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CONCENTRATIONS OF FISSION PRODUCT NOBLE GASES RELEASED DURING THE NP-MHTGR FUEL COMPACT EXPERIMENT-1A vol. 1

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Idaho National Laboratory

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April 1992

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Organization: Physics and Mathematics

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SUMMARY

This report presents the results of gamma-ray spectrometry measurements of the concentrations of fission product noble gases released from New Production- Modular High Temperature Gas-cooled Reactor (NP-MHTGR) fuel compacts during their irradiation in the Advanced Test Reactor (ATR) at the Idaho National Engineering Laboratory. The fuel performance test, known as the NPR-1A Fuel Test, was conducted at the ATR between September 1991 and January 1992. A primary objective of the NPR-1A Fuel Test was to quantify the release-rate to birth-rate ratios of the following 12 noble gases: ^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{89}Kr, ^{90}Kr, ^{131m}Xe, ^{133}Xe, ^{135m}Xe, ^{135}Xe, ^{137}Xe, ^{138}Xe, and ^{139}Xe. The release-rate to birth-rate ratios and other experimental data will be used to determine how well the fuel performed under conditions bounding NP-MHTGR operating conditions.

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ACRONYMS

AIM	acquisition interface module
ATR	Advanced Test Reactor
BR	branching ratio, fraction of radioactive decays resulting in the emission of a specific gamma ray
DMP	data management plan
DRC	Data Review Committee
DOE	U.S. Department of Energy
FPMS	fission product measurement system
ICPP	Idaho Chemical Processing Plant
INEL	Idaho National Engineering Laboratory
MCA	multichannel analyzer
MCS	multichannel scaling or scaler
MHTGR	Modular High-Temperature Gas-Cooled Reactor
NIST	National Institute of Standards and Technology
NPR	New Production Reactor
NP-MHTGR	New Production- Modular High-Temperature Gas-cooled Reactor
QA	quality assurance
QC	quality control
R/B	release rate to birth rate ratio
RML	Radiation Measurements Laboratory
TRA	Test Reactor Area
TRISO	TRI- three materials; ISO- isotropic. Denotes a multilayer coating of carbon, pyrolytic carbon, and silicon carbide used to buffer and encapsulate MHTGR fuel kernels
UCO	uranium oxy-carbide
WINCO	Westinghouse Idaho Nuclear Company

CONCENTRATIONS OF FISSON PRODUCT NOBLE GASES RELEASED DURING THE NP-MHTGR FUEL COMPACT EXPERIMENT-1A

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1. INTRODUCTION

This report presents the experimentally determined concentrations of fission product noble gases released from New Production- Modular High Temperature Gas-cooled Reactor (NP-MHTGR) fuel compacts during their irradiation in the Advanced Test Reactor (ATR) at the Idaho National Engineering Laboratory (INEL). The NP-MHTGR fuel performance test, otherwise known as the NPR-1A Fuel Test, was conducted at the ATR between September 1991 and January 1992. The test objectives and experimental requirements for NPR-1A are defined in reference (1). A primary objective of the NPR-1A Fuel Test was to quantify the release-rate to birth-rate (R/B) ratios of the following 12 noble gases: ^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{89}Kr, ^{90}Kr, ^{131m}Xe, ^{133}Xe, ^{135m}Xe, ^{135}Xe, ^{137}Xe, ^{138}Xe, and ^{139}Xe. The R/B ratios and other experimental data will be used to estimate the number of fuel particles that failed during the test.

2. TEST DESCRIPTION

The NPR-1A Fuel Test was conducted in the ATR to measure the performance of NP-MHTGR fuel at design burnup conditions.[1] The fuel consisted of a carbonaceous matrix containing highly-enriched uranium oxy-carbide (UCO) microspheres, each buffered with carbon and encapsulated with silicon carbide and isotropic, pyrolytic carbon. The multilayer coating on each UCO microsphere is referred to as a TRISO coating and the consolidated collection of encapsulated UCO microspheres bonded together by a carbon matrix is referred to as a fuel compact. Between October 2, 1991 and January 3, 1992, an experiment train containing 72,200 TRISO-coated UCO microspheres in 20 compacts was irradiated in position B-5 of the ATR to ^{235}U burnups, fast neutron fluences, and temperatures bounding NP-MHTGR operating conditions.

