State of Utah

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"DRC-2013-003137"

MEMORANDUM

TO: File

THROUGH: Phil Goble, Compliance Section Manager PRG 9/17/2013

FROM: Tom Rushing, P.G. JR 9/17/13

DATE: September 17, 2013

SUBJECT: Review of the Energy Fuels Resources (USA) Inc., White Mesa Uranium Mill, Blanding, Utah August 30, 2013 Source Assessment Report for Selenium in Monitoring Well MW-31, Ground Water Discharge Permit UGW370004

Summary

An August 30, 2013 Source Assessment Report ('SAR") for Selenium in Monitoring Well MW-31was submitted to the Director by Energy Fuels Resources (USA) Inc. ("EFR"), received on September 3, 2013 for review and approval of a proposed revised Ground Water Compliance Limit (GWCL) for Selenium at monitoring well MW-31.

The SAR is broken up into two primary sections, 1. An approach for analysis of potential sources of the contamination, and 2. A discussion and tables of data used for statistical evaluation and generation of proposed modified GWCL's.

The SAR notes that Selenium is increasing at many monitoring wells across the site including MW-3, MW-3A, MW-11, MW-12, MW-14, MW-15, MW-17, MW-18, MW-22, MW-27, MW-30, MW-31, and MW-35. Per previous EFR studies it has been theorized and EFR "*believes that increasing selenium concentrations in MW-31 are due to background influences, including the natural decreasing trend in pH across the site.*" Per the EFR Pyrite Report (Hydro Geo Chem., December 7, 2012) the site wide declines in pH are thought to be caused by regional dissolution of pyrite in the Burro Canyon Formation mineral matrix.

Figure 1 below depicts the rising selenium concentration trend in monitoring well MW-31 using all available historical data. DRC notes that the most recent five laboratory results for selenium in monitoring well MW-31have been above the GWCL (71 mg/L), with the highest historical value being 81.8 mg/L per the March 19, 2013 sample laboratory results. Figure 2 depicts the pH plot for all historical data available for monitoring well MW-31.

Figure 1 - Selenium Data Plot of Historical Data at MW-31 – Increasing Trend

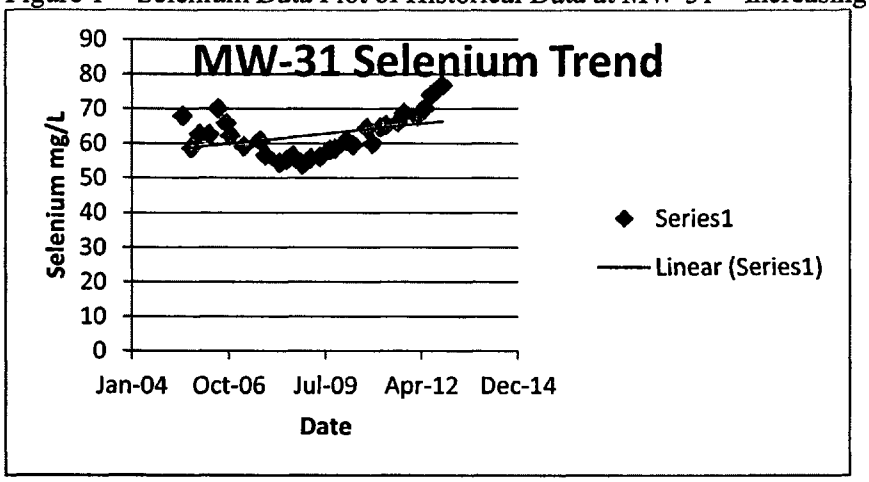
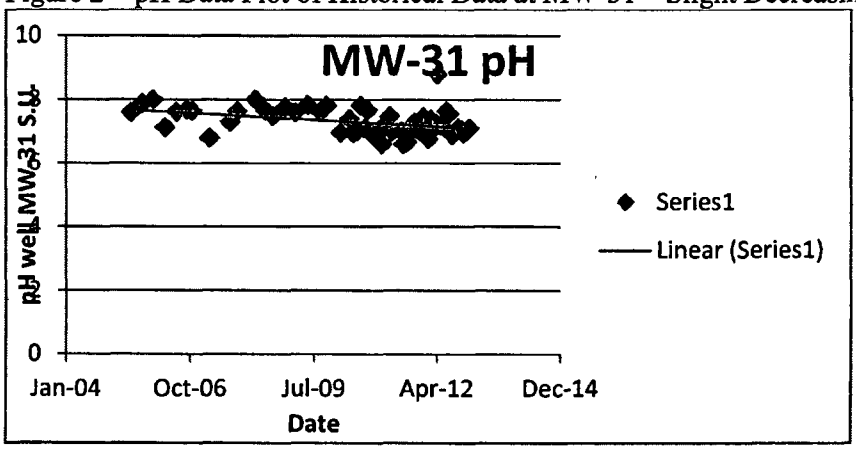


