminates are not "allowed by" but rather subject to RCRA. Furthermore, TSD closure actions must include all RCRA contaminates on site, not only those listed on the Part A form. ***The Yakama Nation ERWM Program recommends rewrite of text for better clarification and more accuracy with regard to the Dangerous Waste Regulation (WAC 173-303).***
- Pg. 8, 2nd Paragraph: It was noted in Draft B of this Proposed Plan that estimated removed soils contained 3282 curies of radionuclide activity. Please confirm accuracy of this statement. ***The Yakama Nation ERWM Program recommends inclusion of this information within this revision of the Proposed Plan.***
- Pg. 11, How much and what type of contamination present: Estimates of Sr-90 inventory as stated in DOE/RL-2009-54, Draft B (submitted to Ecology 12/16/2009; 10-AMCP-0032) differ significantly from values presented in this version of the Proposed Plan. This suggests there is an uncertainty of the remaining Sr-90 in the vadose zone and present in the underlying aquifer. ***The Yakama Nation ERWM Program requests detailed explanation of how these values were derived.***
- Pg. 12, 1st Paragraph: *The Yakama Nation ERWM Program requests DOE provide a reference document to support the statement that hexavalent chromium detected in the 100-N Area groundwater is being addressed through 100-KR-4-OU interim actions.* ***The Yakama Nation ERWM Program expects hexavalent chromium to be considered as a contaminant of concern for both the 100-NR-1 and 100-NR-2 Operable Units.***
- Pg. 12, Scope and role: ***In the selection of remedy alternative during the Final Record of Decision process, the Yakama Nation ERWM Program anticipates a robust evaluation of alternatives for remedy selection as several treatment technologies have already undergone a 'comprehensive review to complement the existing interim remedial actions.***

Furthermore, the Yakama Nation ERWM Program requests DOE employ an independent expert to oversee additional characterization and data collection efforts (including modeling of contaminant transport).

- Pg. 14, Ecological impacts discussion: As identified in our June 2010 comment response letter for our review of *the Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 5: 100-N Decision Unit, DOE/RL-2008-46-ADD5, Draft B, and Sampling and Analysis Plan for the 100-N Decision Unit Remedial Investigation/Feasibility Study, DOE/RL-2009-42, Draft B,* the Yakama Nation ERWM Program identified concerns which the approach used to evaluate ecological impacts. (e.g., Asiatic clams are invasive in the Columbia River and do not constitute an appropriate benchmark species for rating habitat conditions since they are known to "exhibit a high tolerance for the effects resulting from exposure to toxic substances" (Doherty, 2004). ***The Yakama Nation ERWM Program had requested DOE revise using appropriate indicators of habitat and/or water quality). We continue to voice this concern. Please see our comments regarding the above referenced document for additional concerns.***
- Pg. 14, Microbial decomposition of petroleum hydrocarbons: Interpretation of effects is not supported by enough data. Elevated metal levels may indicate a relationship between the geologic environment and other waste sources and not active biodegrading of total petroleum hydrocarbons (TPHs). ***The Yakama Nation ERWM Program expects further evaluation of other techniques for remediation of TPH from 100-N Area soils.***
- Pg. 15, Remedial Action Objectives: Earlier version of the Proposed Plan included discussion of Preliminary Remediation Goals. ***The Yakama Nation ERWM Program recommends this be included (including Table 1) in Appendix A.***
- Pg. 16, Institutional Controls: There are major concerns of treatment actions as mentioned, that does not remove contamination along the river shoreline, but attempts to trap it in place for 300 years and rely heavily on use of institutional controls. ***The Yakama Nation ERWM Program remains concerned of the over-reliance on Institutional Controls to the extent indicated in the Proposed Plan.***
- Pgs. 17-18: Alternative 3: Impermeable Barrier: ***The Yakama Nation ERWM Program requests this alternative be reevaluated in the Final Record of Decision process, employing the independent, professional expertise of someone familiar with the mature technology of grout injection.***
- Pg. 19: It is unclear what the exact length of the extension of PRM is. Total length is stated to be approximately 760m (2500ft). ***The Yakama Nation ERWM Program requests the barrier be deployed to the full 2500 ft and, if necessary to be able to capture the 'metals plume' at the southeastern end of the 116-N-1 (1301-N Crib), extended further.***
- Pg. 19: Statements are made in this sections (and elsewhere) implying that the decision to deploy this apatite sequestration techniques at additional locations will be made through a process outside of the public involvement process. This is incorrect and inappropriate to prospectively decide future remedy selection or imply the approval of use of a "plug-in approach" within the context of this Propose Plan. ***The Yakama Nation ERWM Program request DOE remove this text from the document. Should DOE be considering application of the "plug-in approach" to waste site remediation, the Yakama Nation ERWM Program requests DOE develop a separate document and subject it to the public review process.***