A sweep gas system was used to control the fuel temperature by adjusting the relative amounts of helium and neon in the sweep gas. The sweep gas also continuously transported fission products released from the fuel compacts past a NaI(Tl) scintillation detector and high-resolution germanium gamma-ray spectrometer located in the 1B Cubicle outside the reactor primary shield wall and, when a gas grab sample was desired, through a grab sample station in the ATR Second Basement. The two on-line detectors and the grab sample station were the primary components of the fisson product measurement system (FPMS) used to measure fission product releases during the NPR-1A Fuel Test.[2]

The schematic presented in Figure 1 shows the path of the sweep gas transport line from the NPR-1A fuel compacts test capsule to the FPMS germanium and NaI(Tl) detectors in the 1B Cubicle and then on to the plant ventillation and exhaust system. The sweep gas transport line from the experiment bulkhead to the FPMS gamma-ray spectrometer consisted of 4.7 m of 1.4-mm id stainless steel tubing followed by 27.7 m of 3.0-mm id stainless steel tubing.[3] The time required for the carrier gas and fission products to travel from the top of the fuel compacts test capsule to the FPMS in the 1B Cubicle was calculated to be 7.89 minutes at a sweep gas flow rate of 60 cm^3/minute, which was the flow rate that was maintained during the test.[3]

As shown in Figure 1, an inline particulate filter was installed in the sweep gas effluent line between the test capsule and the germanium detector, a silver zeolite cartridge was installed between the grab sample station and the delay tank, and a second particulate filter was installed between the delay tank and the ventillation exhaust. The particulate filters were Swagelok NUPRO "F" Series inline filters that were each equipped with a 316 sintered stainless steel element having a rating of 0.5 micron. The silver zeolite cartridge was a RADeCO model GY-130.

The length of the carrier gas transport line and the placement of the inline particulate filter between the test capsule and the germanium detector brings attention to a complication that will have to be addressed when R/B ratios are calculated. The problem is that the noble gases of interest are produced both as direct fission products as well as through

