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4/22/97

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March 11, 1997

Mr. Gary Comfort
Division of Industrial & Medical Nuclear Safety
U. S. Nuclear Regulatory Commission
1 White Flint North
11555 Rockville Pike
Rockville, Maryland 20852

Re: USNRC License No. SMB-743

Dear Mr. Comfort:

On behalf of the Shieldalloy Metallurgical Corporation Radiation Safety Officer, Mr. C. Scott Eves, enclosed is the Outreach Laboratory "Standard Operating Procedure for Uranium in Urine" (Revision 1.0, August 1, 1996). This procedure is being submitted as follow-up to our meeting on March 6, 1997. Kindly direct any comments or questions regarding the procedure to Mr. Eves at (609) 692-4200.

Sincerely,

Carol D. Berger, C.H.P.

cc: C. Scott Eves
File 94005.06

260114

NFA

STANDARD OPERATING PROCEDURE
FOR
URANIUM IN URINE

OUTREACH LABORATORY
AUGUST 01,1996
REVISION 1.0

1.0 INTRODUCTION

1.1 Purpose

This method is used to determine the total amount of uranium in urine samples.

1.2 Scope

A known volume of sample is digested with nitric acid and hydrogen peroxide to destroy the organic components of the sample. The sample is then analyzed using instrumentation that exposes the sample to a laser beam for a given time or number of laser pulses. The fluorescence or phosphorescence intensity is measured and then used to calculate the concentration of uranium in the sample.

1.3 Background

1.3.1 The KPA-11A phosphorimeter is an automated unit which is controlled by an (AT) computer. The software supplied with the computer is designed to control the automatic sampling hardware for introduction of samples into the flowcell for trace uranium analyses by the KPA-11. One ml of sample and 1 ml uraplex are mixed together and exposed to the laser beam for a number of laser pulses, and then the intensity is measured.

1.3.2 The LU-4 Fluorometer is an automated unit which is controlled by a built-in XT computer. The software supplied with the instrument is designed to control and position the individual cuvettes in the laser beam for a given time period, measure the fluorescence intensity and display the intensities along with other parameters on the computer screen.

All analyses are performed in a standard addition mode. That is, the sample is exposed to the laser beam:

1. After addition of FLURAN 2, Part A.
2. After addition of FLURAN 2, Part B.
3. After addition of a known amount of uranium spike.

The fluorescence intensity data is saved and imported into Lotus 1-2-3 where the intensities are used to calculate uranium concentrations.

1.4 Range and Precision

1.4.1 Using the KPA, the lower limit of detection for this method is 0.2 ug/l using a five (5) ml sample size. The detection limit can be lowered using a larger sample size.

1.4.2 Using the LU4, the lower limit of detection for this method is 0.5 ug/l.

LU4 PMT Range:
High PMT = 0 -2 ppb U
Medium PMT = 2 -20 ppb U
Low PMT = 20-100 ppb U

1.5 Materials

Equipment:

1.5.1 Chemchek Model Kinetic Phosphorescence Analyzer - 11A.

1.5.2 Flowcell, 100 ul.

1.5.3 Scintillation Vials, 20 ml glass.

1.5.4 Disposable Culture Tubes.

1.5.5 Quartz Cuvettes, 10 by 20mm, Starna Model 3Q20, or equivalent.

1.5.6 Laser Fluorometer, Scintrex Model LU-4.

1.5.7 Mixing paddle.

Reagents:

1.5.8 Deionized water - DI water.

1.5.9 Uraplex, proprietary reagent obtained from Chemchek.

1.5.10 FLURAN 2 Proprietary Reagent, Parts A & B, obtained from Scintrex.

1.5.11 Hydrochloric Acid (HCl), Concentrated.

1.5.12 Nitric Acid (HNO_3), Concentrated, 30%, 10% amd 4m. Tracemetal or equivalent.

1.5.13 Hydrogen Peroxide (30%).

1.5.14 Commercial Uranium Standard (1000 ug/ml), (NIST Traceable).

1.5.15 100 mg/l Uranium Standard. Using 10 ml of 1000 ug/ml Uranium Standard and 0.5 ml of HNO_3 dilute to 100 ml with DI water in a volumetric flask.

