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Sandia National Laboratories
Waste Isolation Pilot Plant

Analysis Plan for an RH-TRU Inventory Impact Assessment
AP-068

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1.0 INTRODUCTION AND OBJECTIVES

This analysis plan directs a study to determine what the impacts on repository performance of the WIPP (Waste Isolation Pilot Plant) should RH-TRU (Remote-Handled Transuranic Waste) not be characterized. The waste characterization would effect the estimates for material components (non-radioactive) and the radionuclide components of the RH-TRU. The RH-TRU Inventory Impact Assessment (RHI-IA) supports a larger CAO directed program, The RH-WAC study. This larger team consists of DOE/CAO, WID, Benchmark, and SNL. The SNL contribution is to conduct a bounding performance assessment covering a 10,000 year timeframe and from which a 300 year record will be extracted consistent with the approach used in the RCRA Permit. It is expected that both NMED and EPA will evaluate the regulatory impacts associated with not characterizing the RH-TRU inventory or with potential changes in RH-TRU inventory.

The WIPP repository is limited by the Land Withdrawral Act of 1982 (Ref. LWA) to 0.25 million cubic feet (7,080 m^3) of RH-TRU mixed waste. Characterization of RH-TRU waste for radioactive and non-radioactive components is expensive for both resources and worker risk. Justification for limited characterization or for not characterizing RH-TRU waste requires the demonstration that regardless of the inventory associated with the RH-TRU waste, that the RH-TRU waste does not significantly contribute to the normalized regulatory release or compromise compliance. The work described in this analysis plan evaluates the impact of bounding RH-TRU inventory assumptions on repository performance. Transportation and generator site impacts are not considered in this analysis.

All calculations will utilize the CCA baseline database (Ref – DOE 1996b) except for the RH-TRU inventory components to be evaluated. The Impact Assessment is made up of two phases. Phase one will utilize DeskTop-PA and GoldSym. These rapid-turn around PA tools will provide preliminary results and serve as screening tools for the later simulations with the fully qualified CCA models. The second phase will utilize the CCA baseline PA models making efficient use of the infrastructure that remains in place, including database, pre- and post-processors, input files, and scripting needed to run the calculations. The defensibility of any calculations will be enhanced because of the regulators acceptance of the CCA baseline. The calculations will be done in a performance assessment framework and on a repository scale and will consider both the undisturbed scenario and human intrusion scenarios. Direct comparisons with the CCA will be performed to demonstrate the impacts from changes in the RH-TRU inventory. Completion of the work will culminate with the delivery of a memo report to CAO describing the risk assessment, and results.

2.0 APPROACH

2.1 Task1 : Identification of the RH-TRU Inventory

Description: This task will identify the appropriate source term for use in the analysis. The Transuranic Waste Baseline Inventory Report, (Ref – BIR-2) will provide the inventory basis. Realistic bounding estimates for key RH-TRU inventory components will be selected. Both radioactive and non-radioactive components will be evaluated. These key components will consider cellulosics, plastics, rubbers, water, ferrous metals, Am, and Pu isotopes.

2.2 Evaluation of Changes in RH-TRU Inventory on Repository Performance

A) 10,000-yr. Undisturbed Performance Assessment
B) 10,000-yr. Human Intrusion Performance Assessment
C) Operational time frame (300 years) Performance Assessment to be extracted from the 10,000-yr. Records.

Description: This task will evaluate any impact on performance for the scenarios and time frames identified in A, B, and C directly above. The PA calculations will be probabilistic. It is expected that the CCA baseline data will be utilized for this assessment. The assessment will determine impacts on the CCDFs and selected intermediate metrics, such as repository pressure, repository brine saturation, and brine migration from repository.

2.2.1 Selection of Input

All calculations will be probabilistic using the CCA input data sets so that the underlying uncertainty captured in the CCA will be preserved. A reasonable upper bound for each of the key RH-TRU inventory components will be selected and added to the input file one at a time. There will be no associated uncertainty in these bounding inventory parameters. This will result in multiple sets of simulations that allow direct comparison to CCA results

2.2.2 Selection of Models

Two types of modeling systems will be used. The first type of system will be used for making preliminary and screening evaluations. This system

will utilize DeskTop-PA and GoldSim. These systems are relatively fast, so they will be used as screening tools to reduce the amount of calculations necessary using the fully qualified CCA system or the most recent fully Qualified software versions. Because these modeling systems having not been developed under the NWMP QA program for use in making compliance decisions with respect to 40 CFR 191 or 40 CFR 194, (REF., EPA 1996) a second type of modeling system will also be used. This system will use the CCA baseline or more recent fully Qualified software versions. The simulations using this second system will be a subset of those cases previously run using DeskTop-PA and GoldSim.