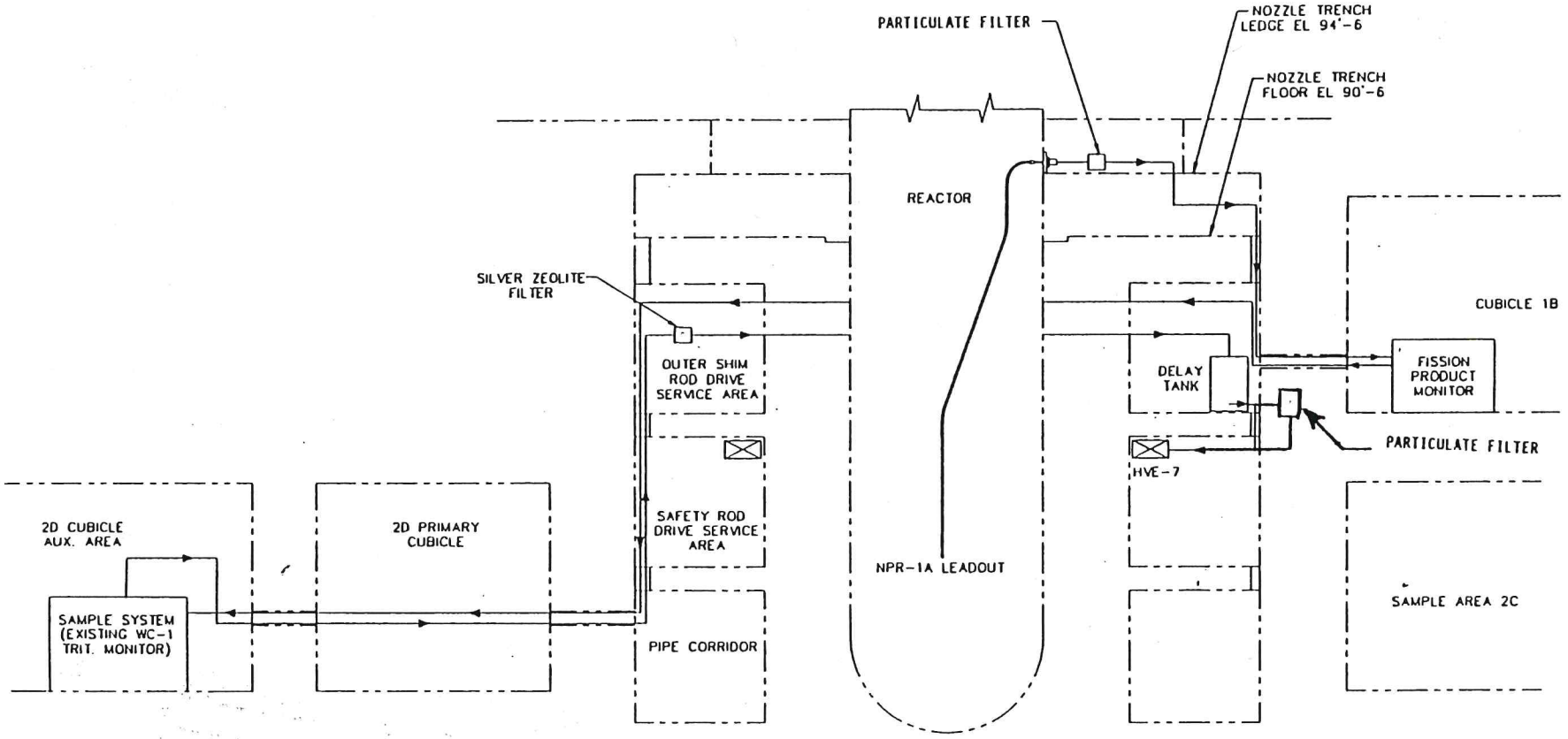


Figure 1. Schematic of carrrier gas transport line.

the decay of other direct fission products in their decay chains. For example, ^{85m}Kr is a direct fission product but is also produced as the result of the decay of isotopes in the decay chain ^{85}As -> ^{85}Se -> ^{85}Br -> ^{85m}Kr. Similarly, ^{135m}Xe is a direct fission product but is also produced as the result of the decay of isotopes in the decay chain ^{135}Sb -> ^{135}Te -> ^{135}I -> ^{135m}Xe. Because of their chemical nature, we can assume that some of the radioactive precursors of the noble gases released from the fuel compacts plated out on internal surfaces of the test capsule, experiment bulkhead, inline particulate filter, and carrier gas transport line. Telurium and the halogens I and Br are known to have a propensity to plate out on transport line surfaces. Consequently, for each noble gas isotope, a portion of the activity measured downstream at the location of the germanium spectrometer evolved from the decay of radioactive precursors that were deposited on internal surfaces of the sampling system.

In order to calculate R/B ratios for the noble gases, concentrations measured at the location of the FPMS germanium spectrometer must be decay-corrected to account for decay during the time of their transport from their point of origin to the germanium spectrometer. Therefore, in light of the previous discussion, a specific problem is to determine the appropriate decay time for each noble gas that will adequately take into account the fact that noble gases originated both in the fuel compacts and at locations on the transport line surfaces between the fuel compacts and the gamma-ray spectrometer.

The degree to which plate out affected noble gas concentrations at the location of the spectrometer was dependent upon the half-lives and relative fission yields of the noble gases and their radioactive precursors. The noble gases most affected are those that have a small independent fission yield relative to the cumulative chain yield and that have precursor half-lives that are long in relation to the expected capsule residence time for released species. The least affected noble gases will be those that derive a high percentage of their fission yield directly rather than through precursor decay, and that have short-lived precursors that might be expected to decay either during or promptly following their release from the fuel compacts.

The nuclear data was investigated in an attempt to define those noble gases that, depending on the degree of precursor release and plate out, could be strongly affected and those that were less affected by this phenomenon. The half-lives and independent and cumulative thermal neutron fission yields of the 12 noble gases of interest are summarized in Table 1. Also presented in Table 1 are the ratios of independent to cumulative fission yields and the radioactive precursors of the noble gases and the half-lives of the precursors.

The following examples are provided to help bound the problem. As shown in Table 1, ^{131m}Xe has virtually no independent fission yield (the ratio of ^{131m}Xe independent to cumulative yields is 2.2×10^{-5}) and thus derives almost entirely from the decay of 8.0-day ^{131}I. How this affected the concentrations of ^{131m}Xe measured at the location of the gamma-ray spectrometer is dependent upon what fraction of the ^{131}I released from the compacts plated out on internal surfaces prior to reaching the spectrometer. If a significant fraction of the ^{131}I released from the compacts did not plate out but was transported past the spectrometer, then the actual birth rate of ^{131m}Xe upstream of the spectrometer would clearly have been lower than that predicted assuming complete retention of ^{131}I in the compacts or on structural surfaces upstream of the spectrometer. If on the other hand, most of the ^{131}I released was retained upstream of the spectrometer, the point of birth of ^{131m}Xe along the transport line is for all practical purposes immaterial given the fact that the half-life of ^{131m}Xe is 11.9 days, a value much longer than the transport time from the compacts to the spectrometer (7.9 minutes).