1.5.16 100 ug/l Uranium Standard. Using 0.1 ml of 100 mg/l Uranium Standard, dilute to 100 ml with DI water in a volumetric flask.

1.5.17 50 ug/l Uranium Standard. Using 5 ml of 100 ug/l Uranium Standard, dilute to 10 ml with DI water in a volumetric flask.

2.0 REFERENCES

2.1 Applicable Source Material License Requirements, none.

2.2 Material Safety Data Sheets (MSDS), refer to MSDS Manuals located in the laboratory.

2.3 Developmental References

2.3.1 Kinetic Phosphorescence Analyzer KPA-11 Operation and Service Manual, Chemchek Instruments.

2.3.2 LU4 Operation Manual, Scintrex.

2.3.3 Analytical Procedures for UA3 Uranium Analysis, Scintrex, 1979.

2.3.4 Laboratory Chemical Hygiene Plan, Outreach Technologies, 1995.

2.3.5 ASTM Method 5174D.

3.0 SAFETY PRECAUTIONS

3.1 Hazardous Chemicals/Equipment

All work shall be performed under a fume hood while digesting samples.

3.2 Radiological Hazards

Because radioactive materials are capable of being volatilized or airborne, perform digestion steps under a fume hood.

3.3 General Laboratory Safety

Refer to the Laboratory Chemical Hygiene Plan for general laboratory safety.

4.0 PROCEDURE

4.1 Sample Preparation

Note: If samples are not to be analyzed within 48-hours of receipt, preserve with 5 ml HCl per sample.

4.1.1 Pipet 5.0 ml of urine into a labeled 20 ml scintillation vial.

4.1.2 Add 2.0 ml (conc.) HNO_3 and 0.5 ml H_2O_2.

Note: Preparation of Spikes
20 ug/l U - Add 1000 ul of 100 ug/l U Std. to 5 ml sample.

4.1.3 Place on a hot plate set to maintain a temperature of approximately 100°C.

4.1.4 Boil the solution to dryness increasing the heat as H_2O_2 reaction stops.

4.1.5 Increase the hot plate setting to maintain a temperature of approximately 500°C.

4.1.6 Fume the solution for approximately 45 minutes.

4.1.7 Remove from the hot plate and allow to cool. Repeat Steps 4.1.2 thru 4.1.6.

4.1.8 Place scintillation vials in muffle furnace set at 500°C for 1 hour to destroy any remaining organics.

4.1.9 Cool and add 1 ml of 4M HNO_3.

4.1.10 Heat the solution at a low temperature on a hot plate to effect dissolution of all solids.

4.1.11 Allow the solution to cool to room temperature, and add 19 ml of DI water to scintillation vial and mix thoroughly.

4.1.12 If there is obvious suspended material, filter through a 0.45 micron filter.

4.1.13 Store sample for analysis.

4.2 Analysis Using the KPA-11

4.2.1 Place scintillation vials in sample holder on automatic sample changer.

4.2.2 Put clean culture tubes in sample mixing holder.

4.2.3 Fill uraplex container to insure there is enough uraplex in the container to perform the analysis required.

4.2.4 Sample Analysis

A. Depress F1 (Analyze) and verify that the correct units are being used. Escape to main menu.

B. Depress F6 (Automatic Analysis) and input data by depressing F1 (Data Input). (Attachment #1)

C. Enter the sample ID, Final Sample Volume, and Sample Aliquot. After all samples have been entered depress F7 to save. Enter the log number from instrument log book. Then depress escape to return to previous menu.

