APPENDIX B
SUMMARY OF INTERLABORATORY COMPARISONS

INTERLABORATORY COMPARISION PROGRAM

The purpose of the Interlaboratory Comparison Program (ICP) is to confirm the accuracy of results produced by TBE. Samples of various matrices (i.e. soil, water, vegetation, air filters, and milk) are spiked with known amounts of radioactivity by commercial vendors of this service and by departments within the government. TBE participates in four programs. Two are commercial, Analytics Inc. and Environmental Resource Associates (ERA) and two are government sponsored programs, the Department of Energy's (DOE) Environmental Measurements Laboratory (EML) and the Mixed Analyte Performance Evaluation Program (MAPEP). The MAPEP is administered by DOE's Idaho National Engineering Laboratory. All four programs are blind performance evaluation studies in which samples with known activities are sent to TBE for analysis. Once analyzed, TBE submits the results to the respective agency for evaluation. The results of these evaluations are published in TBE's quarterly and annual QA reports.

The 2002 (ICP) includes all contractually required matrices and analyses we supply to customers.

The US Environmental Protection Agency (EPA) discontinued their Interlaboratory Comparison Program in December 1998. However, on May 1, 2001, accreditation was granted to Environmental Resource Associates' (ERA) RadCheM Proficiency Testing Program to complete the process of replacing the USEEPA-LV Nuclear Radiation Assessment Division program.

The National Institute of Standards and Technology (NIST) is the approval authority for laboratory providers participating in Intercomparison Study Programs; however, at this time, there are no approved laboratories for environmental and/or radiochemical isotope analyses.

Trending graphs are provided in this section for the Analytics and ERA Programs.

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide (1)	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
February, 2002	A15211-55	Liquid	Sr-89	uCi/mL	1.60E-03	2.03E-03	0.79	W
			Sr-90		2.90E-04	3.64E-04	0.80	A
	A15213-55	Liquid	H-3	uCi/mL	1.08E-03	1.19E-03	0.90	A
March, 2002	E3064-396	Milk	Sr-89	pCi/L	80	83	0.96	A
			Sr-90		28	27	1.04	A
	* E3065-396	Milk	I-131	pCi/L	86	92	0.93	A
			Ce-141		300	326	0.92	A
			Cr-51		256	267	0.96	A
			Cs-134		94	122	0.77	W
			Cs-137		252	266	0.95	A
			Mn-54		217	224	0.97	A
			Fe-59		108	116	0.93	A
			Zn-65		218	221	0.99	A
			Co-60		147	158	0.93	A
	E3067-396	AP	I-131	pCi	202	199	1.02	A
			Cr-51		166	163	1.02	A
			Cs-134		77	74	1.04	A
			Cs-137		162	162	1.00	A
			Mn-54		135	136	0.99	A
			Fe-59		70	70	1.00	A
			Zn-65		128	134	0.96	A
			Co-60		95	96	0.99	A
	E3066-396	Charcoal	I-131	pCi	66	77	0.86	A
May, 2002	A15521-55	Liquid	Gr-Alpha	uCi/mL	8.48E-04	7.15E-04	1.19	A
	A15520-55	Liquid	Sr-89	uCi/mL	2.63E-03	3.25E-03	0.81	A
			Sr-90		2.51E-04	2.70E-04	0.93	A
	A15522-55	Liquid	Tritium	uCi/mL	1.35E-03	1.46E-03	0.92	A

(1) Only analyses performed routinely for the REMP are included on this table.

* Analytics known values were incorrectly calculated. Revised (as shown) evaluation was acceptable.

(a) Teledyne Brown Engineering reported result.

(b) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) Analytics evaluation: A= Acceptable. Reported result falls within ratio limits of 0.80-1.20. W=Acceptable with warning. Reported result falls within ratio limits of 0.70-0.79 and 1.21-1.30.

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide (1)	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
June, 2002	E3220-396	Milk	I-131	pCi/L	86	87	0.99	A
			Ce-141		84	90	0.93	A
			Cr-51		197	235	0.84	A
			Cs-134		110	120	0.92	A
			Cs-137		96	91	1.05	A
			Co-58		95	100	0.95	A
			Mn-54		106	95	1.12	A
			Fe-59		95	81	1.17	A
			Zn-65		186	180	1.03	A
			Co-60		132	125	1.06	A
June, 2002	E3222-396	AP	Ce-141	pCi	85	75	1.13	A
			Cr-51		199	196	1.02	A
			Cs-134		96	100	0.96	A
			Cs-137		92	76	1.21	W
			Co-58		98	83	1.18	A
			Mn-54		87	79	1.10	A
			Fe-59		85	67	1.27	W
			Zn-65		182	150	1.21	W
			Co-60		121	104	1.16	A
August, 2002	A16018-55	Liquid	Sr-89	uCi/mL	4.12E-03	4.99E-03	0.83	A
			Sr-90		2.43E-04	2.64E-04	0.92	A
	A16020-55	Liquid	Tritium	uCi/mL	1.93E-03	2.00E-03	0.97	A
September, 2002	A15989-148	Liquid	Sr-89	uCi/mL	4.02E-03	4.99E-03	0.81	A
			Sr-90		2.49E-04	2.64E-04	0.94	A
September, 2002	E3325-396	Milk	I-131	pCi/L	84	80	1.05	A
			Ce-141		168	160	1.05	A
			Cr-51		210.5	227	0.93	A
			Cs-134		127	132	0.96	A
			Cs-137		136	127	1.07	A
			Co-58		93	97	0.96	A
			Mn-54		165	152	1.09	A
			Fe-59		90	89	1.01	A
			Zn-65		196	187	1.05	A
			Co-60		147	149	0.99	A

(1) Only analyses performed routinely for the REMP are included on this table.

(a) Teledyne Brown Engineering reported result.

(b) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) Analytics evaluation: A= Acceptable. Reported result falls within ratio limits of 0.80-1.20. W=Acceptable with warning. Reported result falls within ratio limits of 0.70-0.79 and 1.21-1.30.

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide (1)	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
	E3324-396	Milk	Sr-89	pCi/L	106	92	1.15	A
			Sr-90		39	39	1.00	A
September, 2002	E-3327-396	Filter	Ce-141	pCi	115	110	1.05	A
			Cr-51		163.6	156	1.05	A
			Cs-134		79	90	0.88	A
			Cs-137		95	87	1.09	A
			Co-58		71	67	1.06	A
			Mn-54		118	104	1.13	A
			Fe-59		76	61	1.25	A
			Zn-65		155	130	1.19	A
			Co-60		108	102	1.06	A
	E3326-396	Charcoal	I-131	pCi	73	85	0.86	A
December, 2002	E3520-396	Milk	Sr-89	pCi/L	88	68	1.29	W
			Sr-90		40	38	1.05	A
	E3521-396	Milk	I-131	pCi/L	97	86	1.13	A
			Ce-141		136	111	1.23	W
			Cr-51		347	346	1.00	A
			Cs-134		97	99	0.98	A
			Cs-137		229	220	1.04	A
			Co-58		143	139	1.03	A
			Mn-54		162	142	1.14	A
			Fe-59		80	72	1.11	A
			Zn-65		217	178	1.22	W
			Co-60		172	164	1.05	A
December, 2002	E3523-396	Filter	Ce-141	pCi	108	128	0.84	A
			Cr-51		370	398	0.93	A
			Cs-134		79	114	0.69	W
			Cs-137		226	253	0.89	A
			Co-58		141	160	0.88	A
			Mn-54		152	163	0.93	A
			Fe-59		89	83	1.07	A
			Zn-65		196	206	0.95	A
			Co-60		170	189	0.90	A

(1) Only analyses performed routinely for the REMP are included on this table.

(a) Teledyne Brown Engineering reported result.

(b) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) Analytics evaluation: A= Acceptable. Reported result falls within ratio limits of 0.80-1.20. W=Acceptable with warning. Reported result falls within ratio limits of 0.70-0.79 and 1.21-1.30.

ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Media	Nuclide (1)	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/ERA	Evaluation (d)
	E3522-396	Charcoal	I-131	pCi	84	96	0.88	A
May, 2002	Rad 49	Water	Gr-Beta	pCi/L	162	189	0.86	A
			Co-60		39.3	39.1	1.01	A
			Cs-134		15.5	17.1	0.91	A
			Cs-137		52.2	52.1	1.00	A
			Sr-89		27.2	31.7	0.86	A
			Sr-90		25.1	28.3	0.89	A
			I-131		13.35	14.7	0.91	A
			H-3		14600	17400	0.84	A
November, 2002	Rad 51	Water	H-3	pCi/L	10100	10200	0.99	A
			I-131		7.94	6.76	1.17	A
			Gr-Beta		280	330	0.85	A
			Sr-89		41.7	47.6	0.88	A
			Sr-90		6.75	7.56	0.89	A
			Co-60		122	104	1.17	A
			Cs-134		60.0	55.5	1.08	A
			Cs-137		140	117	1.20	A

(1) Only analyses performed routinely for the REMP are included on this table.

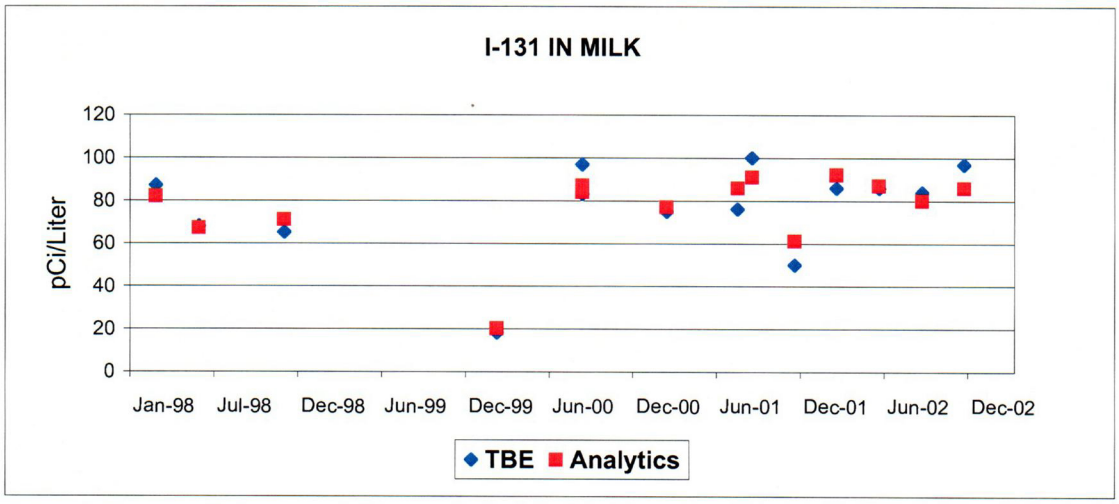
(a) Teledyne Brown Engineering reported result.

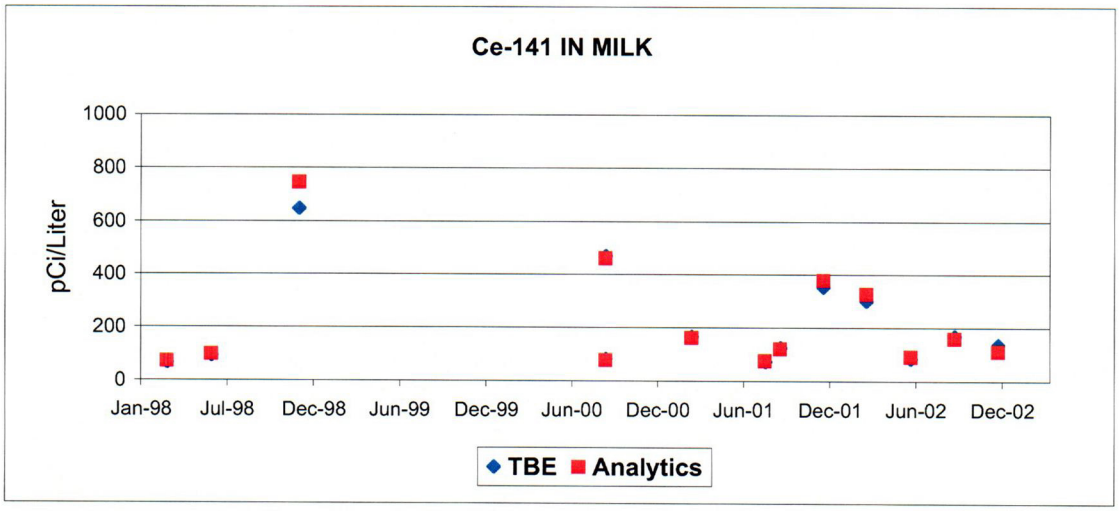
(b) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

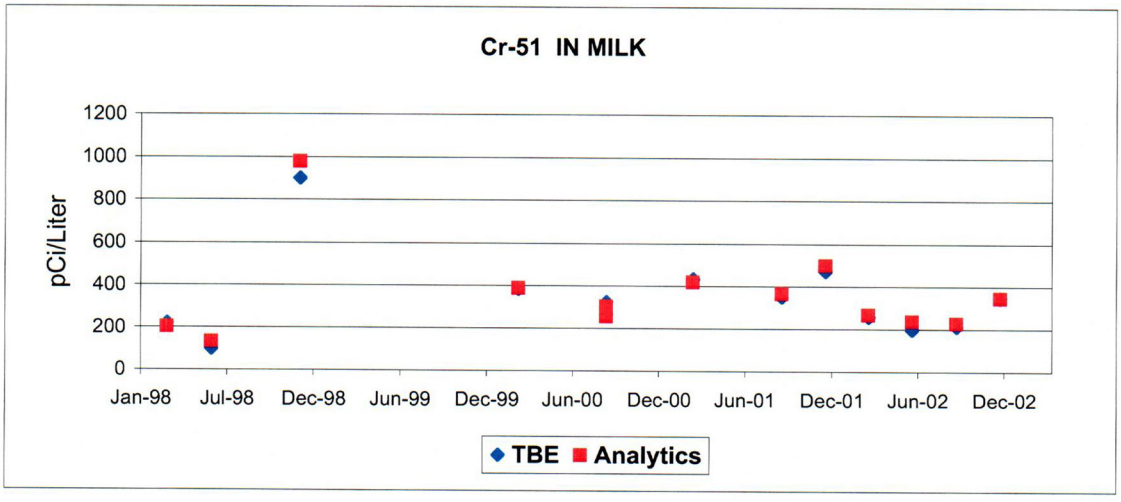
(c) Ratio of Teledyne Brown Engineering to ERA results.