- Pg. 19: Discussion of an additional round of injection at a subset of injection well locations within 5 years of completing all apatite injections is lacking in detail. This suggests an incomplete design and inaccurate costs estimates. ***The Yakama Nation ERWM Program requests DOE provide additional information in a new revision of this Proposed Plan and that this include adjusted cost estimates.***
- Pg. 20 and elsewhere: Discussions state the timeframe required before the Sr-90 pCi/L remedial action goal is achieved in groundwater throughout the aquifer is estimated at 300 years regardless at to what technique is deployed (Alternative 3 vs. 4). However, cost estimate differences are uncertain because full extension of barrier or changes occurring as a result of new information obtained during remedial design and construction do not seem to have been accounted for. ***We are concerned that the U.S. Department of Energy (DOE) is rushing to a decision, presumably in the context of spending stimulus funding in a timely manner, without demonstrating that the remedy has been selected in a thoughtful manner or that there is a reasonable degree of confidence that the remedy will be effective.***
- Pg. 22, Evaluation of Alternative: The Yakama Nation ERWM Program believes there has been an over-reliance on previous and outdated information. ***The Yakama Nation ERWM Program expects DOE to comply with the requirements to fully conduct a Feasibility Study prior to the Final Record of Decision.***
- Pg. 22, Un-reacted liquid apatite-forming chemicals: Discussion indicates the potential for incomplete barrier formation and escape of Sr-90 into the Columbia River. The Yakama Nation ERWM Program requests clarification on how the current design accounts for this contingency.
- Pg. 24, Pump-and-Treat System: It is stated that extensive maintenance, repair, and replacement of system components would be required to return the system to normal operation. DOE was to have maintained this system in 'cold standby' should it be required to be restarted. ***The Yakama Nation ERWM Program requests clarification on why this system was allowed to deteriorate such that these extensive repairs and maintenance are now required. Furthermore, as there is no redundancy built into the Propose Plan, the Yakama Nation ERWM Program requests this system not be eliminated as a option prior to selection of the final remedy.***

Yakama Nation ERWM Program Comment Responses for DOE/RL-2010-29, Draft A, Treatability Test Plan for Apatite Permeable Reactive Barrier Extension for the 100-NR-2 Operable Unit

The Yakama Nation ERWM Program has additional concerns regarding application of this technology and requests additional information and clarification on the following:

- USDOE submitted an initial SEPA checklist and made the statement that the pilot test would be considered successful if the test yields favorable results based on the following criteria.
    - After approximately three weeks apatite residence (assuming one week for formation of amorphous apatite and another two to three weeks for formation of conversion to crystalline apatite), the contractor will withdraw a volume of water from the wells that will be approximately three times the volume of the solution injected.
    - The contractor will use a design analysis that will allow them to extract the groundwater at a rate that in as short a time as possible without adversely affecting the reactions occurring.
    - The water will undergo analysis to determine the concentration of strontium-90 present.
    - If the strontium-90 concentrations are reduced tenfold, the USDOE will consider the pilot test has demonstrated a proof of the principle.

Admittedly, the barrier did not perform to this level of expectation. ***The Yakama Nation ERWM Program requests clarification on the basis for expansion of this approach. Additionally, the Yakama Nation ERWM Program requests clarification as to whether a second checklist was submitted to Ecology to cover process changes in the extension of the barrier.***