As shown in Table 1, ^{85m}Kr, ^{87}Kr, ^{133}Xe, ^{135}Xe, and ^{135m}Xe also have relatively small independent fission yields compared to their respective cumulative fission yields. Of these nuclides, the one that is somewhat problematical is ^{135m}Xe because its half-life is so short (only about twice the transport time from the compacts to the spectrometer). Due to its relatively short half-life, the concentration of ^{135m}Xe measured at the location of the spectrometer was dependent upon the distribution of ^{135}I upstream of the spectrometer. If the vast majority of the ^{135}I was retained in the compacts or on surfaces very near the compacts, then

Table 1. Independent and cumulative fission yields of noble gases[4]

		Thermal Neutron Percent Yields		Ratio Ind. to Cumul.	Precursor	
Nuclide	Half-life	Indep.	Cumulat.	(%)	Nuclide	Half-life
^{85m}Kr	4.48 H	0.000383	1.309835	0.029	^{85}Br	2.87 M
^{87}Kr	76.31 M	0.458163	2.544100	18.01	^{87}Br	55.7 S
^{88}Kr	2.84 H	1.494261	3.612097	41.37	^{88}Br	16.7 S
^{89}Kr	3.16 M	3.449915	4.717969	73.12	^{89}Br	4.37 S
^{90}Kr	32.32 S	4.346554	5.046614	86.13	^{90}Br	1.92 S
^{131m}Xe	11.90 D	8.99E-07	0.040405	0.002	^{131}I	8.04 D
^{133}Xe	5.244 D	0.000722	6.703126	0.011	^{133}I	20.8 H
^{135m}Xe	15.65 M	0.158738	1.085621	14.62	^{135}I	6.55 H
^{135}Xe	9.104 H	0.091629	6.555696	1.40	^{135}I	6.55 H
^{137}Xe	3.818 M	2.722672	6.139336	44.35	^{137}I	24.5 S
^{138}Xe	14.08 M	4.806843	6.443254	74.60	^{138}I	6.4 S
^{139}Xe	39.68 S	4.631373	5.271605	87.86	^{139}I	2.29 S

^{135m}Xe activity produced through the decay of ^{135}I would have decayed about 7.9 minutes prior to reaching the spectrometer. If on the other hand, ^{135}I deposited uniformly along the carrier gas effluent line, then the effective decay time for ^{135m}Xe would have been only about one-half the transport time. Krypton-85m, ^{87}Kr, ^{133}Xe, and ^{135}Xe all have half-lives much longer than the transport time from the fuel compacts to the germanium spectrometer, so the distribution of their Br and I precursors upstream of the spectrometer was unimportant insofar as decay times are concerned. However, as was the case with ^{131m}Xe and ^{135m}Xe, the half-lives of the precursors of ^{133}Xe and ^{135}Xe are much longer than the transit time from the fuel compacts to the germanium spectrometer, so that the effective birth rates of these two nuclides were also dependent upon what fraction of their I precursors were retained upstream of the location of the gamma-ray spectrometer.

Six of the noble gases listed in Table 1 - ^{88}Kr, ^{89}Kr, ^{90}Kr, ^{137}Xe,

^{138}Xe, and ^{139}Xe - have independent fission yields that are greater than 40% of their respective cumulative yields and they also have very short-lived radioactive precursors. In the case of these 6 nuclides, the release and transport behavior of their Br or I precursors is not an important concern.

The concerns previously discussed regarding the effect of the deposition and transport behavior of the noble gas precursors on the noble gas concentrations measured at the location of the germanium spectrometer also apply to the concentrations measured by taking gas grab samples using the gas grab sampling system in the ATR Second Basement. The transport time from the fuel compacts to the gas grab sampling station was calculated to be 21.5 minutes.[5] As shown in Table 1, the half-lives of all 5 Br precursors of the Kr isotopes and the I precursors of ^{137}Xe, ^{138}Xe, and ^{139}Xe are all much shorter than this transport time, indicating the decay of the precursors was complete before they reached the sampling station. The half-lives of the I precursors of ^{131m}Xe, ^{133}Xe, ^{135m}Xe, and ^{135}Xe are all greater than 6 hours and the independent yields of these 4 Xe isotopes are small, dictating that the concentrations of these 4 noble gases at the gas grab sampling station were dependent upon what fraction of the I precursors was retained upstream of the sampling station.