2.3.3 Selection of Simulations

Sets of simulations will be conducted in a ceteris-paribus fashion. That is each key RH-TRU inventory component will be bounded fixed at its bounding value while holding all others at their fixed CCA baseline values. The only exception is in the case of maximizing the biodegradables. Here, for the RH-TRU waste, the plastics are maximized while the rubber and cellulose are set to 0. The iron and water associated with the RH-TRU waste remain at their CCA values as does all CH inventory. All other CCA parameters will be varied over their applicable CCA sampled ranges. These sets may consist of those identified in Table 1. Other sets may be added or sets may be deleted as the analysis proceeds.

The computational sets identified as being important to the WIPP RH-TRU Impact Study are tabulated below. These computational runs are designed to investigate the radioactive and non-radioactive performance assessment impact upon the WIPP repository. The first run corresponds to the WIPP Compliance Certification Application (CCA) [DOE 1996b] baseline. Runs 2 through 4 are the investigation of the non-radioactive components of the RH-TRU waste. Runs 5 through 8 are single-variant RH-TRU radionuclide sensitivity studies. Runs 9 and 10 investigate extreme situations where the repository inventory is completely CH-TRU or RH-TRU waste.

Table 1: Description of Computational Sets

Computational Set	Description
1. CCA BASELINE	Re-run or re-use the existing 1996 CCA calculations for the Baseline. This includes all 569 CH-TRU waste streams and 1 RH-TRU waste bin (equivalent to 401 RH-TRU waste streams). Volumes for CH- and RH-TRU are set at 5.95E+06 ft^3 (1.68485E+05 m^3) and 0.25E+06 ft^3 (7.07921E+03 m^3), respectively. Material mass values are determined from the TWBIR , (REF-BIR-2 and radionuclide inventory information is that derived by EPAUNI (Sanchez 1997) and previously used in the 1996 CCA.
2. Max RH-TRU Cellulosics or Plastics	This computational set resembles the Baseline, with the exception that the material properties of the RH-TRU (only) waste matrices have been zeroed-out with the exception of the biodegradable components, which are to be set to a realistic maximum. Consideration for this computational set is the need to investigate the relative significance of gas generation potential due to biodegradation. Thus the material property for this set should correspond to cellulosics,plastics, or rubbers whichever componet is the greater contributor. Plastics are the greater contributor due to greater carbon atom equivalence and theoreticla density compared to cellulosics or rubbers. Note, the maximum emplacement density (BIR-2) for plastics (620. Kg/m^3) is greater than that identified for a waste surrogate composed of pure plastics (theoretical density of 1200Kg/m^3) and using a loading porosity of 0.50 (600 Kg/m^3). Therefore, a value of 620 Kg/m^3 will be used for the maximum density of plastics to be emplaced in the RH canisters. The other non- biodegradable components of the waste (RH and CH) will be held at their CCA values. Therefore, for RH waste plastics are maximized, cellulose is 0, rubber is 0, iron is CCA value, and water is at CCA value. For CH waste everthing is as in the CCA.
3. Max RH-TRU H_2O	This computational set is similar to Set #2, except that water (flooded RH-TRU canisters) is investigated. Note, for this analysis the maximum mass of water to be contained in the RH canisters will be the theoretical density of water (1000 Kg/m^3) times the volume of the RH canisters times a 50% void volume. Therefore, for RH waste, water is maximized while plastics, cellulose, rubber, and iron are held at CCA values. For CH waste all inventory is as in the CCA.
4. Max RH-TRU Steel	This computational set is similar to Set #2, except that ferrous metals are investigated. Note, for this analysis the maximum mass of iron to be contained in the RH-TRU canister will be the theoretical density of water times the volume of the RH-TRU canisters times a 50% emplacement porosity. Therefore, for RH waste, water is maximized while plastics, cellulose, rubber, and iron are held at CCA values. For CH waste all inventory is as in the CCA.
5. RH-TRU ^{241}Am	For this set the RH-TRU radionuclide contribution is parsed so that the influence of ^{241}Am on the performance assessment of WIPP can be identified. The parsed data corresponds to zeroing out the radionuclide information for all RH-TRU, except for that from ^{241}Am. The full RH curie loading (3.93 x 10^5 Ci) used in the CCA will consist of ^{241}Am. The loading and make up for the CH inventory will be the same as used in the CCA. The total curie loading for the repository will be as in the CCA, $4.2x10^6$.