(d) ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limit.

INTERLABORATORY COMPARISON PROGRAM GRAPHS







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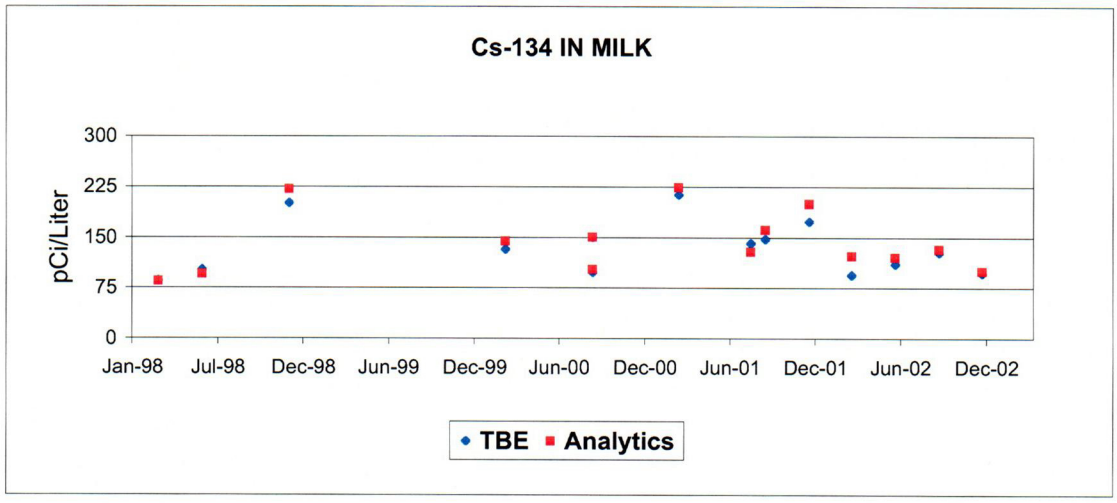

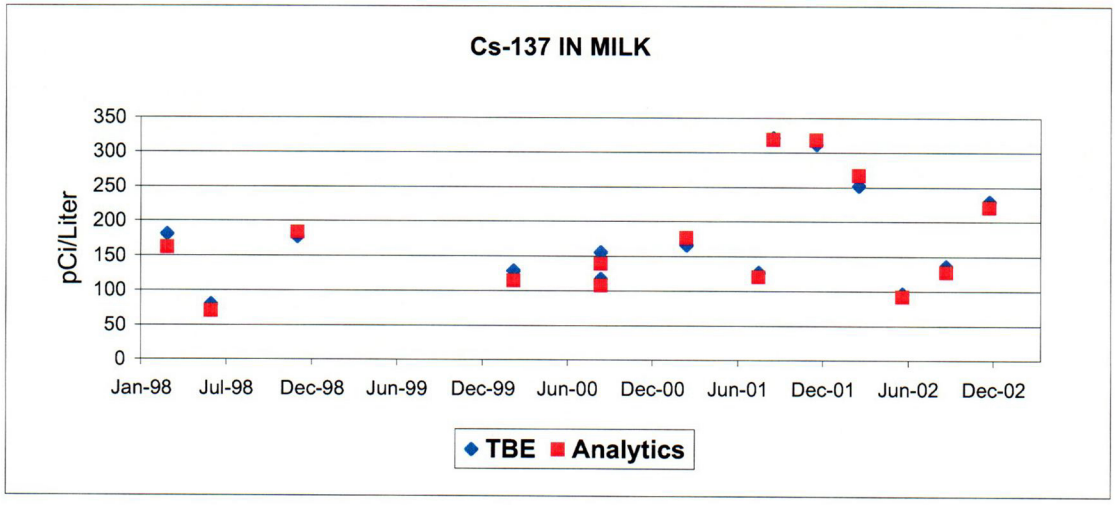

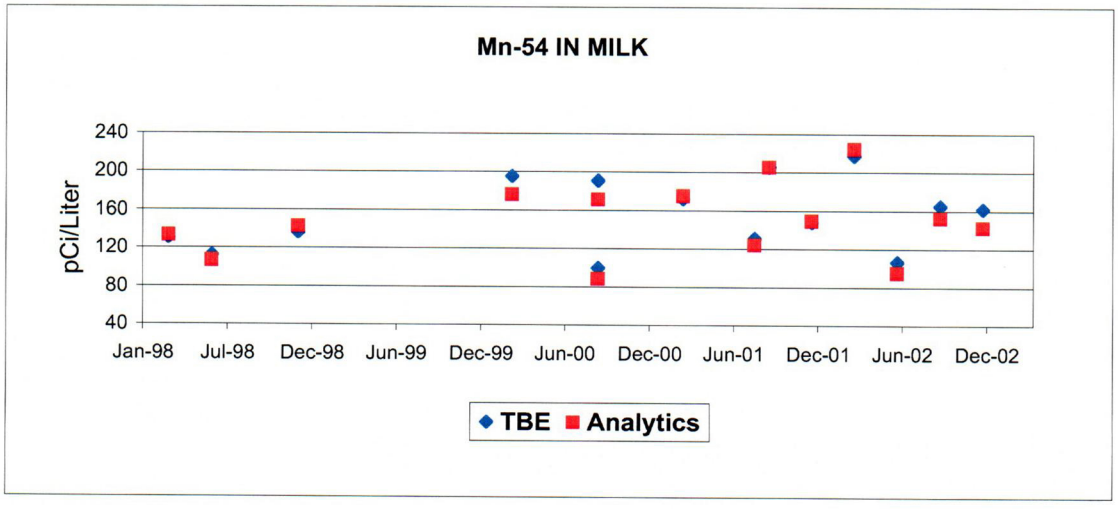

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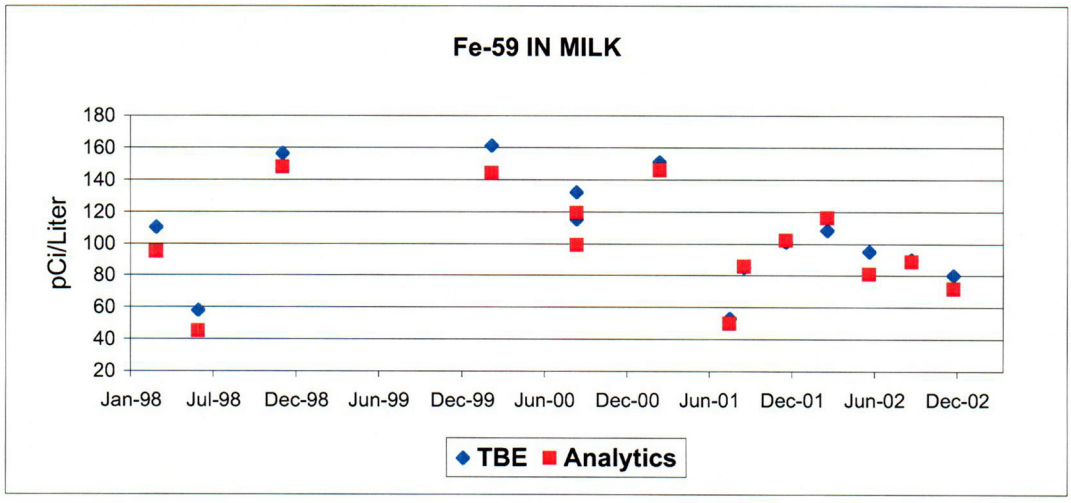

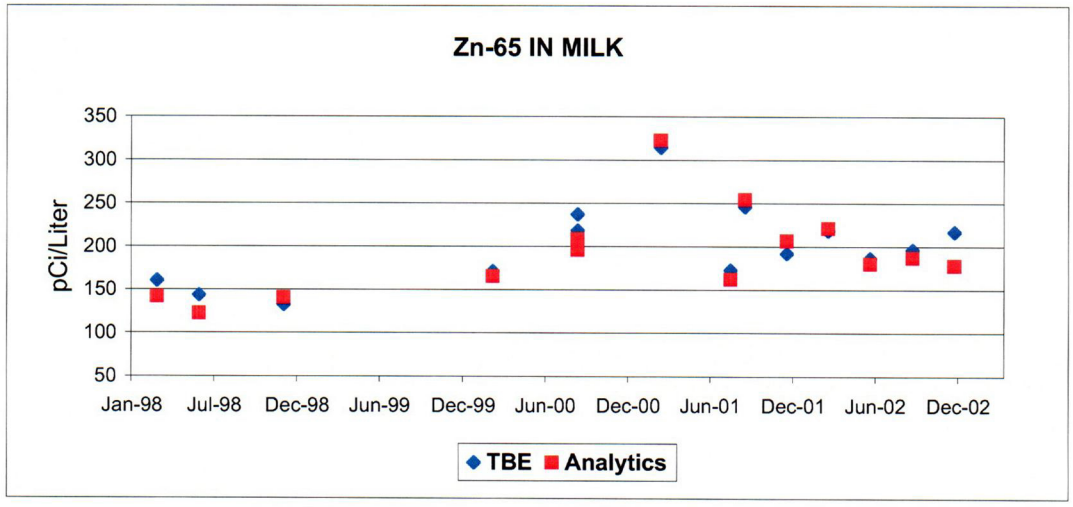

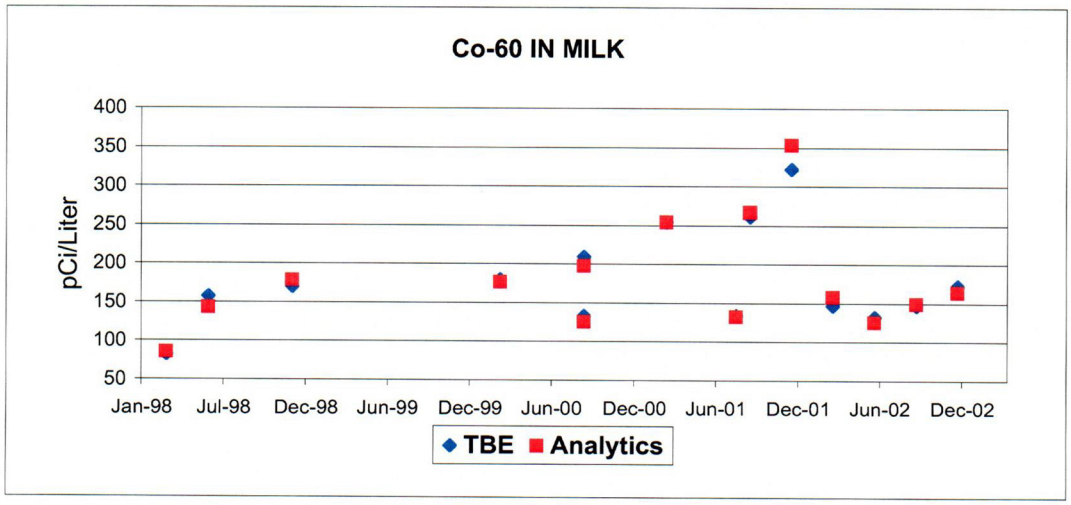

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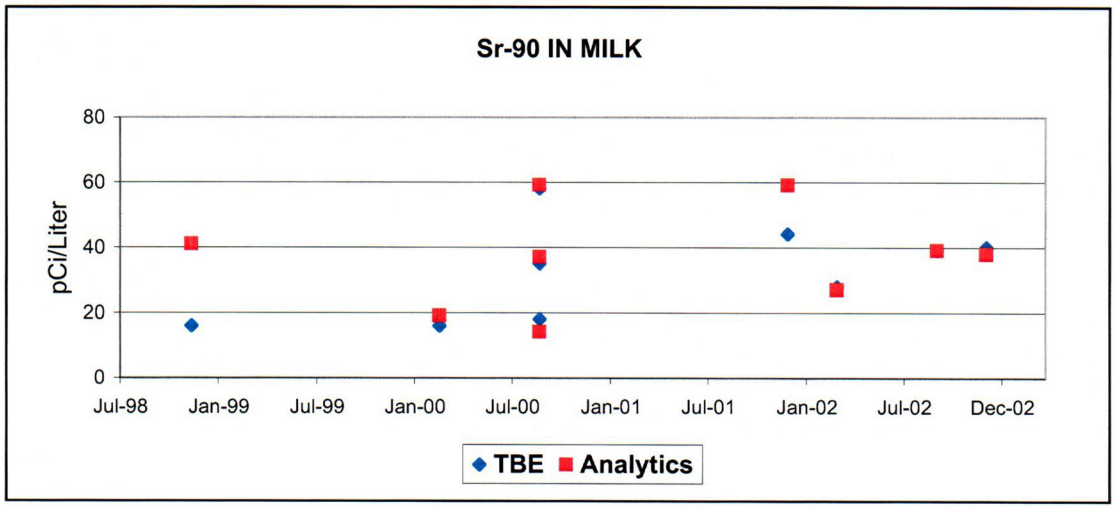