D. Rinse flowcell with DI water by depressing F4.

E. To start analysis depress F2 and enter the starting position.

F. After each sample is analyzed an Analytical Report is printed out. (Attachment 2)

G. If the lifetime is < 100 us or > 350 us or the R^2 is <0.96 reanalyze using a larger dilution.

4.3 Analysis Using the LU4

Note: The carousel will hold 12 cuvettes.

4.3.1 Pipet 6.0 ml of the prepared samples into each cuvette.

4.3.2 Pipet 250 ul of FLURAN 2, Part A into each cuvette.

4.3.3 Mix the solution in the cuvette with a mixing paddle.

4.3.4 Enter the sample size, dilution, milliliters spike and spike concentration into the form on the computer screen, PMT High.

4.3.5 Start the measurement process by depressing F1 on the computer.

4.3.6 After all twelve positions have been analyzed remove the carousel from the instrument.

4.3.7 Pipet 250 ul of FLURAN 2, Part B into each cuvette.

Note: Do not remove the cuvettes from the carousel.

4.3.8 Mix the solution in each cuvette with a mixing paddle.

Note: Rinse with DI water and shake excess water from the mixing paddle after mixing each cuvette.

4.3.9 Continue the measurement process by depressing F1.

4.3.10 After all twelve positions have been analyzed, remove the carousel from the instrument.

4.3.11 Pipet 50 ul of 100 ug/l uranium standard into each cuvette.

Note: Do not remove the cuvettes from the carousel.

4.3.12 Mix the solution in each cuvette with a mixing paddle.

Note: Rinse with DI water and shake excess water from the mixing paddle after mixing each cuvette.

4.3.13 Continue the measurement process by depressing F1.

4.3.14 After all twelve positions have been analyzed, remove the carousel from the instrument.

4.3.15 Save the data to a floppy disk program titled "REDO" by depressing F3.

4.3.16 Print the data from the screen by depressing
F2 and attach the sample identification sheet. (Attachment #3)

4.3.17 The data is then imported into Lotus 1-2-3 from the floppy disk and calculated (See Section 5.1-5.3).

4.4 Cuvette Cleaning

4.4.1 Empty the cuvette into a dump container, and place it in a 600 ml or larger beaker containing approximately 400 ml of 10-30% HNO_3 and allow to soak approximately 5 minutes.

4.4.2 Remove the cuvette from HNO_3 and rinse thoroughly with DI water. Allow it to dry for approximately 5 minutes.

4.4.3 Transfer the cuvette to a beaker containing Acetone and allow it to soak for approximately 5 minutes.

Note: Alcohol may be used if Acetone is not available.

4.4.4 Remove the cuvette from the Acetone, and allow it to air dry.

4.4.5 Place the cuvette under a heat lamp for a few minutes to insure that all the Acetone has evaporated.

4.4.6 Cover the cuvettes for protection.

4.5 Quality Control for Uranium in Urine

4.5.1 One reagent blank is digested with each digestion batch.

4.5.2 A 20 ug/l spike is digested with each batch or every 10 samples.

4.5.3 A duplicate is digested with the each batch or every 20 samples.

4.5.4 A 20 ug/l standard is digested with each batch or every 10 samples.

4.5.5 A rotation like this shall be performed if there is going to be more than two digestions.

QC	Tolerance Range
Duplicate	± 2 Standard Deviations
20 ug/l spike	± 2 Standard Deviations

4.5.5 Quality Control Outliers

If the QC sample is out of specification range, the QC is rechecked by re-measurement.

Note: If the QC sample recheck proves to be within specifications, the set is rechecked along with the QC. If the QC

sample is not in specifications, a known standard will be analyzed to check instrumentation. If the standard passes, the set will be redigested and reanalyzed. If the standard fails, the set can be held for re-measurement after the instrument is repaired.

