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Account No. 20-01403-106

U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Two White Flint North
11545 Rockville Pike
Mail Stop T8A23
Washington, DC 20555

Subject: Programmatic Review of Paper

Dear Mrs. DeMarco:

The enclosed paper is being submitted for programmatic review. This paper will be submitted at the 24th International Symposium on the Scientific Basis for Nuclear Waste Management, to be held in Sydney, Australia, August 27-31, 2000, The title of the paper is:

> "PRETREAT: A Graphical User Interface-Based Spreadsheet Model for Hanford Tank Waste Pretreatment Processes" by Lietai Yang, Roberto Pabalan, and Vijay Jain

This paper is a product of CNWRA and it does not necessarily reflect the view(s) or regulatory position of the NRC.

Please advise me of the results of your programmatic review. Your cooperation in this matter is appreciated.

Sincerely,

Budhi Sagar
Technical Director

/ar
Enclosure
cc: J. Linehan, B. Meehan, R. Pierson, A. Wong, R. Wescott, M. Baker, R. Shewmaker, J. Spraul, E. TenEyck, M. Tokar, G. Comfort, M. Srinivasan, A. Murray, L. Chang, R. Struckmeyer, W. Patrick, CNWRA Directors, CNWRA Element Mgrs, R. Pabalan, J. Weldy, L. Yang, V. Jain, D. Daruwalla, P. Maldonado, T. Nagy (SwRI Contracts)

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MRS 2000 24th International Symposium on the Scientific Basis for Nuclear Waste Management

PRETREAT: A GRAPHICAL USER INTERFACE-BASED SPREADSHEET MODEL FOR HANFORD TANK WASTE PRETREATMENT PROCESSES. Lietai Yang, Roberto Pabalan, and Vijay Jain. Center for Nuclear Waste Regulatory Analyses, San Antonio, Texas, USA.

The high-level radioactive wastes (HLWs) stored at the Hanford (Washington, USA) site will be retrieved from underground storage tanks and chemically separated to form HLW and low-activity waste (LAW) streams, and solidified into a glass form. Pretreatment of the LAW stream is required to remove cesium-137, strontium-90, technetium-99, and transuranic elements, as well as some nonradioactive elements. In evaluating the proposed pretreatment flowsheet, important considerations are radiological, chemical and criticality safety, and the effectiveness of the proposed pretreatment technologies. Assessments of potential hazards require a knowledge of the chemical compositions and radionuclide concentrations of the waste streams.

As a tool for this assessment, a Microsoft Excel© spreadsheet model—PRETREAT Version 0—was developed. Applications of PRETREAT include estimating radionuclide and chemical species concentrations in the waste stream at each stage of the pretreatment process and estimating the amount of spent ion exchange resin or the amount of generated secondary wastes. More than 20 worksheets are used in PRETREAT and a graphical user interface is implemented to help users navigate through the various worksheets and correct or make changes to specific values or equations.

This work is funded by the Nuclear Regulatory Commission (NRC). This abstract is an independent product of the Center for Nuclear Waste Regulatory Analyses and does not necessarily reflect the views or regulatory position of the NRC.

Summary[1]

The U.S. Department of Energy (DOE) is preparing to remediate the 204,000 m^3 of high-level radioactive waste (HLW) stored in 177 aging underground storage tanks at the Hanford (Washington, USA) site. The current plan for remediating these wastes consists of waste retrieval, pretreatment, immobilization, and disposal. Because of the expected high cost of HLW vitrification and geologic disposal, the retrieved waste will be chemically separated to form a HLW stream, which will contain most of the radionuclides, and a low-activity waste (LAW) stream, which will contain the bulk of the nonradioactive chemicals and the soluble components of the tank waste. Both HLW and LAW streams will be solidified in a glass form. Pretreatment of the LAW stream is required to remove cesium-137, strontium-90, technetium-99, and transuranic elements from the waste feed. Removal of nonradioactive elements such as sodium, which could significantly increase the volume of immobilized LAW, or sulfur, which could deleteriously affect vitrification of the wastes, may also be necessary.

Important considerations in the evaluation of the pretreatment flowsheet are radiological, chemical and criticality safety, as well as the effectiveness of the proposed pretreatment technologies. Assessments of potential radiological and chemical hazards and the strategies for mitigating these hazards require a knowledge of the chemical compositions and radionuclide concentrations of the LAW and HLW streams at each stage of the pretreatment process. As an aid for evaluating the chemical, radiological, and criticality hazards of the proposed pretreatment process, a Microsoft Excel© spreadsheet model—PRETREAT Version 0—was developed. The model is based on mass-balance considerations and uses reported waste feed envelope compositions and reported or assumed concentration factors (e.g., from evaporation) and decontamination factors (e.g., by ion exchange or ferric flocculation/coprecipitation). Applications of PRETREAT include estimating radionuclide and chemical species concentrations in the LAW stream at each stage of the pretreatment process and estimating the amount of spent ion exchange resin or the amount of secondary wastes generated by the pretreatment process. The model can also be used to evaluate the sensitivity of model results to uncertainties in model parameters (e.g., the decontamination factors).