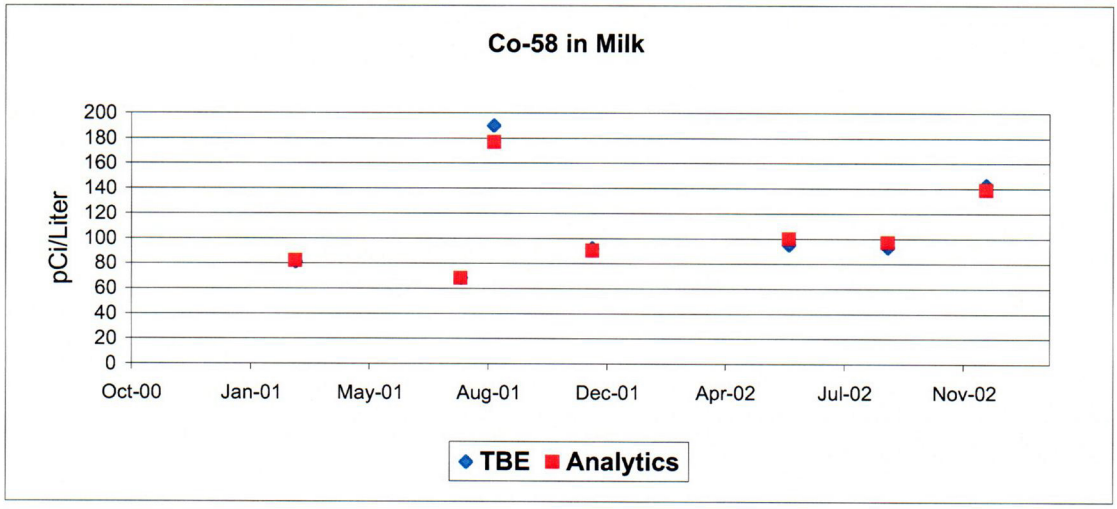

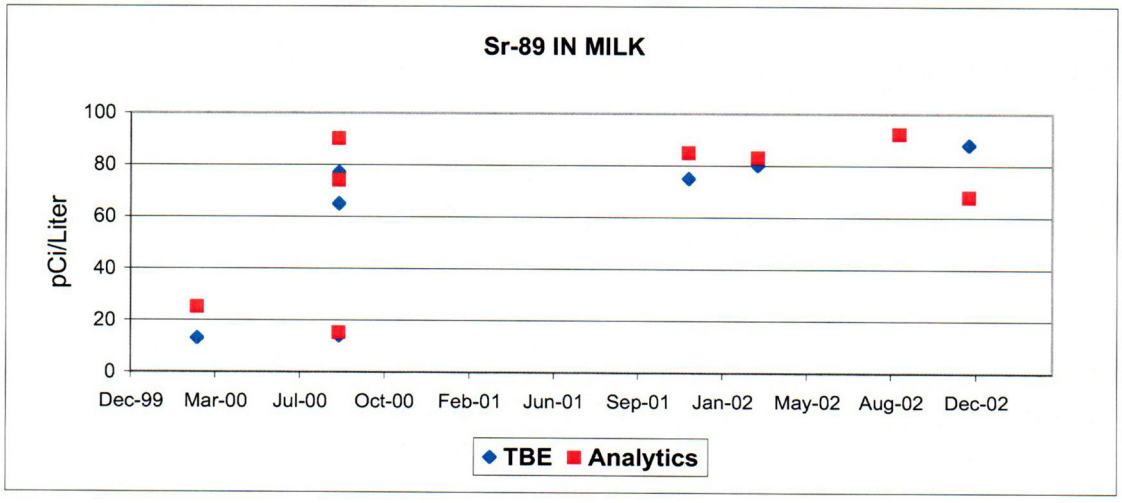

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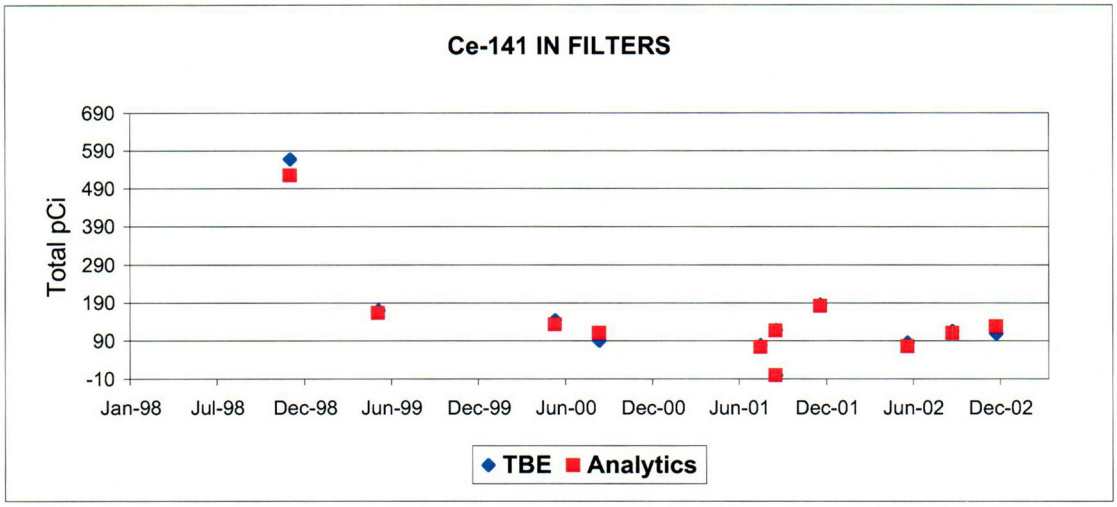

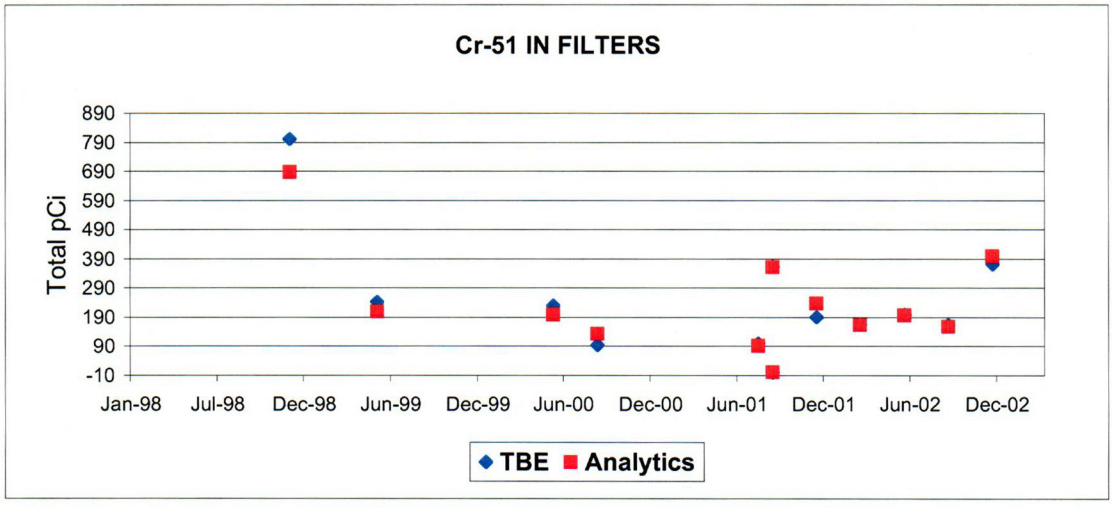

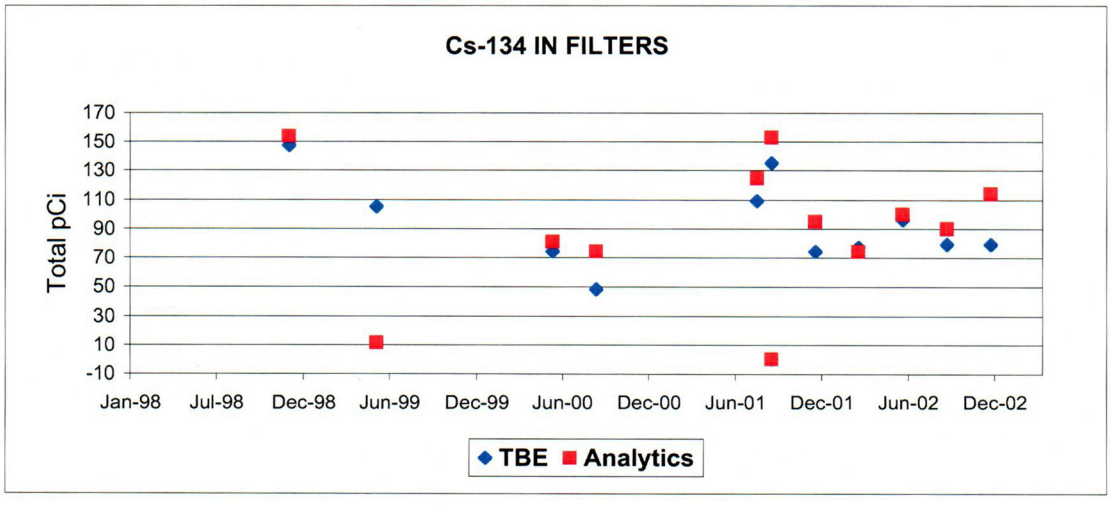

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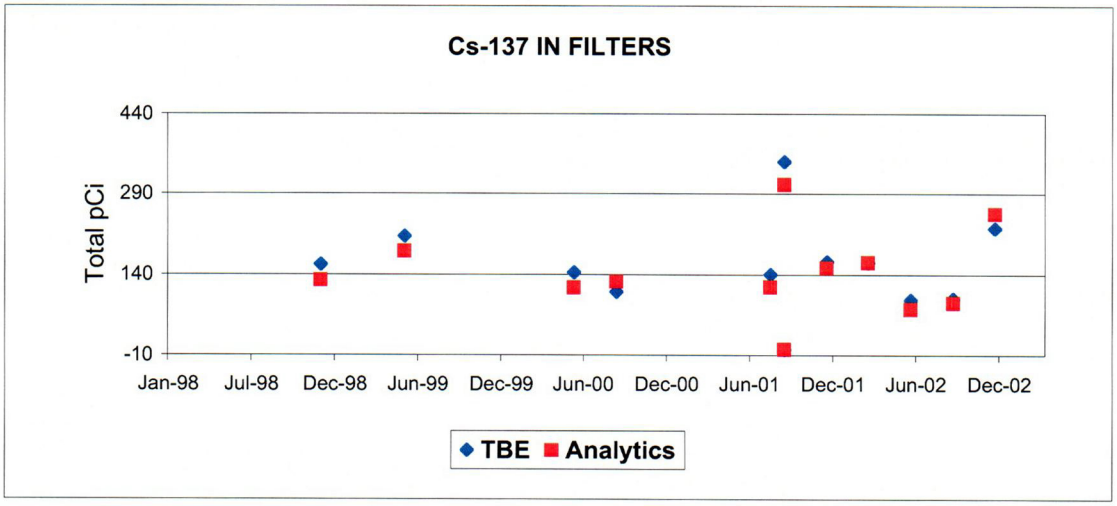

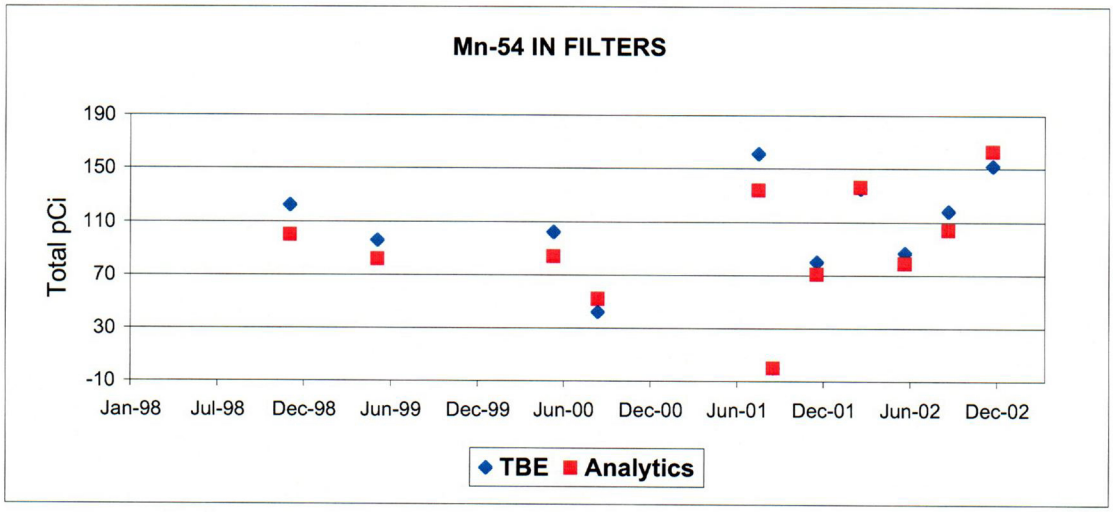

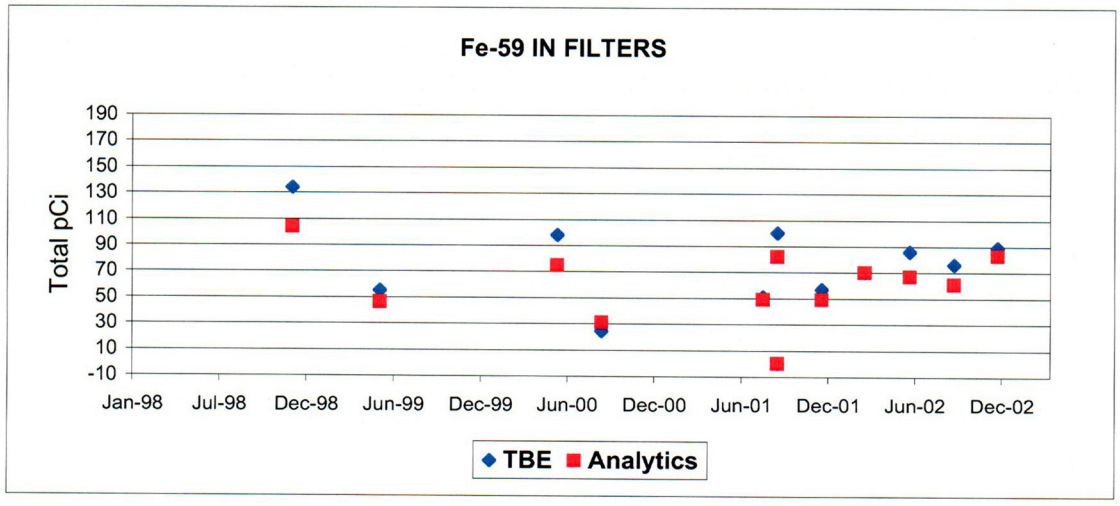

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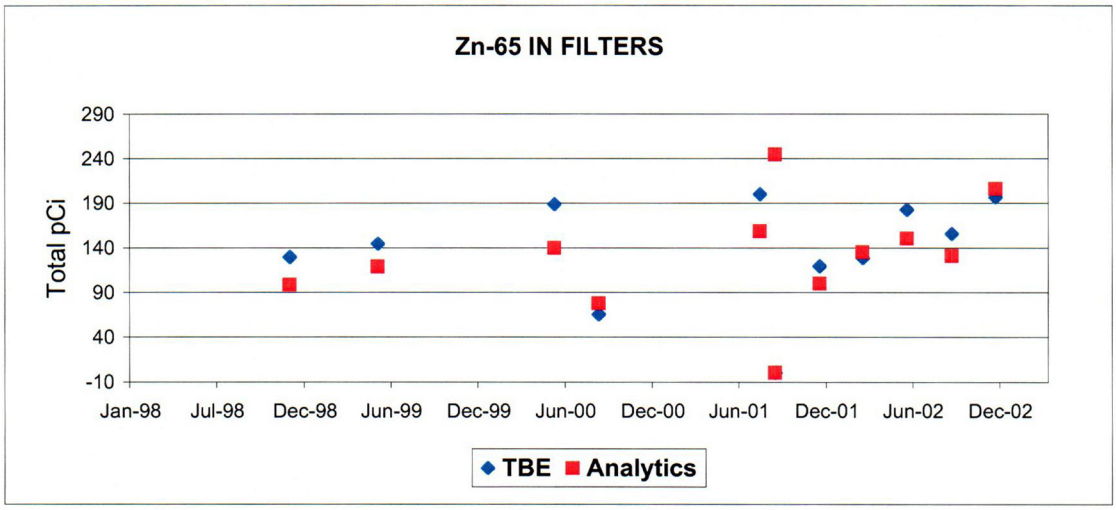