Figure 2 – pH Data Plot of Historical Data at MW-31—Slight Decreasing Trend



Investigations of Potential Sources of Selenium Contamination at Monitoring Well MW-31

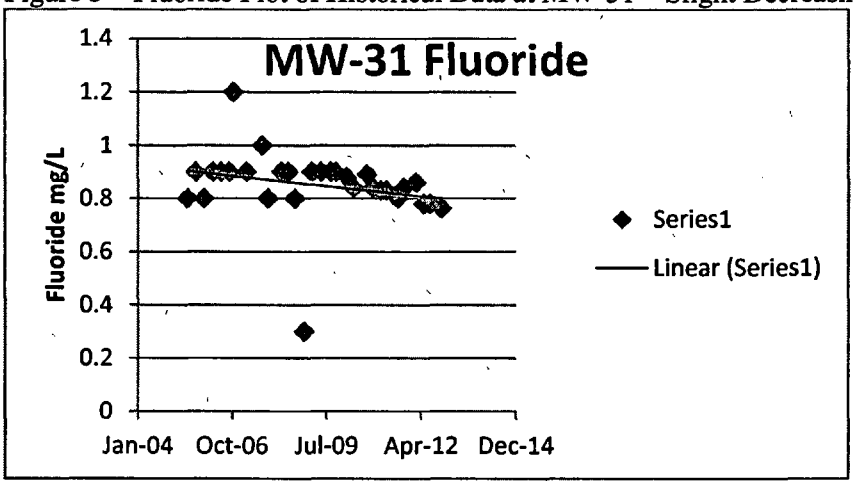
1. ***Discussion of Tailings Solution Groundwater Indicator Parameters at Monitoring Well MW-31***

The SAR Section 3.1 discusses indicator parameters which would be detected in ground water in the event of discharge from the Mill Tailings Cell 1 and reliable indications which would be detected specifically at monitoring well MW-31.

Per the SAR, the indicator parameters in the case of monitoring well MW-31are complicated by the fact that MW-31 is screened within a nitrate/chloride plume, and chloride is therefore not a reliable indicator of cell leakage (would normally be the primary indicator parameter based on high concentrations in Cell 1 and contaminant mobility in groundwater). Sulfate is also not a reliable indicator parameter at monitoring well MW-31 since the sulfate concentrations in the well are among the lowest at the site and are highly variable due to natural background fluctuations site-wide. Based on these conditions, Fluoride and Uranium are the best indicator parameters for cell leakage detection at monitoring well MW-31 as follows:

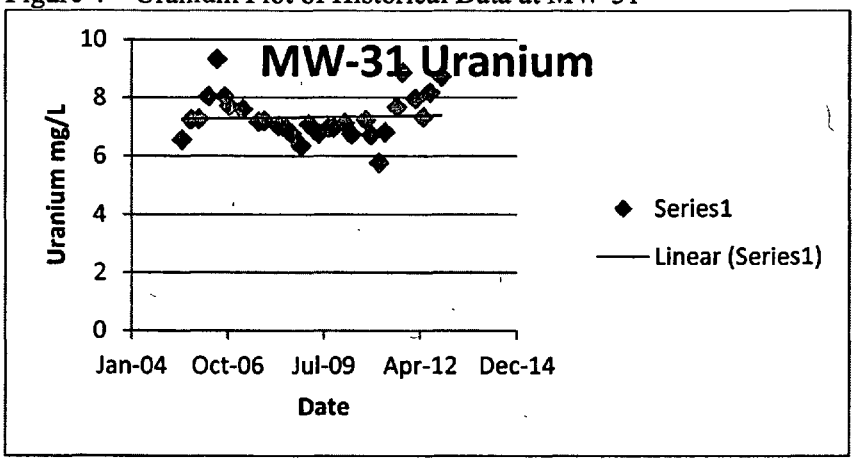
1. Fluoride is the fastest-moving available indicator of tailings seepage at monitoring well MW-31. It is expected that fluoride would travel as fast as selenium (contaminant of concern) in the groundwater at the site. Average concentrations of selenium in the Tailings Cell 1 solution is approximately 10,000 µg/L while average concentrations of fluoride in Tailings Cell 1 solution is approximately 457 mg/L. Therefore, as an indicator of tailings solution release EnergyFuels calculates that fluoride concentrations at monitoring well MW-31 should be at least 3.8 mg/L in conjunction with the current selenium concentrations. However, recent fluoride concentrations in monitoring well MW-31 have been as low as 0.73 mg/L and are showing a decreasing trend. A plot including all available historical data available for fluoride at monitoring well MW-31 is included in Figure 3 below.