6. RH-TRU ^{238}Pu	Same as computational set 5 except with ^{238}Pu
7. RH-TRU ^{239}Pu	Same as computational set 5 except with ^{239}Pu
8. RH-TRU ^{240}Pu	Same as computational set 5 except with ^{240}PU
9. Replace RH-TRU with CH-TRU	This computational set requires using CH-TRU radionuclide densities for the volume associated with RH-TRU. This set requires special attention, in that it requires that the Waste Unit Factor be re-evaluated for this unique computational set.
10. Replace CH-TRU with RH-TRU	This computational set requires using RH-TRU radionuclide densities for the volume associated with CH-TRU. This set requires special attention, in that it requires that the Waste Unit Factor be re-evaluated for this unique computational set.

2.3.4 Evaluation of Repository Performance

The criteria for evaluating to impact of RH-inventory changes on repository performance will consist of both CCDFs of releases to the accessible environment and intermediate metrics. The CCDFs will be constructed as done in the CCA to facilitate comparisons of performance. They will consider all modes of release including direct release during human intrusion and long-term dissolved release. The comparison to the CCA of intermediate metrics will also be considered for evaluation of performance under undisturbed conditions and for evaluation of performance during the operational time frame. All calculations will be performed for the 10,000 yr time period; however, examination of performance will be made over the initial 300-year records for consideration of the operational period.

3.0 SOFTWARE LIST

Unless otherwise identified, all software used in this analysis will be CCA versions of the WIPP PA software baseline, examples of which are shown in Table 2.

Table 2. RH-TRU Inventory Impact Assessment Software List and Qualification Method

CODE	VERSION #	QA METHOD
BRAGFLO	4.10	NP19-1
NUTS	2.05	NP19-1
PANEL	3.60	NP19-1
DESKTOP_PA	1.1	One Time Use
GOLDSIM	6.02.000	3rd Party

4.0 TASKS

Palmer Vaughn and Mert Fewell will handle coordination and management of the RH Inventory Impact Assessment Study. The task descriptions, deliverables, responsible individuals, and due dates are outlined in Table 3.

RH Inventory Impact Assessment Study Schedule

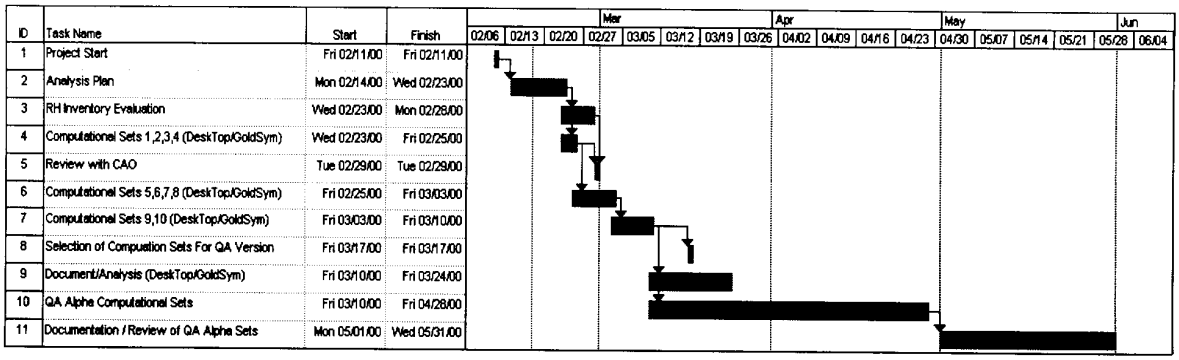

Table 3. RH Inventory Impact Assessment Study Tasks and Deliverables

Task #	Task Description	Responsible Individual(s)	Deliverable(s)	Due Date
1	Project Team leaders submit Analysis Plan to Records Center	Palmer Vaughn, Mert Fewell	AP to Records Center	2/23/00
2	PIs submit RH inventory evaluation report to Project leaders	Lawrence C. Sanchez	Memo to project Leaders	2/28/00
3	Computational sets 1,2,3,4	Noel Belcourt, Bruce Baker	Results to project Leaders	2/25/00
4	Review Results with CAO	Palmer Vaughn, Mert Fewell	Meeting With CAO	2/29/00
5	Computational Sets 5,6,7,8	Noel Belcourt, Bruce Baker	Results to project Leaders	3/3/00
8	Computational Set 9,10	Noel Belcourt, Bruce Baker	Results to Project Leaders	3/10/00

9	Documentation/Analysis	All	Memo Report to CAO	3/24/00
10	QA'd Alpha Computational Subset	Jim Bean, Mike Lord, Jim Garner	Results to Project Leaders	4/30/00
11	Documentation/Review of Alpha Computations and Analysis	Palmer Vaughn, Mert Fewell	Report to CAO	5/31/00

5.0 SPECIAL CONSIDERATIONS

CAO will be advised of results, as they become available through out the course of the project.