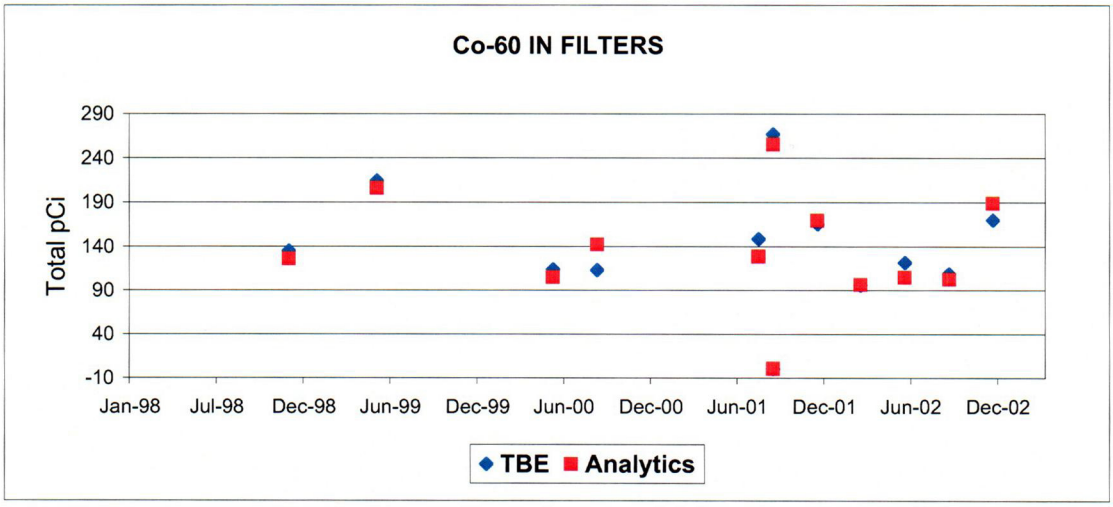

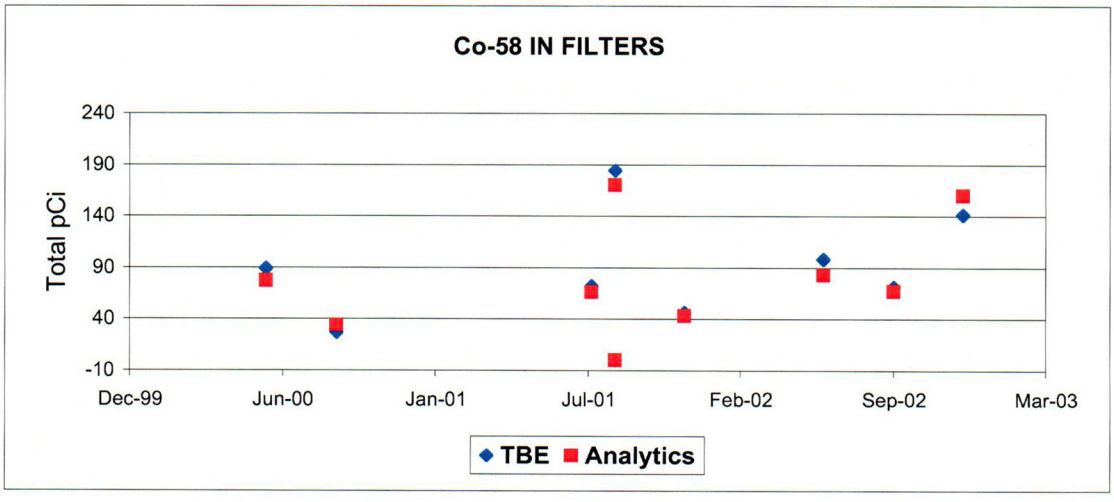

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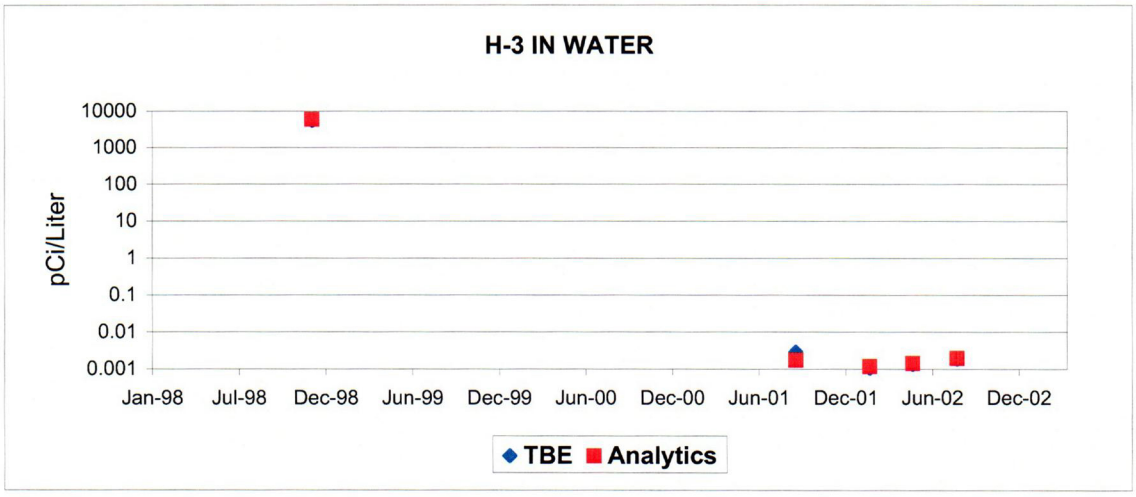

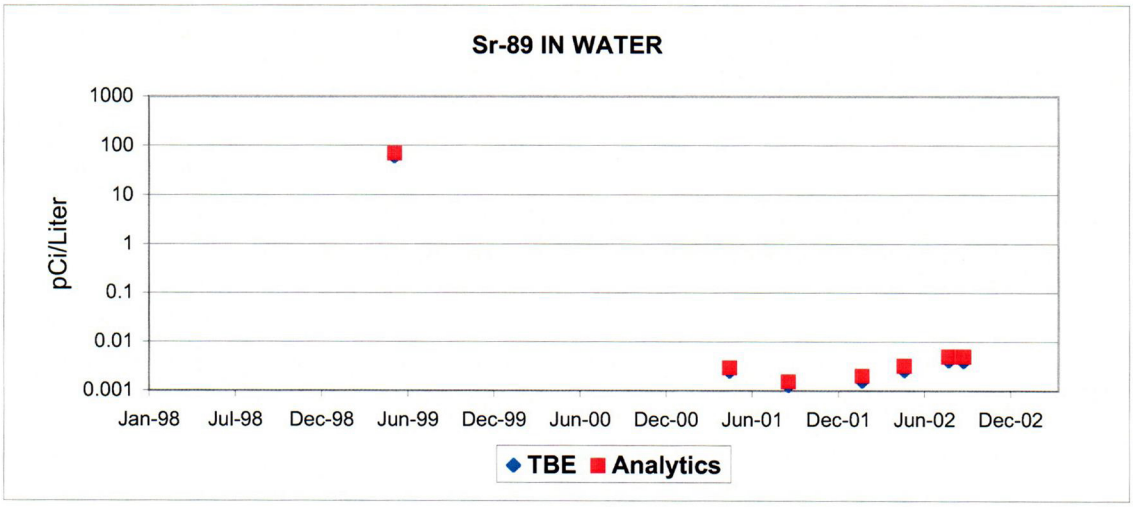

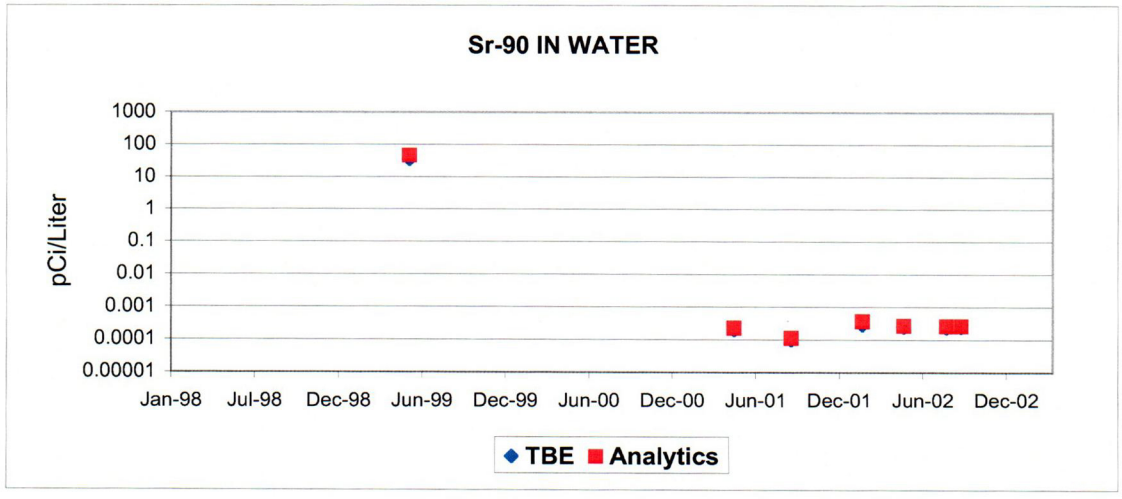

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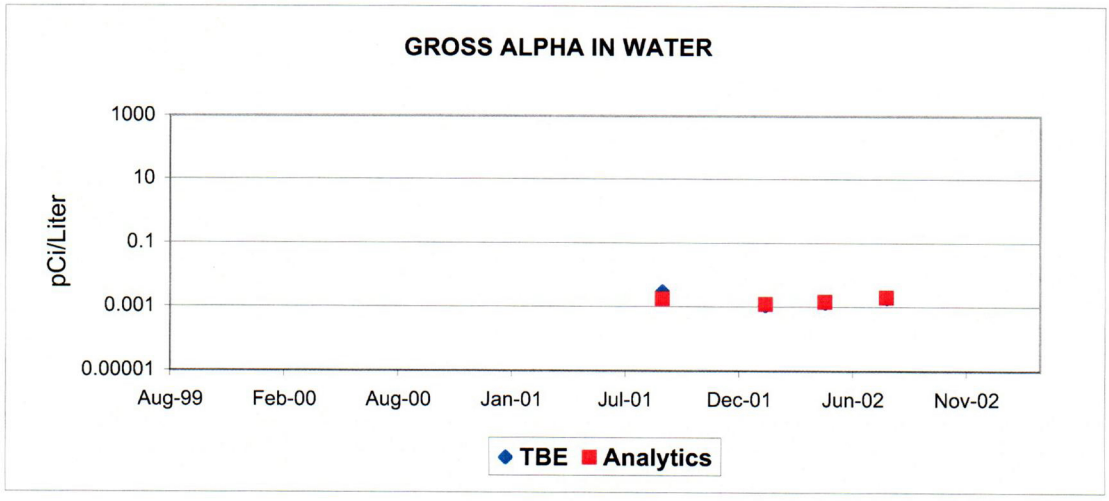