Another issue regarding the conduct of the NPR-1A Fuel Test that merits discussion concerns the pressure and temperature of the carrier gas at the on-line and grab sample measurement locations. Carrier gas was supplied to the carrier gas inlet line at 22.3 psia from regulated standard gas supply bottles. Mass flow controllers downstream of the gas supply bottle regulators were adjusted to maintain a total flow rate of 60 cm^3/minute. As was previously mentioned, the carrier gas transport line was routed from the fuel compacts test capsule to the FPMS in the 1B Cubicle, then to the gas grab sample station in the ATR Second Basement, then to a delay tank, and finally on to the plant ventillation exhaust system. Gas pressure in the carrier gas inlet line downstream of the mass flow controllers was maintained between about 16 and 18 psia. Based on the length of the carrrier gas effluent line between the test capsule and the FPMS, the pressure of the carrier gas at the FPMS on-line

measurement location is expected to have been close to atmospheric pressure.[6]

The NPR-1A carrier gas effluent line was not equipped with sensors to measure gas temperature and pressure at the locations of the FPMS germanium spectrometer and gas grab sample station. However, a limited number of measurements of gas pressure and temperature were made. The results are as follows. Two gas grab samples were collected 45 minutes apart on January 11, 1992 when the carrier gas was pure He flowing at 60 cm^3/minute. The pressure of each bomb was measured by Westinghouse Idaho Nuclear Company (WINCO) personnel prior to analysis for CO and CO_2. The pressures of the two bombs were reported to be 7.20 and 7.16 psia.[7] The negative pressures at this point in the carrier gas effluent line are not surprising considering the fact that the carrier gas line terminated in the ventillation exhaust system. On two occasions the temperature of the carrier gas transport line at the location of the gamma-ray spectrometer was measured using a digital thermometer equipped with a Type K thermocouple probe. The surface temperature of the tube was 24.7 °C on November 27, 1991 and was 23.6 °C on December 2, 1991. On the latter date the carrier gas consisted of 41.4 cm^3/minute He and 18.2 cm^3/minute Ne. These temperatures compared closely with the ambient temperature in the 1B Cubicle.

The following sections of this report desribe the on-line gamma-ray spectrometer, its shielding and electronics, the methods used to calibrate it and operate it during the NPR-1A Fuel Test, and the methods used to analyze collected gamma-ray spectra and qualify the results. Similar information is also presented for the gas grab sample system and the on-line NaI(Tl) scintillation detector. Finally, the experimental results for the three measurement systems are presented.

3. ON-LINE GAMMA-RAY SPECTROMETER

The on-line gamma-ray spectrometer consisted of a high-resolution germanium gamma-ray detector shielded and collimated to view a 10.16-cm long section of the carrier gas effluent line. The section of the carrier

gas effluent line assayed by the germanium detector is known as the spool piece. The general arrangement of the germanium detector including its liquid nitrogen dewar, detector end cap, and shield is shown in Figure 2 and an overhead cross-sectional view of the detector end cap, collimator, spool piece, and spool piece shield is shown in Figure 3.

The detector was mounted in the shield by inserting the end cap into its cylindrical shield cavity and then bolting the dewar to an electrically insulated aluminum bracket positioned to center the detector endcap inside the cavity. Once calibration measurements commenced, the positions of the edges of the bracket were marked on the surface of the stand that supported the detector so that the bracket could be repositioned if necessary. The detector and shield were oriented tangentially to the reactor shield wall so that the detector axis was perpendicular to the paths of the penetrations through the reactor shield wall through which the carrier gas line passed. The carrier gas line exited the reactor shield wall horizontally, passed through the spool piece shield cavity, turned 90 degrees and went below the base of the bottom of the spool piece shield cavity, turned 90 degrees again and passed horizontally through the bottom region of the spectrometer shield and then back through the reactor shield wall.