5.0 CALCULATIONS

5.1 Calculations - Using the KPA-11

5.1.1 The background or samples normalization

$$\frac{RM}{RB \text{ or } RI} \times IS = I_s$$

RM = Reference Mark
RB = Reference Background
RI = Intercept
IS = Luminescence intensity at each time gate
I_s = Normalized intensities

5.1.2 A Least Squares Regression (LSR) is performed on standard net intensities to obtain lifetime (T), correlation coefficient (R2), and intercept (SI) in counts per unit of concentration. The calibration equations are produced by LSR of SIi. The program offers the choices of:

A. Linear fit of the form SI = aC + b
B. Quadratic fit, SI = aC2 + bC + c

C. Linear fit with forced zero intercept SI = aC

Where (C) is concentration and the constants a, b, and, c are determined by the LSR. Quantification for concentration C is by entering the SI from the Sample Measurement into the calibrated equation.

$$C * \frac{FV}{SV} = U$$

FV = Final Sample Volume
SV = Sample Volume
U = Final Uranium Concentration

5.2 Calculations - Using the LU4

5.2.1 Load Lotus 1-2-3 spreadsheet, "REDO".

5.2.2 Insert floppy disk titled "LU-4 Data Files" and save to "REDO".

5.2.3 A macro is programmed that imports the LU-4 file "REDO" into the Lotus 1-2-3 spreadsheet by entering "Alt C". The data is then used to calculate the Uranium content in ug/l. The macro automatically prints the data which is attached to the LU-4 printout (See Section 4.4.16). (Attachment 4)

5.2.4 Formula for Calculating Uranium

$$\frac{V_2 - V_1}{V_3 - V_2} \times \frac{a}{b} \times Z = U$$

V_1 = Deflection of meter due to sample plus FLURAN 2, Part A.
V_2 = Deflection of meter due to sample plus FLURAN 2, Part B.
V_3 = Deflection of Meter due to sample plus standard addition.
a = Volume of standard addition.
b = Volume of sample.
Z = Uranium concentration of standard addition.
U = Uranium concentration of sample in parts per billion (ppb).

Attachment 1

Automatic Analysis Data Input

Automatic Analysis Data Input

F1 - Auto Number F3 - Erase Field F5 - Print F7 - Save
F2 - Erase All F4 - Replicate F6 - Load/Delete Esc - End
Use Arrow Keys and PgUP PgDn to Position Cursor

	Sample ID	Final Samp. Vol.	Ali-quot	Std. Conc.	Std. Vol, mL	Samp. Vol, mL
1,1						
1,2						
1,3						
1,4						
1,5						
1,6						
1,7						
1,8						
1,9						
1,10						
1,11						
1,12						
1,13						
1,14						

Attachment 2

Sample Analysis Analytical Report

```
Sample ID  DIWATER                      Date/Time  08/26/96/12:39:49
[illegible]  AUTO 1:1                   Cal  Y=3987.961X+173.164
[illegible]  .946                       Intensity 257          (t=  52     us)
Laser Pulses 1000                       Conc 3.24E-02 + 4.73E-03 ug/L
[illegible] + 20.164 us                 Dilution Factor 1 mL/L
[illegible]
Integrated 2414
Range: LOW                   FINAL RESULT  3.24E-02 + 4.73E-03 ug/L
------------------------------------------------------------------------------
Sample ID  1.[illegible]                Date/Time  08/26/96/12:42:16
[illegible]  AUTO 1:1                   Cal  Y=3987.961X+173.164
[illegible] 1000                        Intensity [illegible]  (t=  52     us)
[illegible] + 1.28E us                  Conc 1.04276 + 2.07E-02 ug/L
[illegible]                             Dilution Factor 1 mL/L
Integrated 53278
Range: LOW                   FINAL RESULT  1.043 + 2.07E-02 ug/L
------------------------------------------------------------------------------
Sample ID  100                          Date/Time  08/26/96/12:45:03
[illegible]  AUTO 1:1                   Cal  Y=3987.961X+173.164
[illegible]  .947                       Intensity 218491       (t= 117     us)
[illegible]                             Conc 93.15727 + 1.5687 ug/L
[illegible]                             Dilution Factor 1 mL/L
Integrated [illegible]
Range: LOW                   FINAL RESULT  93.157 + 1.569 ug/L
------------------------------------------------------------------------------
Sample ID  100                          Date/Time  08/26/96/12:46:13
[illegible]  AUTO 1:1                   Cal  Y=29.303X+22.862
[illegible]                             Intensity 2306         (t=  52     us.
Laser Pulses 1000                       Conc 98.31359 + 3.1739 ug/L
[illegible] + 1.128 us                  Dilution Factor 1 mL/mL
[illegible] -048
[illegible]                  FINAL RESULT  98.314 + 3.174 ug/L
------------------------------------------------------------------------------
```