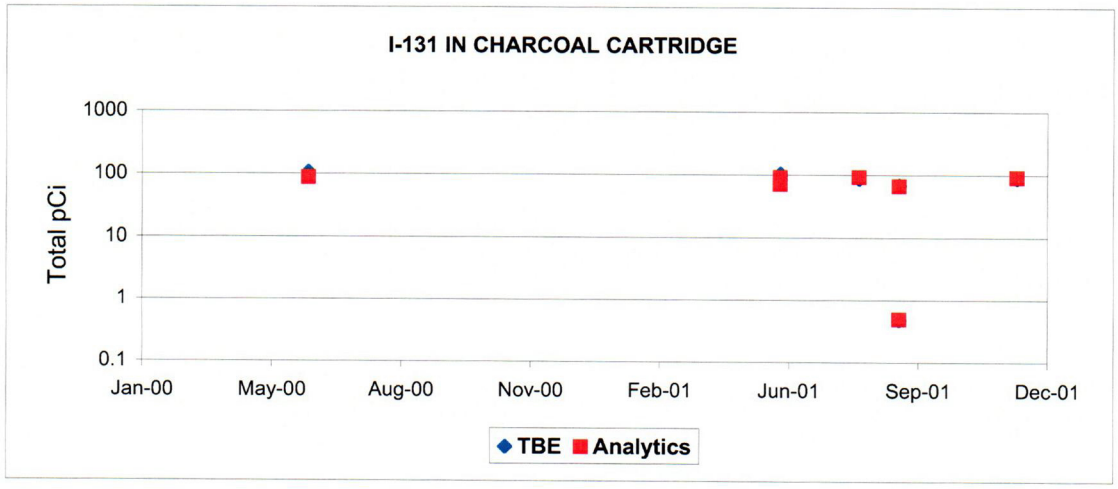

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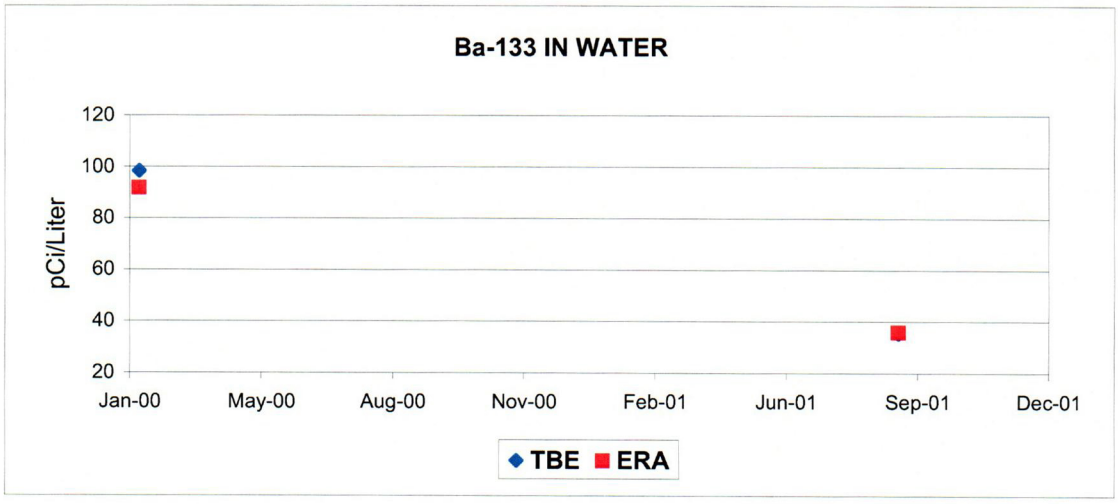

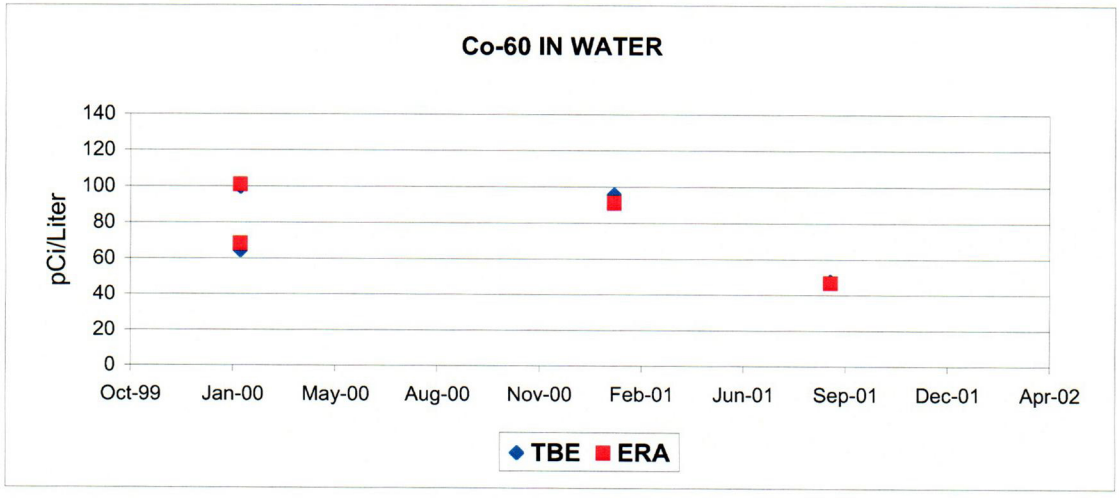

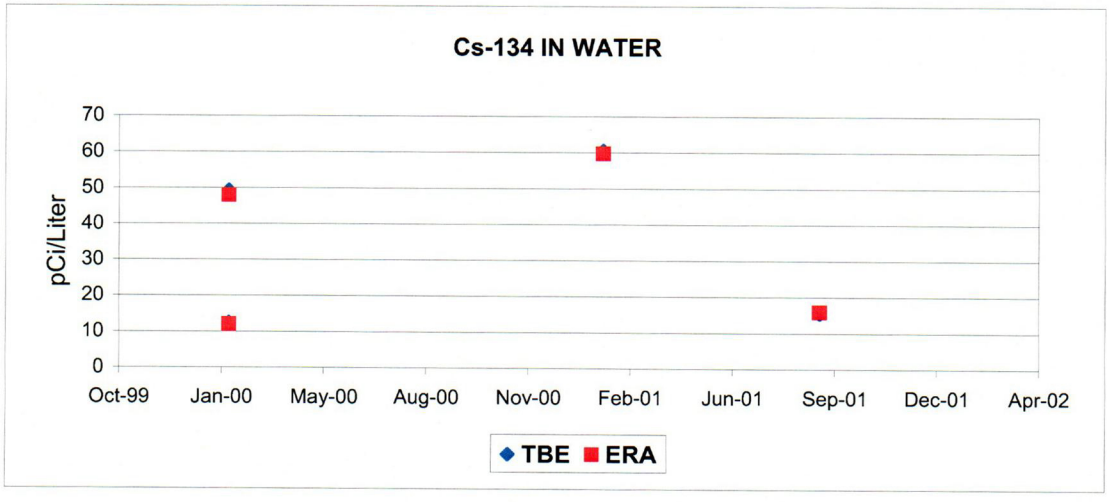

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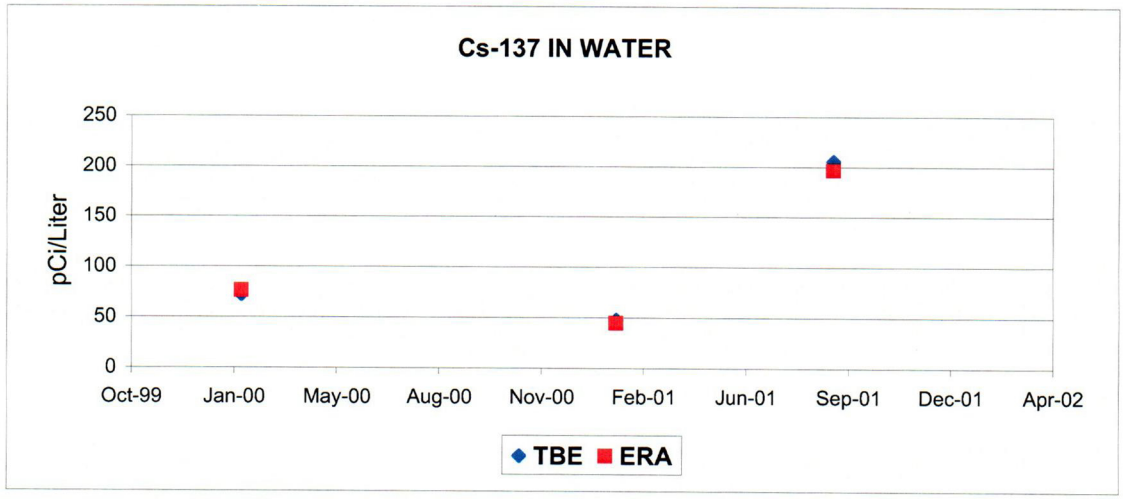
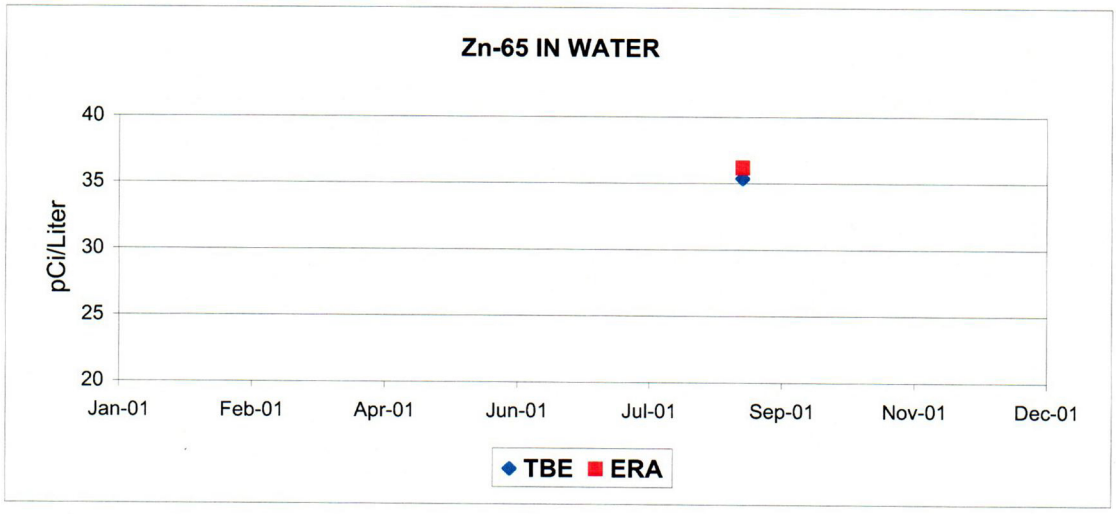
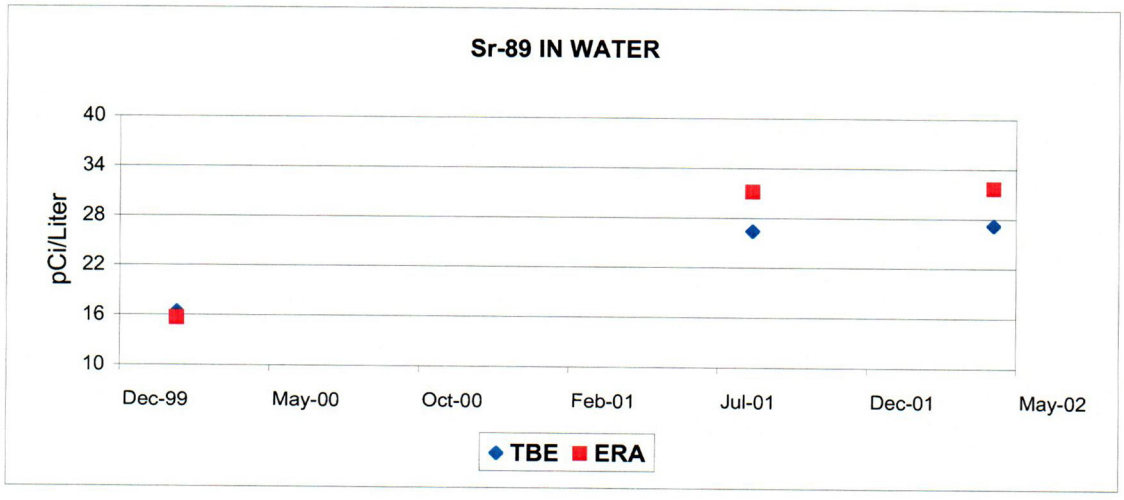
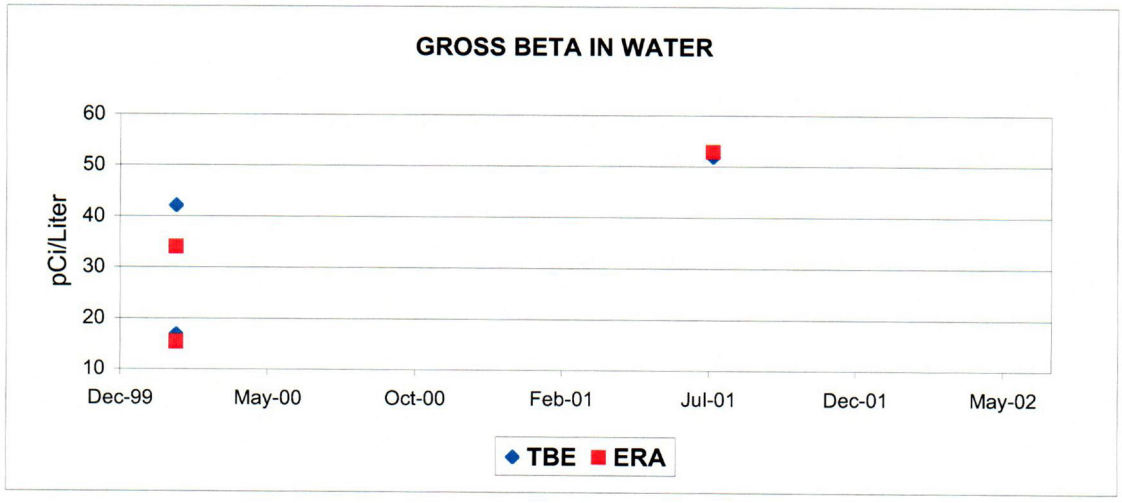