- In a separate phase, the contractor was to drill 10 six-inch diameter injection wells, 30 feet apart, and another performance monitoring well between two of the new wells. The contractor was to then inject the liquid solution containing apatite precursors in sufficient volume to create a 300-foot barrier. The barrier was to be considered successful if there was a greater than 90% reduction in strontium-90 concentrations in the water samples that the contractor would have withdrawn from the pilot test and performance monitoring wells and/or injection wells in the treatment zone. ***The Yakama Nation ERWM Program requests clarification as to whether this criterion of a greater than 90% reduction in strontium-90 was achieved.***
- Earlier (~2005) modeling presented by Mark Williams assumed homogeneous properties for each stratigraphic unit (i.e., the Hanford and Ringold Formations). This is an oversimplification, but useful as a planning tool with limitations. Heterogeneity of the sediments present some challenges in assuring the distribution of the calcium citrate that were not addressed. Given the work by Andy Ward and Glendon Gee in demonstrating the importance of microstratigraphic features in the subsurface transport of liquids, this factor cannot be overlooked. Stratigraphic information should be incorporated if the model is to be used in any assessment of the performance and future predictions. ***The Yakama Nation ERWM Program requests clarification on whether this information has been incorporated into the model.***
- Injection mechanisms are assumed. ***The Yakama Nation ERWM Program requests clarification on what the backup plan is if these do not proceed as hoped.***

- Assurances that the calcium citrate is distributed as planned are needed. ***The Yakama Nation ERWM Program requests clarification how this uncertainty has been addressed.***
- Assurances that the system remains effective and does not saturate (creating waste sites) after some unspecified interval on time are needed. What happens should this occur? Is there a contingency plan to cover this possibility? ***The Yakama Nation ERWM Program requests clarification how this uncertainty has been addressed.***
- What is the maintenance issues associated with keeping the system functional? ***The Yakama Nation ERWM Program requests clarification on this issue.***
- Proposed Barrier length does not extend to capture the known metals plume area to the southeast end of Crib 1301-N. ***The Yakama Nation ERWM Program remains concerned of the lack of soil characterization at 100-N. The Yakama Nation recommends DOE reconsider and extend the barrier the additional length needed to support clarification of the nature and extent of contamination at the 100-N Area.***

Yakama Nation ERWM Program comment on the Use and Effectiveness of Phytoremediation: While not specifically mentioned in the proposed plan, other DOE documents have specifically identified phytoremediation as a technology that would be used in conjunction with an expanded apatite PRB (DOE/RL-2008-46 Addendum 5; DOE/RL-2008-66). The use of phytoremediation as a remedial technology brings forth additional concerns that should be resolved before the proposed plan is approved.

While some strontium-90 uptake has been documented in vegetation growing along the Columbia River (ITRD, 2001) basic data and information regarding this remedial method's application are still deficient. Plans to implement phytoremediation in the 100-N Operable Unit provided by the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan Addendum 5* do not offer any information on the rate of strontium-90 uptake by coyote willow (the plant selected for this action), the depth of root penetration, kinetics of young versus old trees, or water use.

Management of contaminated biomass is generally described as including fencing and netting. Justification for these institutional controls relies in part on a study that concluded detectable transfer for strontium-90 from natural willow trees to the riparian food chain along the 100-N shoreline was not significant (PNNL-18294; not available online). However, the RI/FS Work Plan fails to acknowledge that this is generally thought to be due to the willow's tendency to concentrate strontium-90 in the woody part of the tree rather than the more edible leaves (ITRD, 2001). No information is provided as part of the Work Plan regarding how strontium-90 is partitioned in coyote willow, though this information a critical component in controlling potential mobilization of the radioisotope to the food chain at the surface.

Additionally, the sites of the proposed apatite barrier and phyto-remediation (i.e. coyote willows) are/will be located in a complex hydrogeologic area with multiple possibilities of preferential pathways yet to be defined, but have been recognized as noted in Columbia River upwelling data. The ERWM Program is concerned such that use of phyto-remediation as proposed will create additional secondary waste issues with limited effective deep treatment.

Finally, much like the apatite PRB, Phytoremediation depends on regular monitoring maintenance in the form of harvesting and disposing of contaminated biomass. Because the apatite PRB retains strontium-90, and additional strontium-90 can be expected to break through the PRB periodically, monitoring and maintenance activities will likely need to continue for the next 300 years.

The Yakama Nation ERWM Program requests DOE prepare and circulate for review a detailed plan for phytoremedial components of the proposed remedy. The plan should include an estimate of the root depth for the proposed plants and demonstrate how this relates to the depth of contaminated groundwater. Additionally, there should be uptake estimates and a sampling schedule to verify strontium uptake in the willows. DOE should include the cost of biomass harvesting and disposal in this documentation.