Figure 3 – Fluoride Plot of Historical Data at MW-31 – Slight Decreasing Trend



2. Uranium – Uranium concentrations in monitoring well MW-31 are low for the site, in the 6 to 9 µL range and are not exhibiting a significant upward trend. A plot including all available historical data available for uranium at monitoring well MW-31 is included in Figure 4 below.

Figure 4 – Uranium Plot of Historical Data at MW-31



Energy Fuels Resources (USA) Inc. ("EFR") concludes that "*based on the indicator parameters that are available for MW-31, namely, fluoride and uranium, it can be concluded that the increases in*

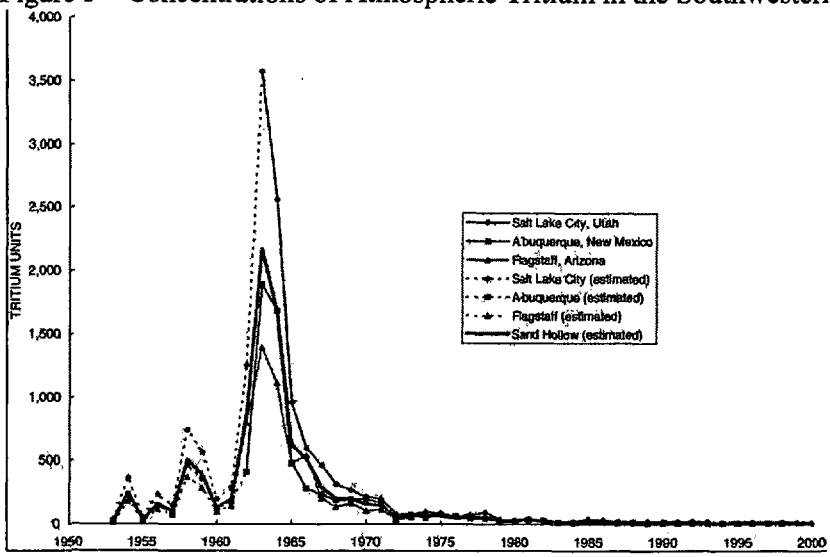
concentrations of selenium are not due to potential tailings cell leakage." Per review of the report findings and historical data plots of fluoride and uranium DRC staff concurs that the data does not appear to indicate contamination from the tailings cells.

2. *University of Utah Study*

Monitoring well MW-31 was included in a University of Utah study conducted at the White Mesa Uranium Mill during July 2007 (Final Report of Study Findings Dated May, 2008). Based on groundwater age dating at monitoring well MW-31 [chlorofluorocarbon ("CFC") analysis], the groundwater was found to exhibit CFC recharge dates which predate the construction of the Mill in 1980.

Additionally, tritium concentrations in monitoring well MW-31 were found to be non-detect. If ground water in monitoring well MW-31 had a surface infiltration source post 1950's (time period of atmospheric injection of tritium during above-ground thermonuclear weapons testing) then tritium concentrations would be expected in ground water samples in monitoring well MW-31. Figure 5 below is taken from the University of Utah ("U of U") Report (Hurst and Solomon 2008) and depict atmospheric concentrations of tritium in the southwest by year.

Figure 5 – Concentrations of Atmospheric Tritium in the Southwestern United States



Based on review of the U of U Report and specific data results for monitoring well MW-31 age dating of groundwater at the well indicates that the MW-31 groundwater predates Mill construction.

3. *Source Assessment Conclusions*

Based on findings related to indicator parameter analysis and age dating studies conducted by the U of U (Hurst and Solomon 2008), and also supported by the slight decreasing pH trend at monitoring well MW-31, DRC staff concur with the EFR finding that elevated selenium concentrations in the well are not due to seepage discharge of tailings solution from the White Mesa Mill tailings cells to the groundwater. It therefore appears appropriate to attribute the elevated selenium concentrations to background groundwater sources and modify the current Permit GWCL for selenium in monitoring well MW-31.

EFR Proposed Modified GWCL Statistical Evaluation of Data:

The following statistical methods were used to develop the EFR proposed modified GWCL for Se in monitoring well MW-31:

Standard Deviation Calculation
Shapiro-Wilk Test for Normality
Least Squares Regression Analysis

A DRC cross-check of the Shapiro-Wilk Test for normality and standard deviation was conducted (n = 34) and is attached as an appendix to this memo. The DRC calculation results were essentially the same as the EFR conclusions. The EFR proposed modified GWCL is based on the mean value of historic data plus two standard deviations and appears to be in conformance with the Director approved statistical flow chart which outlines a decision making process when calculating background GWCL's (Intera 2007).

The table below summarizes the EFR calculations and background rationale for the proposed selenium GWCL.