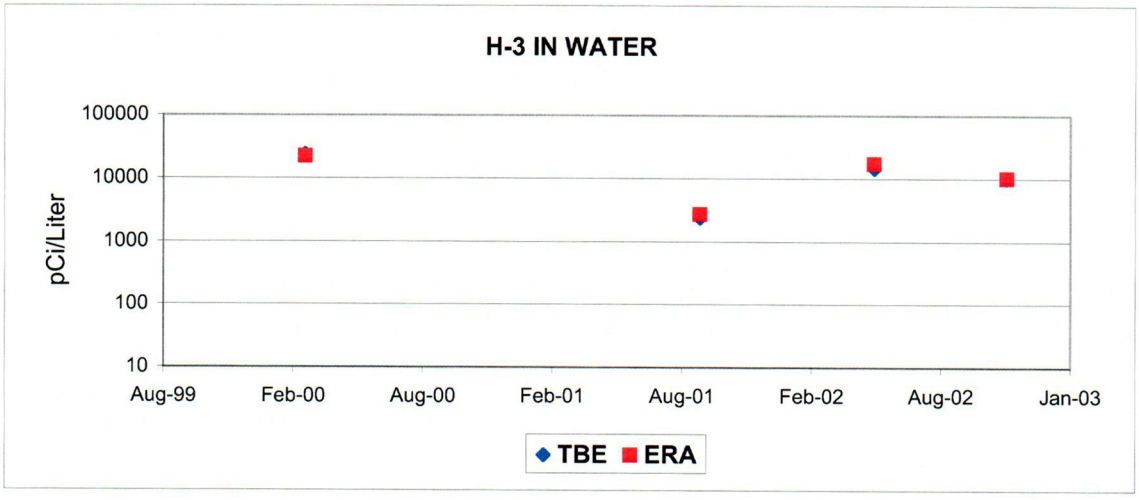
C14

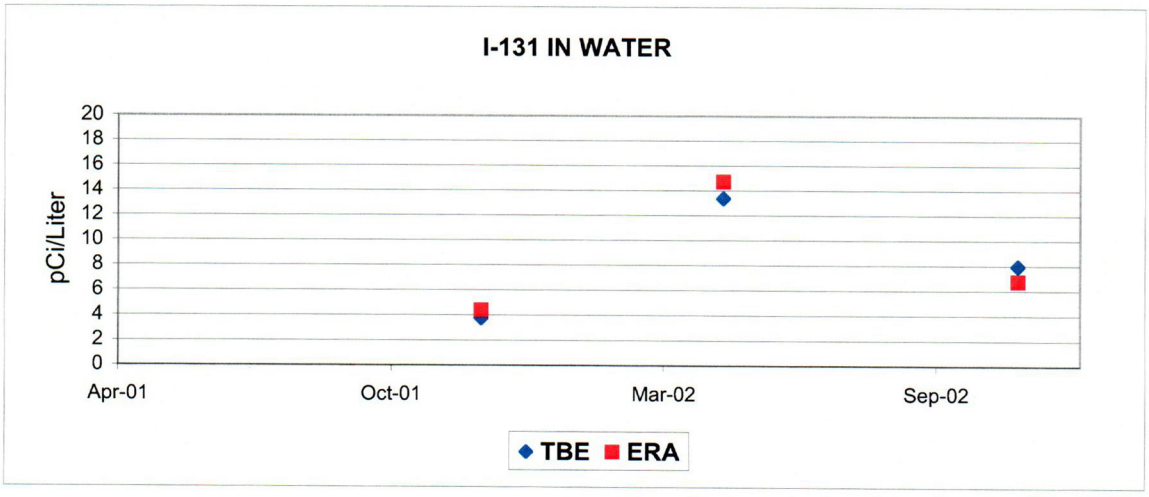
INTERLABORATORY COMPARISON PROGRAM GRAPHS



C15

INTERLABORATORY COMPARISON PROGRAM GRAPHS





C16

APPENDIX C
SYNOPSIS OF ANALYTICAL PROCEDURES

ANALYTICAL PROCEDURES SYNOPSIS

Appendix C is a synopsis of the analytical procedures performed during 2002 on samples collected for the Nebraska Public Power Nuclear Plant's Radiological Environmental Monitoring Program. All analyses have been mutually agreed upon by Nebraska Public Power District and Teledyne Brown Engineering and include those recommended by the USNRC Branch Technical Position, Rev. 1, November 1979.

GROSS BETA ANALYSIS OF SAMPLES

Air Particulates

After a delay of five or more days, allowing for the radon-222 and radon-220 (thoron) daughter products to decay, the filters are counted in a gas-flow proportional counter. An unused air particulate filter, supplied by the customer, is counted as the blank.

Calculations of the results, the two sigma error and the lower limit of detection (LLD):

$$\text{RESULT } (pCi/m^3) = ((S/T) - (B/t))/(2.22\ V\ E)$$

$$\text{TWO SIGMA ERROR } (pCi/m^3) = 2((S/T^2) + (B/t^2))^{1/2}/(2.22\ V\ E)$$

$$\text{LLD } (pCi/m^3) = 4.66(B^{1/2})/(2.22\ V\ E\ t)$$

where:

S	=	Gross counts of sample including blank
B	=	Counts of blank
E	=	Counting efficiency
T	=	Number of minutes sample was counted
t	=	Number of minutes blank was counted
V	=	Sample aliquot size (cubic meters)

DETERMINATION OF GROSS BETA ACTIVITY IN WATER SAMPLES

Introduction

The procedures described in this section are used to measure the overall radioactivity of water samples without identifying the radioactive species present. No chemical separation techniques are involved.

One liter of the sample is evaporated on a hot plate. A smaller volume may be used if the sample has a significant salt content as measured by a conductivity meter. If requested by the customer, the sample is filtered through No. 54 filter paper before evaporation, removing particles greater than 30 microns in size.

After evaporating to a small volume in a beaker, the sample is rinsed into a 2-inch diameter stainless steel planchette which is stamped with a concentric ring pattern to distribute residue evenly. Final evaporation to dryness takes place under heat lamps.

Residue mass is determined by weighing the planchette before and after mounting the sample. The planchette is counted for beta activity on an automatic proportional counter. Results are calculated using empirical self-absorption curves which allow for the change in effective counting efficiency caused by the residue mass.

Detection Capability

Detection capability depends upon the sample volume actually represented on the planchette, the background and the efficiency of the counting instrument, and upon self-absorption of beta particles by the mounted sample. Because the radioactive species are not identified, no decay corrections are made and the reported activity refers to the counting time.

The minimum detectable level (MDL) for water samples is nominally 1.6 picoCuries per liter for gross beta at the 4.66 sigma level (1.0 pCi/L at the 2.83 sigma level), assuming that 1 liter of sample is used and that ½ gram of sample residue is mounted on the planchette. These figures are based upon a counting time of 50 minutes and upon representative values of counting efficiency and background of 0.2 and 1.2 cpm, respectively

The MDL becomes significantly lower as the mount weight decreases because of reduced self-absorption. At a zero mount weight, the 4.66 sigma MDL for gross beta is 0.9 picoCuries per liter. These values reflect a beta counting efficiency of 0.38.

ANALYSIS OF SAMPLES FOR TRITIUM
(Liquid Scintillation)

Water

Ten milliliters of water are mixed with 10 ml of a liquid scintillation "cocktail" and then the mixture is counted in an automatic liquid scintillator.

Calculation of the results, the two sigma error and the lower limit detection (LLD) in pCi/L:

RESULT = $(N-B)/(2.22\ V\ E)$

TWO SIGMA ERROR = $2((N + B)/\Delta t)^{1/2} / (2.22\ V\ E)$

LLD = $4.66(B/\Delta t)^{1/2}/(2.22\ V\ E)$

where:

N	=	the gross cpm of the sample
B	=	the background of the detector in cpm
2.22	=	conversion factor changing dpm to pCi
V	=	volume of the sample in ml
E	=	efficiency of the detector
Δt	=	counting time for the sample

ANALYSIS OF SAMPLES FOR STRONTIUM-89 AND -90

Water

Stable strontium carrier is added to 1 liter of sample and the volume is reduced by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using nitric acid. A barium scavenge and an iron (ferric hydroxide) scavenge are performed followed by addition of stable yttrium carrier and a minimum of 5 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Milk

Stable strontium carrier is added to 1 liter of sample and the sample is first evaporated, then ashed in a muffle furnace. The ash is dissolved and strontium is precipitated as phosphate, then is dissolved and precipitated as $SrNO_3$ using fuming (90%) nitric acid. A barium chromate scavenge and an iron (ferric hydroxide) scavenge are then performed. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and then re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Soil and Sediment

The sample is first dried under heat lamps and an aliquot is taken. Stable strontium carrier is added and the sample is leached in hydrochloric acid. The mixture is filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. A barium chromate scavenge and an iron (ferric hydroxide) scavenge are then performed. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Organic Solids

A wet portion of the sample is dried and then ashed in a muffle furnace. Stable strontium carrier is added and the ash is leached in hydrochloric acid. The sample is

filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. An iron (ferric hydroxide) scavenge is performed, followed by addition of stable yttrium carrier and a minimum of 5 days period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is counted on a nylon planchette and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Air Particulates

Stable strontium carrier is added to the sample and it is leached in nitric acid to bring deposits into solution. The mixture is then filtered and the filtrate is reduced in volume by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. A barium scavenge is used to remove some interfering species. An iron (ferric hydroxide) scavenge is performed, followed by addition of stable yttrium carrier and a 7 to 10 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is counted on a nylon planchette and is covered with 80 mg/cm^2 aluminum absorber for low level beta counting.

Calculations of the result, two sigma errors and lower limits of detection (LLD) are expressed in activity of pCi/volume or pCi/mass:

RESULT Sr-89 = $(N/\Delta t - B_C - B_A)/(2.22\ V\ Y_S\ DF_{SR\text{-}89} E_{SR\text{-}89})$

TWO SIGMA ERROR Sr-89 = $2(N/\Delta t + B_C + B_A)/\Delta t)^{1/2}/(2.22\ V\ Y_S DF_{SR\text{-}89} E_{SR\text{-}89})$

LLD Sr-89 = $4.66(B_C + B_A)/\Delta t)^{1/2}/(2.22\ V\ Y_S DF_{SR\text{-}89} E_{SR\text{-}89})$

RESULT Sr-90 = $(N/\Delta t - B)/(2.22\ V\ Y_1\ Y_2\ DF\ IF\ E)$

TWO SIGMA ERROR Sr-90 = $2(N/\Delta t + B)/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ DF\ E\ IF)$

LLD Sr-90 = $4.66(B/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ IF\ DF\ E)$

Where :

N	=	total counts from sample
Δt	=	counting time for sample (min)
B_C	=	background rate of counter (cpm) using absorber configuration
2.22	=	dpm /pCi
V	=	volume or weight of sample analyzed
B_A	=	background addition from Sr-90 and ingrowth of Y-90
B_C	=	$0.016(K) + (K)\ E_Y/_{abs})(IG_{Y\text{-}90})$
Y_S	=	chemical yield of strontium
$E_{SR\text{-}89}$	=	efficiency of the counter for Sr-89 with the 80 mg/cm. q. aluminum absorber
K	=	$(N\Delta t\text{-}B_C)_{Y\text{-}90})/E_{Y\text{-}90}\ IF_{Y\text{-}90}\ DF_{Y\text{-}90}Y_1)$
$DF_{Y\text{-}90}$	=	the decay factor for Y-90 from the "milk" time to the mid count time
$E_{Y\text{-}90}$	=	efficiency of the counter for Y-90
$IF_{Y\text{-}90}$	=	ingrowth factor for Y-90 from scavenge time to milking time
$IG_{Y\text{-}90}$	=	the ingrowth factor for Y-90 into the strontium mount from the "milk" time to the mid count time
0.016	=	the efficiency of measuring Sr-90 through a No. 6 absorber
$EY/_{abs}$	=	the efficiency of counting Y-90 through a No. 6 absorber
B	=	background rate of counter (cpm)
Y_1	=	chemical yield of yttrium
Y_2	=	chemical yield of strontium
DF	=	decay factor of yttrium from the radiochemical milking time to the mid count time
IF	=	ingrowth factor for Y-90 from scavenge time to the radiochemical milking time

ANALYSIS OF SAMPLES FOR IODINE-131

Milk or Water

Two liters of sample are first equilibrated with stable iodide carrier. A batch treatment with anion exchange resin is used to remove iodine from the sample. The iodine is then stripped from the resin with sodium hypochlorite solution, is reduced with hydroxylamine hydrochloride and is extracted into carbon tetrachloride as free iodine. It is then back-extracted as iodide into sodium bisulfite solution and is precipitated as palladium iodide. The sodium bisulfite solution and is precipitated as palladium iodide. The precipitate is weighed for chemical yield and is mounted on a nylon planchette for low level beta counting. The chemical yield is corrected by measuring the stable iodide content of the milk or the water with a specific ion electrode.

Calculations of results, two sigma error and the lower limit of detection (LLD) in pCi/L:

RESULT		=	$(N/\Delta t - B)/(2.22\ E\ V\ Y\ DF)$
TWO SIGMA ERROR		=	$2((N/\Delta t + B)/\Delta t)^{1/2}/(2.22\ E\ V\ Y\ DF)$
LLD		=	$4.66(B/\Delta t)^{1/2}/(2.22\ E\ V\ Y\ DF)$
where:	N	=	total counts from sample (counts)
	Δt	=	counting time for sample (min)
	B	=	background rate of counter (cpm)
	2.22	=	dpm/pCi
	V	=	volume or weight of sample analyzed
	Y	=	chemical yield of the mount or sample counted
	DF	=	decay factor from the collection to the counting date
	E	=	efficiency of the counter for I-131, corrected for self absorption effects by the formula
	E	=	$E_s(\exp -0.0061M)/(\exp -0.0061M_s)$
	E_s	=	efficiency of the counter determined from an I-131 standard mount
	Ms	=	mass of PdI_2 on the standard mount, mg
	M	=	mass of PdI_2 on the sample mount, mg

GAMMA SPECTROMETRY OF SAMPLES

Milk and Water

A 1.0 liter Marinelli beaker is filled with a representative aliquot of the sample. The sample is then counted for approximately 1000 minutes with a shielded high purity germanium (HPGe) detector coupled to a VAX-based data acquisition system which performs pulse height analysis.

Dried Solids Other Than Soils and Sediments

A large quantity of the sample is dried at a low temperature, less than 100°C. As much as possible (up to the total sample) is loaded into a tared 1-liter Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded HPGe detector coupled to a VAX-based data acquisition system which performs pulse height analysis.

Fish

As much as possible (up to the total sample) of the edible portion of the sample is loaded into a tared Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded HPGe detector coupled to a VAX-based data acquisition system which performs pulse height analysis.

Soils and Sediments

Soils and sediments are dried at a low temperature, less than 100°C. The soil or sediment is loaded fully into a tared, standard 300 cc container and weighed. The sample is then counted for approximately six hours with a shielded HPGe detector coupled to a VAX-based data acquisition system which performs pulse height and analysis.

Charcoal Cartridges (Air Iodine)

Charcoal cartridges are counted up to five at a time, with one positioned on the face of a HPGe detector and up to four on the side of the HPGe detector. Each HPGe detector is calibrated for both positions. The detection limit for I-131 of each charcoal cartridge can be determined (assuming no positive I-131) uniquely from the volume of air which passed through it. In the event I-131 is observed in the initial counting of a set, each charcoal cartridge is then counted separately, positioned on the face of the detector.

Air Particulate

The thirteen airborne particulate filters for a quarterly composite for each field station are aligned one in front of another and then counted for at least six hours with a shielded HPGe detector coupled to a VAX-based data acquisition system which performs pulse height analysis.