6.0 APPLICABLE PROCEDURES

All analyses will be conducted in accordance with the quality assurance (QA) procedures listed below. This impact assessment is conducted in 2 phases. The results of the first phase using DeskTop_PA and GoldSim are not to be used for EPA compliance decision making. This work will be conducted in accordance with the QA requirements for single use software prescribed in NP 19-1, Software Requirements. The second phase will be used to demonstrate to EPA the expected impact on long term compliance with 40 CFR 191 and 40 CFR 194. This phase will be conducted following all applicable QA requirements in NP 19-1.

1. *Training:* Training will be performed in accordance with the requirements in NP 2-1,Qualification and Training.
2. *Parameter Development and Database Management*: Selection and documentation of parameter values will follow SP 9-1, Control and Documentation of Parameter Values used in Performance Assessment. The database will be managed in accordance with TOP 569, Database Management of Parameter Values.
3. *Computer Codes*: Computer codes used in the analyses will be qualified in accordance with NP 19-1.
4. *Analysis and Documentation*: Documentation will meet the applicable requirements in NP 9-1, Analyses.
5. *Reviews*: Reviews will be conducted and documented in accordance with NP 6-1,Document Review Process and NP 9-1, as appropriate.

Training to the above procedures for personnel listed in Table 3 will be completed prior to beginning work. Training will be conducted in accordance with the NWMP QA Training Program. Training records will be maintained in the NWMP Records Center.

7.0 References

[BIR-2 1996]
See DOE 1996.

[C&C 1988]
DOE (U.S. Department of Energy) and State of New Mexico (1981 originally); Agreement doe Consulation and Cooperation Between Department of Energy and the State of New Mexico on the Waste Isolation Pilot Plant, Updated April 18, 1988; Article VI (WIPP Mission), pg. 4; {could not find a more recent upgrade version than this 1988 copy].

[CRC 1985]
Weast, R.C., "CRC Handbook of Chemistry and Physics, 1985-1986 66th Edition", CRC Press, Inc., Boca Raton, Florida, 1985-1986, (pg. B-21).

[DOE 1981]
U.S. DOE (U.S. Department of Energy), Waste Isolation Pilot Plant (WIPP); Record of Decision, Federal Register, Vol. 46, No. 18, pg. 9163, January 28, 1981 (46 FR 9162), Office of Environmental Restoration and Waste Management, Washington D.C.

[DOE 1996]
U.S. DOE (U.S. Department of Energy), "Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report", DOE/CAO-95-1121, Revision 3, printed June 1996. [The TWBIR (BIR-2) establishes the methodology for grouping wastes of similar physical and chemical properties from across the U.S. DOE TRU waste system into a series of "waste profiles" that can be used as the basis for waste form discussions with regulatory agencies.], 1996.

[DOE 1996b]
U.S. DOE (U.S. Department of Energy), "Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant", DOE/CAO-1996-2184, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, 1996.

[EPA 1996]
U.S> EPA (U.S> Environmental Protection Agency), "Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic

Radioactive Wastes"; Final Rule, 40 CFR 191, *Federal Register*, 61, 5224-5245, 1996.

[LWA 1992]
Public Law 102-579, 102d Congress, October 30, 1992; *Waste Isolation Pilot Plant Land Withdrawal Act*,; 1992. Section 7, subparts (a)(1)(A) and (a)(3). [Note, the WIPP LWA in addition to limiting the RH-TRU canister surface dose equivalent rate to 1,000 rem.hr also limits the design capacity of all transuranics to 6.2 million cubic feet of volume of which no more than 5.1 million curies (Ci) may ne RH-TRU. The volue limit for the RH-TRU is identified in the WIPP ROD (Record of Decision) to be 0.25 million cubic feet of volume [Ref. DOE 1981].]

[Sanchez 1999]
Sanchez, L.C. (SNL Org. 6832); Memo to: P. Vaughn (SNL Org. 6821), Subject: "Radionuclide Inventory Sensitivity Analysis (RISA) for Waste Streams to be Emplaced in WIPP", Dated: November 09, 1999, (memo# lcs99-4003).