Attachment 3

EXAMPLE

LU-4 URANIUM ANALYZER DATA SHEET

Name: Bioassay Date: 09/28/92 - BC

Filename: 0800 PMT: High

Sample			Spike		Readings			Conc[1]
#	ml.	dil	ml	ppb	1[2]	2[3]	3[4]	ppb
1	6.00	50	.050	100	336.91	532.88	2298.2	5.45
2	6.00	50	.050	100	311.19	493.22	2008.2	4.26
3	6.00	50	.050	100	432.90	546.47	2078.3	2.85
4	6.00	50	.050	100	529.55	906.58	2415.1	12.08
5	6.00	50	.050	100	351.20	513.82	2205.9	4.09
6	6.00	50	.050	100	337.17	462.30	2091.4	4.16
7	6.00	50	.050	100	597.15	1009.1	2629.9	11.38
8	6.00	50	.050	100	339.62	472.81	2086.8	2.36
9	6.00	50	.050	100	308.80	476.61	2113.3	6.33
10	6.00	50	.050	100	665.85	883.61	2505.2	4.29
11	6.00	50	.050	100	398.40	524.44	2157.4	3.37
12	6.00	100	.050	100	873.40	1773.1	3504.0	35.33

(1) The concentrations calculated by the LU-4 are subject to error due to problems with the software. Therefore, the data from the LU-4 is downloaded to Lotus 1-2-3, and calculated with a program utilizing the formula shown in Section 5.4 and printed as shown in Attachment 4.