Table of EFR Proposed Revised GWCL for Selenium at Monitoring Well MW-31:

Well Number	Parameter	Location	Current GWCL (mg/L)	EFR Proposed GWCL Revision (mg/L)	EFR Background Rationale	EFR Method to Determine GWCL	DRC Finding – Is Proposed GWCL in Conformance with the Statistical Flow Chart?
MW-31	Selenium	Downgradient Cells 1 and 2	71	79	Indicator Parameters Fl and U U of U Study pH Decreasing Trend	Mean + 2(SD)	Yes Mean + 2(SD)

Conclusions:

Based on DRC staff review of the SAR it is recommended that a correspondence letter which summarizes the DRC review of the proposed modified GWCL for selenium at monitoring well MW-31 be sent to EFR. The letter will provide a recommendation that the proposed modified GWCL (Se 79 mg/L) be included in the Permit renewal. Notification that the modification is subject to public notice and public participation requirements of the permitting process, and will not be effective until formal issuance of the updated Permit, will be included in the letter.

14. References

[1] Energy Fuels Resources (USA) Inc., August 30, 2013, *Transmittal of Source Assessment Report for Selenium in MW-31 White Mesa Mill Groundwater Discharge Permit UGW370004 Conditional Approval of May 30, 2013 Plan and Time Schedule*

[2] Energy Fuels Resources (USA) Inc., June 6, 2012, *White Mesa Uranium Mill Ground Water Monitoring Quality Assurance Plan (QAP), Revision 7.3*

[3] Energy Fuels Resources (USA) Inc., October 12, 2012, *Source Assessment Report*, Prepared by Intera

[4] Energy Fuels Resources (USA) Inc., November 9, 2012, *pH Report*, Prepared by Intera

[5] Hurst, T.G., and Solomon, D.K. University of Utah, 2008, *Summary of Work Completed, data Results, Interpretations and Recommendations for the July 2007 Sampling Event at the Denison Mines, USA White Mesa Uranium Mill Near Blanding,* Utah, Prepared by Department of Geology and Geophysics

[6] Hydro Geo Chem, December 7, 2012, *Pyrite Investigation Report*

[7] Intera, 2007, *Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site, San Juan County, Utah*

[8] Utah Department of Environmental Quality, August 24, 2012, *Utah Division of Radiation Control, Ground Water Discharge Permit, Permit No. UGW370004, Energy Fuels Resources (USA) Inc.*

Attachment – DRC cross check of Shapiro Wilk Test for Normality of Data and Development of a proposed revised GWCL based on Mean + 2α for Selenium evaluation of Monitoring Well MW-31

Shapiro Wilk (n<50) Method DRC Cross Check			Data Entered 9/10/2013 TR		
Energy Fuels Monitoring Well MW-31 Selenium Shapiro Wilk					
i	x(i)	x(n-1+1)	x(n-i+1)*x(i)	a(n-i+1)	bi
1	53.8	81.8	28	0.4127	11.5556
2	54.4	76.9	22.5	0.2854	6.4215
3	55.3	75.9	20.6	0.2439	5.02434
4	55.6	74.1	18.5	0.2132	3.9442
5	56.1	74.0	17.9	0.1882	3.36878
6	56 4	72.9	16.5	0.1667	2.75055
7	56.6	70.2	13.6	0.1475	2.006
8	58.2	70.1	11.9	0.1301	1.54819
9	58.4	68.8	10.4	0 114	1.1856
10	58.6	68 0	9.4	0.0988	0.92872
11	59.2	67.8	8.6	0.0844	0.72584
12	59.6	66.2	6.6	0.0706	0.46596
13	60.0	65.8	5.8	0.0572	0.33176
14	60.8	65.2	4.4	0.0441	0.19404
15	60.8	64.6	3.8	0.0314	0.11932
16	62.3	64.4	2.1	0.0187	0.03927
17	62.5	62.6	0.1	0.0062	0.00062
18	62.6	62.5	-0.1		
19	64.4	62.3	-2.1		
20	64.6	60.8	-3.8		
21	65.2	60.8	-4.4		
22	65.8	60.0	-5.8		
23	66.2	59.6	-6.6		
24	67.8	59.2	-8.6		
25	68.0	58.6	-9.4		
26	68.8	58.4	-10.4		
27	70.1	58.2	-11.9		
28	70.2	56.6	-13.6		
29	72.9	56.4	-16.5		
30	74.0	56.1	-17.9		
31	74.1	55.6	-18.5		
32	75.9	55.3	-20.6		
33	76.9	54.4	-22.5		
34	81.8	53.8	-28		total =
					40.61029
Standard Deviation Calculation:					
Mean =	64.05588235	Variables =	1742.663824		
Standard Deviation =		7.159247051			
W Statistic =	0.975042493		.01 Critical n(34) = 0.908		
DRC Calculated Limit		78.4			
Energy Fuels Calculated Limit		79			