Because the pretreatment flowsheet is complex, tracing every component of all the flowsheet streams at each process unit involves a large amount of data processing. More than 20 worksheets are used in PRETREAT. To help users navigate through the various worksheets, a graphical user interface is implemented to:

(1) Guide the user in navigating through the worksheets and find locations of cells (variables) that require modification.

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[1]This work is funded by the Nuclear Regulatory Commission (NRC). This summary is an independent product of the Center for Nuclear Waste Regulatory Analyses (CNWRA) and does not necessarily reflect the views or regulatory position of the NRC. The spreadsheet model PRETREAT Version 0 is being placed into CNWRA configuration control (Technical Operating Procedure TOP-018).

(2) Minimize the tendency of the user to make incomplete specifications on the worksheet. For instance, the user interface has built-in commands that prompt a user to verify an entry before a change is applied.

(3) Enforce other useful rules, such as those that prevent a user from accidentally entering data in cells that contain mathematical formulas or from making a data entry in a cell that has the wrong data type. In some cases, the user interface has drop down lists that provide the user with a selection of available entries.

The user interface in PRETREAT is implemented in a Microsoft Visual Basic© environment. It consists of forms and control boxes, buttons, and dialogs located on the forms. Figure 1 shows a typical form, the Process Units form. In this form, the user can select a process unit from a drop-down list box at the top, and click on the Process Parameters button to go to a separate form where the process parameters used in the calculations for the unit operation can be specified or changed. The options in the "Input Stream is Composed of" frame provide the user with the flexibility to specify the input stream to the unit. The command buttons inside the "Spreadsheet" frame allow the user to work with the spreadsheet directly.

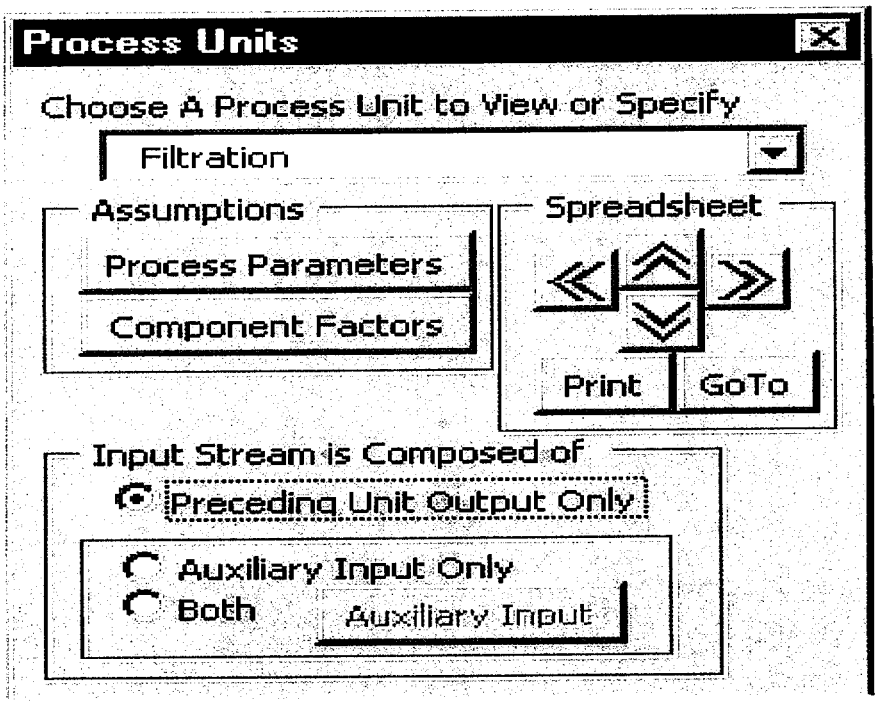
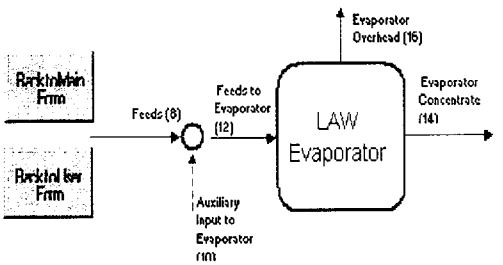


Figure 1. Process Units form of the PRETREAT user interface

Figure 2 shows a typical worksheet for one of the process units, the LAW evaporator unit.