(2) V_1 in Section 5.4
(3) V_2 in Section 5.4
(4) V_3 in Section 5.4

Attachment 4
Page 1 of 2

LU-4 Lotus 1-2-3 Macro

```
B3: (T) |::
A4: [W16] 'NUMBER
B4: (T) 'SAMPLE
C4: (T) ^DILUTION
D4: (T) ^STD
E4: (T) ^STD PPB
G4: (T) ^READINGS
B5: (T) ^ML
C5: (T) ^ML
D5: (T) ^ML
F5: (T) ^1
G5: (T) ^2
H5: (T) ^3
I5: (T) ^CONC
A6: [W16] 1
B6: (T) U @VALUE(@MID(A$24,$K6$16,4))
C6: (T) U @VALUE(@MID($A$25,$K6$16,4))
D6: (T) U @VALUE(@MID($A$26,$K6$16,4))
E6: (T) U @VALUE(@MID($A$27,$K6$16,4))
F6: (T) U @VALUE(@MID($A$28,$K6$16,6))
G6: (T) U @VALUE(@MID($A$29,$K6$16,6))
H6: (T) U @VALUE(@MID($A$30,$K6$16,6))
I6: (T) U @IF(B6<5,0,((G6-F6)/(H6-G6))$(D6/B6)$E6$C6)
A7: [W16] +A6+1
B7: (T) U @VALUE(@MID(A$24,$K7$16,4))
C7: (T) U @VALUE(@MID($A$25,$K7$16,4))
D7: (T) U @VALUE(@MID($A$26,$K7$16,4))
E7: (T) U @VALUE(@MID($A$27,$K7$16,4))
F7: (T) U @VALUE(@MID($A$28,$K7$16,6))
G7: (T) U @VALUE(@MID($A$29,$K7$16,6))
H7: (T) U @VALUE(@MID($A$30,$K7$16,6))
I7: (T) U @IF(B7<5,0,((G7-F7)/(H7-G7))$(D7/B7)$E7$C7)
A8: [W16] +A7+1
B8: (T) U @VALUE(@MID(A$24,$K8$16,4))
C8: (T) U @VALUE(@MID($A$25,$K8$16,4))
D8: (T) U @VALUE(@MID($A$26,$K8$16,4))
E8: (T) U @VALUE(@MID($A$27,$K8$16,4))
F8: (T) U @VALUE(@MID($A$28,$K8$16,6))
G8: (T) U @VALUE(@MID($A$29,$K8$16,6))
H8: (T) U @VALUE(@MID($A$30,$K8$16,6))
I8: (T) U @IF(B8<5,0,((G8-F8)/(H8-G8))$(D8/B8)$E8$C8)
A9: [W16] +A8+1
B9: (T) U @VALUE(@MID(A$24,$K9$16,4))
C9: (T) U @VALUE(@MID($A$25,$K9$16,4))
D9: (T) U @VALUE(@MID($A$26,$K9$16,4))
E9: (T) U @VALUE(@MID($A$27,$K9$16,4))
F9: (T) U @VALUE(@MID($A$28,$K9$16,6))
G9: (T) U @VALUE(@MID($A$29,$K9$16,6))
H9: (T) U @VALUE(@MID($A$30,$K9$16,6))
I9: (T) U @IF(B9<5,0,((G9-F9)/(H9-G9))$(D9/B9)$E9$C9)
A10: [W16] +A9+1
B10: (T) U @VALUE(@MID(A$24,$K10$16,4))
C10: (T) U @VALUE(@MID($A$25,$K10$16,4))
D10: (T) U @VALUE(@MID($A$26,$K10$16,4))
E10: (T) U @VALUE(@MID($A$27,$K10$16,4))
F10: (T) U @VALUE(@MID($A$28,$K10$16,6))
G10: (T) U @VALUE(@MID($A$29,$K10$16,6))
H10: (T) U @VALUE(@MID($A$30,$K10$16,6))
I10: (T) U @IF(B10<5,0,((G10-F10)/(H10-G10))$(D10/B10)$E10$
A11: [W16] +A10+1
B11: (T) U @VALUE(@MID(A$24,$K11$16,4))
C11: (T) U @VALUE(@MID($A$25,$K11$16,4))
D11: (T) U @VALUE(@MID($A$26,$K11$16,4))
E11: (T) U @VALUE(@MID($A$27,$K11$16,4))
F11: (T) U @VALUE(@MID($A$28,$K11$16,6))
G11: (T) U @VALUE(@MID($A$29,$K11$16,6))
H11: (T) U @VALUE(@MID($A$30,$K11$16,6))
I11: (T) U @IF(B11<5,0,((G11-F11)/(H11-G11))$(D11/B11)$E11
A12: [W16] +A11+1
```