A VAX software program defines peaks by certain changes in the slope of the spectrum. The program also compares the energy of each peak with a library of peaks for isotope identification and then performs the radioactivity calculation using the appropriate fractional gamma ray abundance, half life, detector efficiency, and net counts in the peak region.

The calculation of results, two sigma error and the lower limit of detection (LLD) in pCi/volume of pCi/mass:

$$\text{RESULT} = (S-B)/(2.22\ t\ E\ V\ F\ DF)$$

$$\text{TWO SIGMA ERROR} = 2(S+B)^{1/2}/(2.22\ t\ E\ V\ F\ DF)$$

$$\text{LLD} = 4.66(B)^{1/2}/(2.22\ t\ E\ V\ F\ DF)$$

where:

S	=	Area, in counts, of sample peak and background (region of spectrum of interest)
B	=	Background area, in counts, under sample peak, determined by a linear interpolation of the representative backgrounds on either side of the peak
t	=	length of time in minutes the sample was counted
2.22	=	dpm/pCi
E	=	detector efficiency for energy of interest and geometry of sample
V	=	sample aliquot size (liters, cubic meters, kilograms, or grams)
F	=	fractional gamma abundance (specific for each emitted gamma)
DF	=	decay factor from the mid-collection date to the counting date

ADDENDUM TO GAMMA SPEC PROCEDURE

Ba-140 (half-life =~12.8d) decays to LA-140 (half-life ~40 hrs) and the daughter radionuclide, La-140 approaches ~ 90 % of the Ba-140 activity within ~ 6 days. The La-140 photon energy at 1596 KeV is used to quantify the Ba-140 activity due to its high photon emission probability yield (96%) producing a higher count rate when present and therefore, a smaller associated counting error.

Zr-95 (half-life = ~65d) decays to Nb-95 (half-life = ~35d). The photon energy of Nb-95 (~765 KeV) is used to quantify Zr-95 because of the high photon emission probability yield (~100%) yielding a higher count rate and an associated lower counting error. The daughter radionuclide, Nb-95 approaches the Zr-95 activity after a time period of ~65 days, an estimated time interval occurring between sample exposure, collection and shipping, and analysis.

Environmental Dosimetry

Teledyne Brown Engineering out-sources its environmental Dosimetry services to Proxtronics Dosimetry LLC, a Wholly Owned Subsidiary of Proxtronics, Inc. Proxtronics uses a thermo luminescent dosimeter (TLD) manufactured by Panasonic, Inc. Panasonic identifies it as an UD-814 TLD. The TLD has four elements, numbered 1-4. Elements and their filtration are composed of:

ELEMENT	MATERIAL	FILTRATION
1	$^{n}Li_2{}^{n}B_4O_7$-Cu	Thin plastic
2	$CaSo_4$-Tm	Plastic
3	$CaSo_4$-Tm/Pb	Lead
4	$CaSo_4$-Tm/Pb	Lead

This material has a high light output, negligible thermally induced signal loss (fading) and negligible self-dosing. The energy response curve (as well as other features) satisfies NRC Regulatory Guide 4.13. Transit doses are accounted for by use of separate TLDs.

Prior to being sent to Teledyne brown, the Proxtronics badges are exposed to Cs-137, to a known dose and read in the Panasonic UD-710ARreader, with reference badges to establish an element response level for each badge. Badges are then re-annealed for assignment and distribution to Teledyne Brown.

Following the field exposure the badges are returned to Proxtronics for processing in a Panasonic UD-710 Reader. Each element is heated and the measured light emission is recorded. The transit controls are read in the same manner.

Transit Controls are calculated using the following equation:

$$\text{TRANSDOSE} = \left[\frac{(E3_1 + E4_1 + E3_2 + E4_2)}{4}\right] - \left[\frac{(E3_{trans} + Ee4_{trans})}{2}\right]$$

All dose is reported as "mR/standard month" using the following equation to calculate:

Net Exposure ÷ 90 Days X 30.44 Days + $^{\text{Net Exposure}}/_{\text{Standard Month}}$

LLD FORMULAS

The LLD formulas in Section C are consistent with the LLD discussion in the ODAM. The term s_b in the ODAM equals $\sqrt{B}/t$ by Poisson statistics, where B = blank counts and t = blank counting intervals. The decay factor term $e^{-\lambda\Delta t}$ in the ODAM is the same as the DF terms in Section C, but does not appear in certain analyses such as gross beta because decay does not apply. In the tritium analysis, decay is not considered because of the relatively long half-life.

Efficiencies and volumes are consistent between the two documents, Chemical yields appear in Section C where applicable but do not apply to other analyses such as tritium and gross beta.

APPENDIX D
DETECTION LIMITS AND REPORTING LEVELS

NEBRASKA PUBLIC POWER - COOPER NUCLEAR STATION
DETECTION LIMITS AND REPORTING LEVELS

Isotope	ODAM LLD	Rept. Level
Water - pCi/liter		
Gross beta	4	
H-3	2000	6700
Mn-54	15	330
Fe-59	30	130
Co-58	15	330
Co-60	15	100
Zn-65	30	100
Zr-95	30	130
Nb-95	15	130
I-131	1[(c)]	1
Cs-134	15	15
Cs-137	18	18
Ba-140	60	67
La-140	15	67
Air Filter - pCi/m^3		
Gross Beta	0.01	N/A
I-131	0.07	0.3
Cs-134	0.05	3.3
Cs-137	0.06	6.7
Fish - pCi/kg-wet		
Mn-54	130	10000
Fe-59	260	3300
Co-58	130	10000
Co-60	130	3300
Zn-65	260	6700
Cs-134	130	330
Cs-137	150	670
Milk - pCi/liter		
I-131	1	
Cs-134	15	
Cs-137	18	
Ba-140	60	
La-140	15	

(c) LLD for drinking water

NEBRASKA PUBLIC POWER - COOPER NUCLEAR STATION
DETECTION LIMITS AND REPORTING LEVELS

Isotope	ODAM LLD	Rept. Level
Vegetation - pCi/kg-wet		
I-131	60	
Cs-134	60	
Cs-137	80	
Sediment - pCi/kg-dry		
Cs-134	150	
Cs-137	180	

APPENDIX E
REMP SAMPLING AND ANALYTICAL EXCEPTIONS

EXCEPTIONS

Appendix E contains the exceptions to the 2002 REMP Program. Where possible, causes of the deviation have been corrected to prevent recurrence. Several samples were unavailable due to seasonal unavailability. A number of samples were held by the laboratory for a long period of time before they were analyzed. NRC Regulatory Guide 4.1 Section C., Subsection b., states, "When a radionuclide with an intermediate half-life (weeks to months) is released continuously or frequently, sampling and analysis of environmental media in the associated pathway should generally be carried out at intervals no greater than two or three half-lives of the nuclide.

All deviations from the sampling schedule have been documented on the data tables. Data Tables are in Section VII

Exceptions for Scheduled REMP Sampling and Analysis During 2002, NPPD Cooper Nuclear Station

Station(s)	Pathway	Sample	Collection Period	Exception/Reason	Actions Taken and Replacement Samples, Where Applicable
89	Ambient Gamma	TLD	4/4/02 - 7/10/02	Sample Badge Missing	TLD's for next sampling period were placed at sites; no further action necessary.
12, 28	Aquatic	River Water	01/02/02	Sample not taken due ice conditions on the river.	Regular sampling resumed when conditions allowed; no further action necessary.
99	Ingestion	Milk - Other Producer	01/22/02	Provider didn't have sample available on original sample date.	Collected sample 2 weeks later, no further action necessary.

APPENDIX F
SUMMARY OF DOSES TO A MEMBER OF THE PUBLIC OFF-SITE

Summary of Doses to Maximum Individual at the Site Boundary, Resulting from Exposure to Radioactivity Discharged in Liquid Effluents, January-December 2002, Cooper Nuclear Station

Period and Pathway	Dose to Individual, mrem							
	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
1st Quarter	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
2nd Quarter	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
3rd Quarter	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
4th Quarter	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
Totals for 2002	**0.00 E+00**	**0.00 E+00**	**0.00 E+00**	**0.00 E+00**	**0.00 E+00**	**0.00 E+00**	**0.00 E+00**	**0.00 E+00**

Summary of Gaseous Effluent Dose Calculations

DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2002

SPECIAL LOCATION NO. 1 A Site Boundary
AT .69 MILES NNW

ANNUAL BETA AIR DOSE = 3.70E-01 MILLRADS
ANNUAL GAMMA AIR DOSE = 5.65E-01 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.76E-01	3.76E-01	3.76E-01	3.76E-01	3.76E-01	3.76E-01	3.80E-01	7.17E-01
GROUND	4.84E-03	4.84E-03	4.84E-03	4.84E-03	4.84E-03	4.84E-03	4.84E-03	5.69E-03
VEGET								
ADULT	4.37E-04	1.91E-03	1.07E-02	1.87E-04	1.20E-04	1.58E-02	1.17E-05	0.00E+00
TEEN	6.33E-04	2.25E-03	1.66E-02	2.93E-04	1.84E-04	2.13E-02	2.18E-05	0.00E+00
CHILD	1.33E-03	1.69E-03	3.84E-02	4.91E-04	2.98E-04	4.08E-02	3.32E-05	0.00E+00
MEAT								
ADULT	2.79E-05	1.85E-04	1.20E-04	1.83E-05	5.36E-06	4.25E-04	9.50E-07	0.00E+00
TEEN	2.01E-05	1.02E-04	9.43E-05	1.45E-05	4.37E-06	3.08E-04	8.99E-07	0.00E+00
CHILD	2.93E-05	5.31E-05	1.68E-04	1.83E-05	5.55E-06	4.65E-04	1.06E-06	0.00E+00
COW MILK								
ADULT	8.40E-05	1.05E-04	5.64E-04	1.10E-04	8.71E-05	1.19E-02	8.03E-06	0.00E+00
TEEN	1.07E-04	1.36E-04	9.79E-04	1.94E-04	1.55E-04	1.88E-02	1.66E-05	0.00E+00
CHILD	1.62E-04	1.03E-04	2.30E-03	3.36E-04	2.58E-04	3.71E-02	2.55E-05	0.00E+00
INFANT	2.64E-04	1.00E-04	3.89E-03	7.13E-04	4.39E-04	9.02E-02	4.61E-05	0.00E+00
GOATMILK								
ADULT	1.91E-04	1.34E-04	1.20E-03	2.58E-04	1.48E-04	1.42E-02	2.41E-05	0.00E+00
TEEN	2.19E-04	1.82E-04	2.09E-03	4.55E-04	2.63E-04	2.25E-02	4.98E-05	0.00E+00
CHILD	2.82E-04	1.45E-04	4.92E-03	7.89E-04	4.36E-04	4.46E-02	7.65E-05	0.00E+00
INFANT	4.25E-04	1.46E-04	8.25E-03	1.61E-03	7.31E-04	1.08E-01	1.38E-04	0.00E+00
INHAL								
ADULT	4.55E-06	3.47E-05	4.77E-05	6.51E-06	7.54E-06	9.08E-04	3.63E-04	0.00E+00
TEEN	5.65E-06	5.96E-05	5.92E-05	8.93E-06	1.04E-05	1.14E-03	5.52E-04	0.00E+00
CHILD	6.27E-06	2.67E-04	7.36E-05	8.69E-06	9.76E-06	1.33E-03	4.59E-04	0.00E+00
INFANT	3.92E-06	2.30E-04	3.81E-05	7.50E-06	6.37E-06	1.22E-03	3.31E-04	0.00E+00

Summary of Gaseous Effluent Dose Calculations

DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2002 (CONTINUED)

SPECIAL LOCATION NO. 2 A Site Boundary
AT .67 MILES N

ANNUAL BETA AIR DOSE = 4.84E-01 MILLRADS
ANNUAL GAMMA AIR DOSE = 7.39E-01 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.91E-01	4.91E-01	4.91E-01	4.91E-01	4.91E-01	4.91E-01	4.96E-01	9.38E-01
GROUND	7.83E-03	7.83E-03	7.83E-03	7.83E-03	7.83E-03	7.83E-03	7.83E-03	9.21E-03
VEGET								
ADULT	7.21E-04	3.16E-03	1.77E-02	3.09E-04	1.97E-04	2.59E-02	1.93E-05	0.00E+00
TEEN	1.04E-03	3.72E-03	2.75E-02	4.82E-04	3.03E-04	3.49E-02	3.62E-05	0.00E+00
CHILD	2.20E-03	2.80E-03	6.36E-02	8.08E-04	4.91E-04	6.69E-02	5.51E-05	0.00E+00
MEAT								
ADULT	4.55E-05	3.01E-04	1.99E-04	2.99E-05	8.87E-06	6.97E-04	1.58E-06	0.00E+00
TEEN	3.27E-05	1.65E-04	1.56E-04	2.37E-05	7.22E-06	5.05E-04	1.49E-06	0.00E+00
CHILD	4.77E-05	8.64E-05	2.78E-04	3.00E-05	9.18E-06	7.62E-04	1.75E-06	0.00E+00
COW MILK								
ADULT	1.39E-04	1.72E-04	9.32E-04	1.81E-04	1.43E-04	1.94E-02	1.33E-05	0.00E+00
TEEN	1.77E-04	2.24E-04	1.62E-03	3.20E-04	2.55E-04	3.08E-02	2.75E-05	0.00E+00
CHILD	2.67E-04	1.71E-04	3.82E-03	5.55E-04	4.24E-04	6.09E-02	4.23E-05	0.00E+00
INFANT	4.36E-04	1.66E-04	6.46E-03	1.18E-03	7.22E-04	1.48E-01	7.66E-05	0.00E+00
GOATMILK								
ADULT	3.17E-04	2.23E-04	1.99E-03	4.27E-04	2.44E-04	2.33E-02	4.00E-05	0.00E+00
TEEN	3.62E-04	3.02E-04	3.46E-03	7.54E-04	4.33E-04	3.69E-02	8.26E-05	0.00E+00
CHILD	4.67E-04	2.42E-04	8.16E-03	1.31E-03	7.20E-04	7.31E-02	1.27E-04	0.00E+00
INFANT	7.03E-04	2.43E-04	1.37E-02	2.66E-03	1.21E-03	1.78E-01	2.30E-04	0.00E+00
INHAL								
ADULT	5.80E-06	4.38E-05	5.99E-05	8.35E-06	9.69E-06	1.16E-03	4.55E-04	0.00E+00
TEEN	7.21E-06	7.51E-05	7.44E-05	1.15E-05	1.34E-05	1.46E-03	6.92E-04	0.00E+00
CHILD	8.00E-06	3.36E-04	9.25E-05	1.11E-05	1.25E-05	1.70E-03	5.76E-04	0.00E+00
INFANT	5.01E-06	2.90E-04	4.80E-05	9.64E-06	8.18E-06	1.56E-03	4.15E-04	0.00E+00