Stream Name:	Feeds to LAW Evaporato
Stream No:	12
Tot Mass (Mt/d):	68.0964
Tot Vol (m3/d):	58
Density (Mt/m3):	1.1741
Tot Act. (Bq/d):	7E+14
Temperat. (oC):	0

Ionic	Co	g/L	Other	C	g/L
Al		0	Precip.		0.091
B		0	Solids		18.393
Ba		0			
CN		0.018	TIC		7.5005
C as CO3		0.009	TOC		2.9853
Ca		0	CsIX		0
Cd		0	TcIX		0.182
Cl		2.303			
Cr		0.1772	Gases		g/L
F		0	CH4		0
Fe		0.003	H2		0
H2O		965.22	N2		0
Hg		0	NH3		0
K		1.8935	NO		0
La		0	NO2(g)		0
Li		0			
Mg		0	Fissile		g/L
Mn		0	Pu239/2		0
Na		80.758	U-235		0
Ni		0			
NO2		23.409	Activity		Bq/m3
NO3		50.322	Am241		0
OH		8.4837	Ba137m		0
Pb		0	Co60		1E+07
P as PO4		0.7389	Cs137		1E+13
Pu(total)		0	Eu154/15		4E+09
Si		0	Ni63/59		0
S as SO4		1.7358	Pa		0
Sr		0	Sm151		0
U (total)		0	Sr90		1E+11
Zn		0	Tc99		2E+10
Zr		0	TRU		1E+09
			Y-90		0
			Solid		5E+11

Stream Name:	LAW Concentrate
Stream No:	14
Tot Mass (Mt/d):	33.169
Tot Vol (m3/d):	25.053
Density (Mt/m3):	1.347
Tot Act. (Bq/d):	7E+14
Temperat. (oC):	20

Ionic	Co	g/L	Other	t	g/L
Al		0	Precip.		0.181
B		0	Solids		36.67
Ba		0			
CN		0.036	TIC		14.35
C as CO3		0.018	TOC		2.976
Ca		0	CsIX		0
Cd		0	TcIX		0.181
Cl		5.755			
Cr		0.353	Gases		g/L
F		0	CH4		0
Fe		0.006	H2		0
H2O		530.7	N2		0
Hg		0	NH3		0
K		3.775	NO		0
La		0	NO2(g)		0
Li		0			
Mg		0	Fissile		g/L
Mn		0	Pu239/2		0
Na		161	U-235		0
Ni		0			
NO2		46.67	Activity		Bq/m3
NO3		101.5	Am241		0
OH		16.91	Ba137m		0
Pb		0	Co60		2E+07
P as PO4		1.473	Cs137		2E+13
Pu(total)		0	Eu154/15		8E+09
Si		0	Ni63/59		0
S as SO4		3.461	Pa		0
Sr		0	Sm151		0
U (total)		0	Sr90		3E+11
Zn		0	Tc99		4E+10
Zr		0	TRU		3E+09
			Y-90		0
			Solid		9E+11

	Evaporator Overhead
Stream No:	16
Tot Mass (Mt/d):	28.907
Tot Vol (m3/d):	28.907
Density (Mt/m3):	1
Tot Act. (Bq/d):	0
Temperat. (oC):	20

Ionic	Co	g/L	Other	C	g/L
Al		0	Precip.		0
B		0	Solids		0
Ba		0			
CN		4E-05	TIC		0
C as CO3		0	TOC		2.3945
Ca		0	CsIX		0
Cd		0	TcIX		0.1826
Cl		0			
Cr		0	Gases		g/L
F		0	CH4		0
Fe		0	H2		0
H2O		1000	N2		0
Hg		0	NH3		0
K		0	NO		0
La		0	NO2(g)		0
Li		0			
Mg		0	Fissile		g/L
Mn		0	Pu239/2		0
Na		0	U-235		0
Ni		0			
NO2		0	Activity		Bq/m3
NO3		0	Am241		0
OH		2E-15	Ba137m		0
Pb		0	Co60		0
P as PO4		0	Cs137		0
Pu(total)		0	Eu154/15		0
Si		0	Ni63/59		0
S as SO4		0	Pa		0
Sr		0	Sm151		0
U (total)		0	Sr90		0
Zn		0	Tc99		0
Zr		0	TRU		0
			Y-90		0
			Solid		0

Figure 2. Typical worksheet for a process unit (low-activity waste evaporator unit)