Attachment 4
Page 2 of 2

LU-4 Lotus 1-2-3 Macro

```
C12: (T) U @VALUE(@MID($A$25,$K12$16,4))
D12: (T) U @VALUE(@MID($A$26,$K12$16,4))
E12: (T) U @VALUE(@MID($A$27,$K12$16,4))
F12: (T) U @VALUE(@MID($A$28,$K12$16,6))
G12: (T) U @VALUE(@MID($A$29,$K12$16,6))
H12: (T) U @VALUE(@MID($A$30,$K12$16,6))
I12: (T) U @IF(B12<5,0,((G12-F12)/(H12-G12))$(D12/B12)$E12$C12)
A13: [W16] +A12+1
B13: (T) U @VALUE(@MID(A$24,$K13$16,4))
C13: (T) U @VALUE(@MID($A$25,$K13$16,4))
D13: (T) U @VALUE(@MID($A$26,$K13$16,4))
E13: (T) U @VALUE(@MID($A$27,$K13$16,4))
F13: (T) U @VALUE(@MID($A$28,$K13$16,6))
G13: (T) U @VALUE(@MID($A$29,$K13$16,6))
H13: (T) U @VALUE(@MID($A$30,$K13$16,6))
I13: (T) U @IF(B13<5,0,((G13-F13)/(H13-G13))$(D13/B13)$E1
A14: [W16] +A13+1
B14: (T) U @VALUE(@MID(A$24,$K14$16,4))
C14: (T) U @VALUE(@MID($A$25,$K14$16,4))
D14: (T) U @VALUE(@MID($A$26,$K14$16,4))
E14: (T) U @VALUE(@MID($A$27,$K14$16,4))
F14: (T) U @VALUE(@MID($A$28,$K14$16,6))
G14: (T) U @VALUE(@MID($A$29,$K14$16,6))
H14: (T) U @VALUE(@MID($A$30,$K14$16,6))
I14: (T) U @IF(B14<5,0,((G14-F14)/(H14-G14))$(D14/B14)$E
A15: [W16] +A14+1
B15: (T) U @VALUE(@MID(A$24,$K15$16,4))
C15: (T) U @VALUE(@MID($A$25,$K15$16,4))
D15: (T) U @VALUE(@MID($A$26,$K15$16,4))
E15: (T) U @VALUE(@MID($A$27,$K15$16,4))
F15: (T) U @VALUE(@MID($A$28,$K15$16,6))
G15: (T) U @VALUE(@MID($A$29,$K15$16,6))
H15: (T) U @VALUE(@MID($A$30,$K15$16,6))
I15: (T) U @IF(B15<5,0,((G15-F15)/(H15-G15))$(D15/B15)$
A16: [W16] +A15+1
B16: (T) U @VALUE(@MID(A$24,$K16$16,4))
C16: (T) U @VALUE(@MID($A$25,$K16$16,4))
D16: (T) U @VALUE(@MID($A$26,$K16$16,4))
E16: (T) U @VALUE(@MID($A$27,$K16$16,4))
F16: (T) U @VALUE(@MID($A$28,$K16$16,6))
G16: (T) U @VALUE(@MID($A$29,$K16$16,6))
H16: (T) U @VALUE(@MID($A$30,$K16$16,6))
I16: (T) U @IF(B16<5,0,((G16-F16)/(H16-G16))$(D16/B16)
A17: [W16] +A16+1
B17: (T) U @VALUE(@MID(A$24,$K17$16,4))
C17: (T) U @VALUE(@MID($A$25,$K17$16,4))
D17: (T) U @VALUE(@MID($A$26,$K17$16,4))
E17: (T) U @VALUE(@MID($A$27,$K17$16,4))
F17: (T) U @VALUE(@MID($A$28,$K17$16,6))
G17: (T) U @VALUE(@MID($A$29,$K17$16,6))
H17: (T) U @VALUE(@MID($A$30,$K17$16,6))
I17: (T) U @IF(B17<5,0,((G17-F17)/(H17-G17))$(D17/B17
```

Attachment 5

Data Printout

NUMBER	SAMPLE ML	DILUTION ML	STD ML	STD PPB	READINGS 1	2	3	CONC
1	6.000	50	0.050	100	552.33	737.06	1982.2	6.18
+A5+1	6.000	50	0.050	100	632.52	831.74	1785.3	8.71
+A6+1	6.000	50	0.050	100	611.88	701.84	1864.2	3.22
+A7+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A8+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A9+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A10+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A11+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A12+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A13+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A14+1	0.000	0	0.000	0	0.00	0.00	0.0	0.00
+A15+1	0.000	0	0.00	0	0.00	0.00	0.0	0.00