Summary of Gaseous Effluent Dose Calculations

DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2002 (CONTINUED)

SPECIAL LOCATION NO. 3 A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 1.16E-01 MILLRADS
ANNUAL GAMMA AIR DOSE = 1.69E-01 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.13E-01	1.13E-01	1.13E-01	1.13E-01	1.13E-01	1.13E-01	1.14E-01	2.21E-01
GROUND	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	1.84E-03	2.17E-03
VEGET								
ADULT	2.60E-04	1.16E-03	6.58E-03	1.08E-04	6.81E-05	8.40E-03	7.79E-06	0.00E+00
TEEN	3.79E-04	1.39E-03	1.04E-02	1.69E-04	1.05E-04	1.13E-02	1.46E-05	0.00E+00
CHILD	8.09E-04	1.07E-03	2.46E-02	2.85E-04	1.71E-04	2.17E-02	2.22E-05	0.00E+00
MEAT								
ADULT	1.28E-05	7.87E-05	7.31E-05	9.43E-06	3.33E-06	2.26E-04	6.35E-07	0.00E+00
TEEN	8.82E-06	4.41E-05	5.86E-05	7.52E-06	2.71E-06	1.64E-04	6.01E-07	0.00E+00
CHILD	1.25E-05	2.36E-05	1.06E-04	9.64E-06	3.45E-06	2.47E-04	7.06E-07	0.00E+00
COW MILK								
ADULT	5.17E-05	6.10E-05	3.49E-04	6.77E-05	4.96E-05	6.30E-03	5.36E-06	0.00E+00
TEEN	6.45E-05	8.07E-05	6.17E-04	1.20E-04	8.82E-05	9.97E-03	1.11E-05	0.00E+00
CHILD	9.51E-05	6.27E-05	1.48E-03	2.07E-04	1.46E-04	1.97E-02	1.70E-05	0.00E+00
INFANT	1.55E-04	6.17E-05	2.59E-03	4.35E-04	2.49E-04	4.80E-02	3.08E-05	0.00E+00
GOATMILK								
ADULT	1.23E-04	9.10E-05	7.48E-04	1.66E-04	8.85E-05	7.56E-03	1.61E-05	0.00E+00
TEEN	1.40E-04	1.24E-04	1.32E-03	2.93E-04	1.57E-04	1.20E-02	3.32E-05	0.00E+00
CHILD	1.77E-04	9.93E-05	3.17E-03	5.08E-04	2.61E-04	2.37E-02	5.11E-05	0.00E+00
INFANT	2.67E-04	9.98E-05	5.51E-03	1.03E-03	4.35E-04	5.75E-02	9.24E-05	0.00E+00
INHAL								
ADULT	2.54E-06	1.63E-05	1.70E-05	4.12E-06	3.98E-06	2.90E-04	1.16E-04	0.00E+00
TEEN	3.28E-06	2.82E-05	2.18E-05	5.67E-06	5.48E-06	3.64E-04	1.80E-04	0.00E+00
CHILD	3.82E-06	1.19E-04	2.78E-05	5.55E-06	5.15E-06	4.23E-04	1.51E-04	0.00E+00
INFANT	2.57E-06	1.04E-04	1.58E-05	4.96E-06	3.37E-06	3.88E-04	1.16E-04	0.00E+00

APPENDIX G
REMP SAMPLE STATION DESCRIPTIONS

REMP SAMPLE STATION DESCRIPTIONS

The following pages contain descriptions of the CNS REMP Sample Stations that were active or were used for part or all of 2002. There were no changes to the CNS REMP Sample Stations from the previous year.

REMP SAMPLE STATION DESCRIPTIONS
SAMPLE TYPES AND SAMPLE LOCATIONS

Sample Station (a)	Sample Description – Type and Location
No. 1	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Outside the northwest edge of fence, east of the gate to the LLRW storage pad on the CNS site, NW ¼, S32, T5N, R16E, Nemaha County, Nebraska.
No. 2	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: North side of county road to the south portion of CNS site, SW ¼, S32, T5N, R16E, Nemaha County, Nebraska.
No. 3	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Located on the north side of the Brownsville State Recreation Park access road near water gauging station, SE ¼, S18, T5N, R16E, Nemaha County, Nebraska.
No. 4	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Located ½ mile south of Phelps City, Missouri, on west side of highway "U", NE ¼, S2, T64N, R42W, Atchison County, Missouri.
No. 5	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Located ¼ mile south and ¼ mile east of Langdon, Missouri, on north side of road, west of railroad tracks, SW ¼, T64N, R41W, Atchison County, Missouri.
No. 6	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: One mile west of the end of Missouri State Highway "U", SW corner of the intersection, NW ¼, S34, T64N, R42W, Atchison County, Missouri

NOTES:
(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample Station	Sample Description – Type and Location
No 7	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: 300 yards east of Highway 67 on north side of road, SW ¼, S6, T4N, R16E, Nemaha, Nebraska.
No. 8	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: ½ mile north, ¾ mile west and ¾ mile north of Nemaha, on west side of road adjacent to transmission line, NE ¼, S35, T5N, R15E, Nemaha County, Nebraska.
No. 9	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Four miles north of Highway 136, on Highway 67. Then 1 mile east of Highway 67 and ½ mile north on west side of road, SW ¼, S26, T6N, R15E, Nemaha County, Nebraska.
No. 10	Type (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: One mile north of Barada, Nebraska, in SW corner of intersection, NE ¼, S14, T3N, R16E, Richardson County, Nebraska.
No. 11	Type: (1) Water – Ground Location: Plant well water supply header at well pits, NW ¼, S32, T5N, R16E, Nemaha County, Nebraska.
No. 12	Type: (1) Water – River Location: Sample (1) taken from the Missouri River immediately upstream form the Plant Intake Structure (River Mile 532.5). During periods when unsafe conditions warrant, Station 35 may be used as an alternate upstream collection site.

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample Station	Sample Description – Type and Location
No.20	Type: (1) Environmental Thermoluminescent Dosimetry Location: On NNW boundary of NPPD property, east side of county road, SE , S30, T5N, R16E, Nemaha County, Nebraska.
No.28	Type (1) Water – River, (2) Fish (3) Sediment from Shoreline (4) Food Products – Broadleaf Vegetation Location: Samples (1), (3), and (4) are taken from the Missouri River or its shore downstream near River Mile 530, Sample (2) is taken from the Missouri River ½ to 3 miles downstream of the plant site.
No. 35	Type (1) Fish (2) Water – River (Alternate Site) (3) Food Products – Broadleaf Vegetation Location: Sample (1) will be taken from the Missouri River about 1 to 3 miles above the CNS intake structure. During periods when unsafe conditions warrant, Station 35 may be used as an alternate to Station 12 (upstream collection site) for sample type (2). Sample (3) is taken about ¼ mile south of the Brownville State Recreation Area in Sector A.
No. 42	Type: (1) Milk – Other Producer Location: One mile south, 1 ¼ miles east of Barada, Nebraska, south side of county road, NW ¼, S30, T3N, R17E, Richardson County, Nebraska.
No. 44	Type: (1) Environmental Thermoluminescent Dosimetry Location: ¼ mile south of Auburn Country Club on Highway 75, then ½ mile east of Highway 75 at fence line north of county road, SE1/4, S27, T5N, R14E, Nemaha County, Nebraska.
No. 47	Type: (1) Water – Ground Location: At Falls City Municipal water supply well

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample Station	Sample Description – Type and Location
No. 56	Type: (1) Environmental Thermoluminescent Dosimetry Location: 1 ¼ miles SW of Langdon, Missouri, on Highway "U", on the right side of the highway, NW ¼, S23, T64N, R42W, Atchison County, Missouri.
No. 58	Type: (1) Environmental Thermoluminescent Dosimetry Location: Three miles south of Brownville, Nebraska, on county road, at the SE corner of the intersection with the farm road leading to Sample Station No. 2, SE1/4, S31, T5N, R16E, Nemaha County, Nebraska.
No. 59	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile SSE of the CNS Elevated Release Point, in the vicinity of the levee at the south boundary of NPPD property, SE ¼, S32, T5N, R16E, Nemaha County, Nebraska.
No. 61	Type (1) Milk – Nearest Producer Location: One mile west of Brownville, Nebraska, on Highway 136, then 1 mile north on the county road, turn right and proceed approximately ½ mile east on south side of road, NW1/4, S13, T5N, R15E, Nemaha County, Nebraska.
No. 66	Type: (1) Environmental Thermoluminescent Dosimetry Location: Two miles south of Nemaha, Nebraska, on Highway 67 – east side of road, NW1/4, S19, T4N, R16E, Nemaha County, Nebraska.
No. 67	Type: (1) Environmental Thermoluminescent Dosimetry Location: 2 miles west of Brownville, Nebraska, on Highway 136, then north 1 ½ miles on county road and east ½ mile, on north side of road, NE1/4, S11, T5N, R15E, Nemaha County, Nebraska.Sample

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample Station	Sample Description – Type and Location
No. 71	Type: (1) Environmental Thermoluminescent Dosimetry
	Location: Two miles east of Phelps City, Missouri, on Highway 36, then south 1 ½ miles on county road and west ¼ mile, SE1/4, S6, T64N, R41W, Atchison County, Missouri.
No. 79	Type: (1) Environmental Thermoluminescent Dosimetry
	Location: 1 7/8 miles south of Brownville, NE, on east side of paved road, NPPD property, SE1/4, S30, T5N, R16E, Nemaha County, Nebraska.
No. 80	Type: (1) Environmental Thermoluminescent Dosimetry
	Location: 2 1/8 miles south of Brownville, on east side of paved road, NPPD property, NE1/4, S31, T5N, R16E, Nemaha County, Nebraska.
No. 81	Type: (1) Environmental Thermoluminescent Dosimetry
	Location: 2 3/8 miles south of Brownville, Nebraska, in the NE corner of the intersection of the paved county road and CNS access road, NPPD property, NE1/4, S31, T5N, R16E, Nemaha County, Nebraska.
No. 82	Type: (1) Environmental Thermoluminescent Dosimetry
	Location: 7/8 mile south of CNS in a field, on NPPD property, SW1/4, S32, T5N, R16E, Nemaha County, Nebraska.
No. 83	Type: (1) Environmental Thermoluminescent Dosimetry
	Location: 2 ¼ miles south of Nemaha, Nebraska, on Highway 67, then east 1 mile to the junction of the driveway and county road (east side of drive), NE1/4, S19, T4N, R16E, Nemaha County, Nebraska.
No. 84	Type: (1) Environmental Thermoluminescent Dosimetry
	Location: 2 ½ miles west of Brownville, NE, south side of Highway 136 west of Locust Grove School, NW1/4, S22, T5N, R15E, Nemaha County, Nebraska.Sample

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample Station	Sample Description – Type and Location
No. 85	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile east of Brownville, Nebraska, on Highway 136, then north ¼ mile on the east side of the county road, NE1/4, S33, T65N, R42W, Atchison County, Missouri.
No. 86	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile west of Phelps City, Missouri, on Highway 136, then north 1 ½ miles on Highway "D" on west side, SE1/4, S22, T65N, R42W, Atchison County, Missouri.
No. 87	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile west of Phelps City, Missouri, on Highway 136, then south ½ mile on county road and ¾ mile west on county road to the end of the road, NW1/4, S3, T64N, R42W, Atchison County, Missouri.
No. 88	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile west of Phelps City, Missouri, on Highway 136, then south 2 miles at the end of the county road, NW1/4, S11, T64N, R42W, Atchison County, Missouri.
No. 89	Type: (1) Environmental Thermoluminescent Dosimetry Location: 2 ½ miles south of Phelps City, Missouri, on Highway "U", then ½ mile west in the SE corner of the county road intersection, NE1/4, S14, T64N, R42W, Atchison County, Missouri.
No. 90	Type: (1) Environmental Thermoluminescent Dosimetry Location: 1 ½ miles west and ¾ mile south of Langdon, Missouri, on Highway "U", then ¼ mile west, SW1/4, S23, T64N, R42W, Atchison County, Missouri Sample

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample Station	Sample Description – Type and Location
No. 91	Type: (1) Environmental Thermoluminescent Dosimetry Location: ½ mile west of Rockport, Missouri,on the south side of the intersection of U.S. Highway 136 and U.S. Highway 275, at the south side of the water tower, NW1/4, S28, T65N, R41W, Atchison County, Missouri.
No. 94	Type: (1) Environmental Thermoluminescent Dosimetry Location: ¼ mile of Langdon, Missouri, on the west side of the road, NE1/4, S24, T64N, R42W, Atchison County, Missouri.
No. 96	Type: (1) Food products – Broadleaf Vegetation Location: Approximately 1 mile south of Brownville, Nebraska, along the paved road, in the road ditch in Sector R, SW1/4, S19, T5N, R16E, Nemaha County, Nebraska.
No. 99	Type: (1) Milk (Nearest and Other Producer) Location: 1 ¼ mile south of Shubert, Nebraska, on the west side of Highway 67, NE1/4, S24, T3N, R15E, Richardson County, Nebraska.
No. 100	Type (1) Milk (Other Producer) Location: Two miles south and 1 mile west of Shubert, Nebraska, SW1/4, S23, T3N, R15E, Richardson County, Nebraska.
No. 101	Type: (1) Food Products – Broadleaf Vegetation Location: 5 ½ miles east and ½ mile north of Rock Port, Missouri, near the junction of Highway 136 and Highway 59, in Sector D, encompasses portions of several sections, Athison County, Missouri.

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.