The carrier gas line was connected to the spool piece inside the spectrometer shield by means of Swagelok fittings so that if necessary the spool piece could be replaced with minimal effort. A drawing of the spool piece used during the NPR-1A Fuel Test is shown in Figure 4. The spool piece consisted of a 13.1-cm long section of 12.7-mm od x 1.24-mm wall (1/2-inch od x 0.049-inch wall) stainless steel tube to each end of which was welded a 12.7-mm od Cajun weld adapter and a short section of 6.35 mm-od x 0.89-mm wall (1/4-inch od x 0.035-inch wall) stainless steel tube. The total length of the section of the spool piece having a nominal inside diameter of 10.2 mm was 15.2 cm. Thus, the internal volume of the section of the spool piece having a 10.2-mm od was 12.5 cm^3. As shown in Figure 3, 10.16 cm of the spool piece was exposed inside the spool piece shield cavity. The internal volume of the section exposed inside the shield cavity was 8.3 cm^3, which means that at a carrier gas flow rate of 60 cm^3/minute, the gas inside the spool piece cavity was

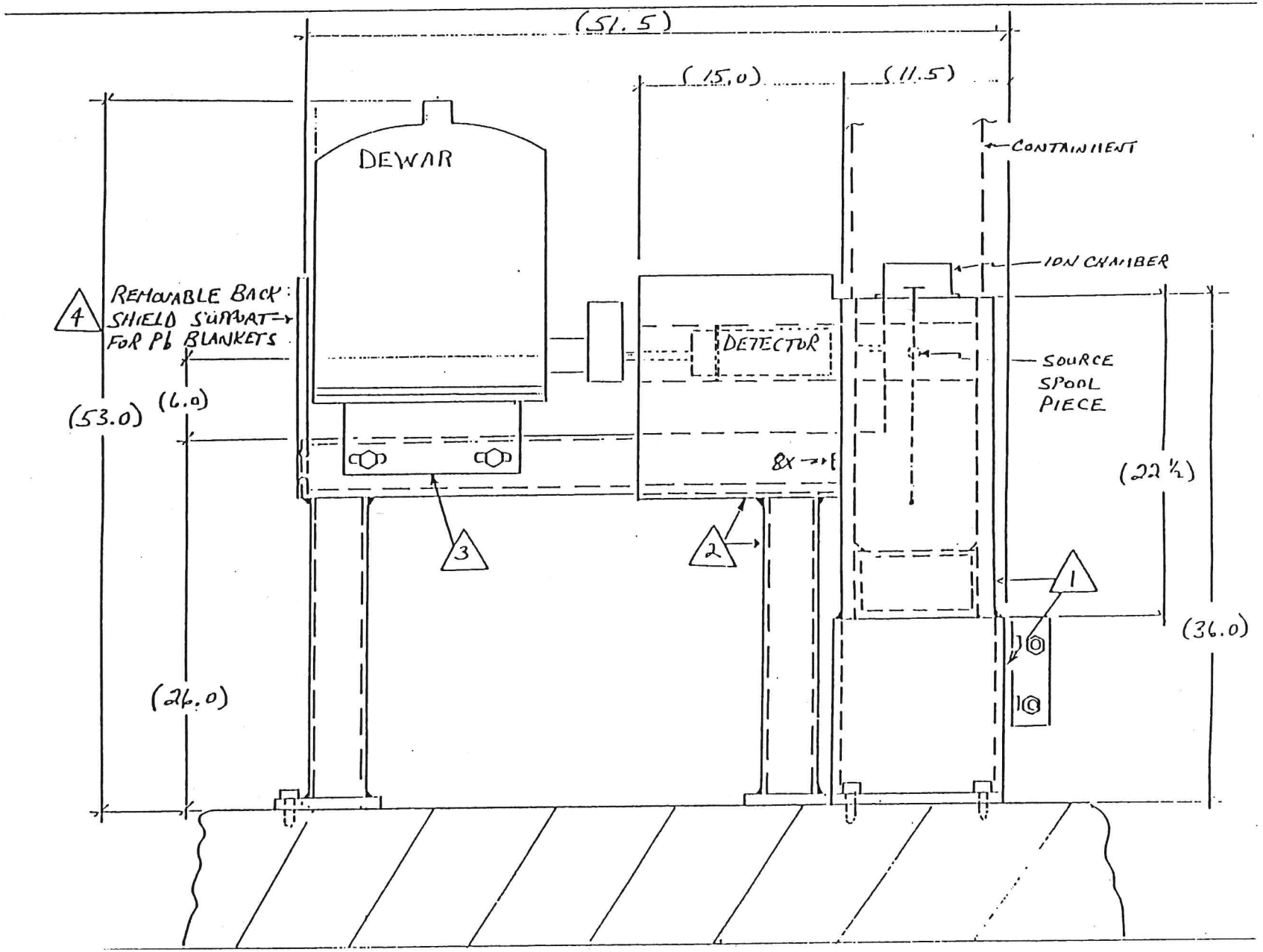


Figure 2. Arrangement of FPMS on-line gamma-ray detector and shield.

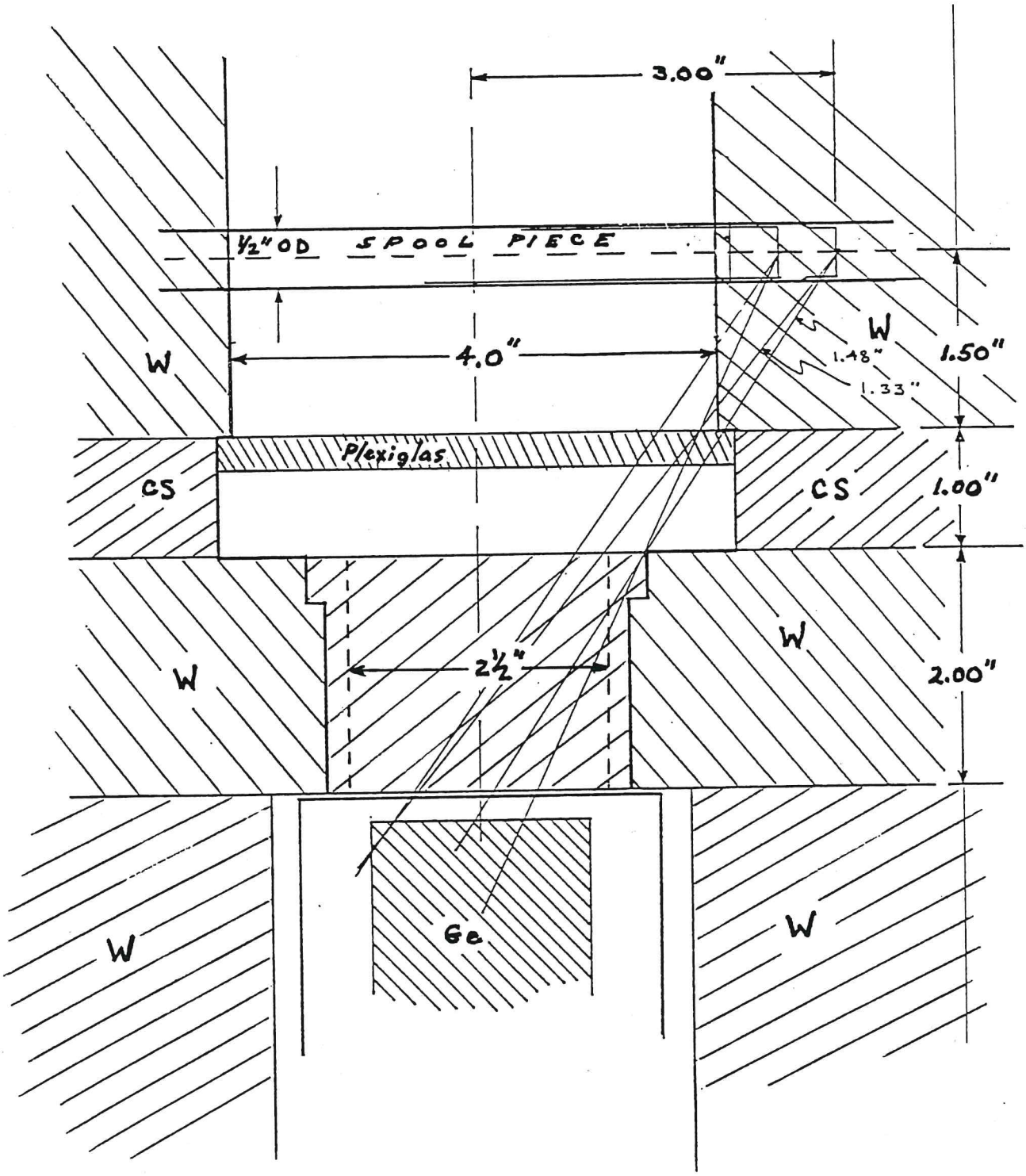


Figure 3. Cross-sectional view of the spool piece cavity.

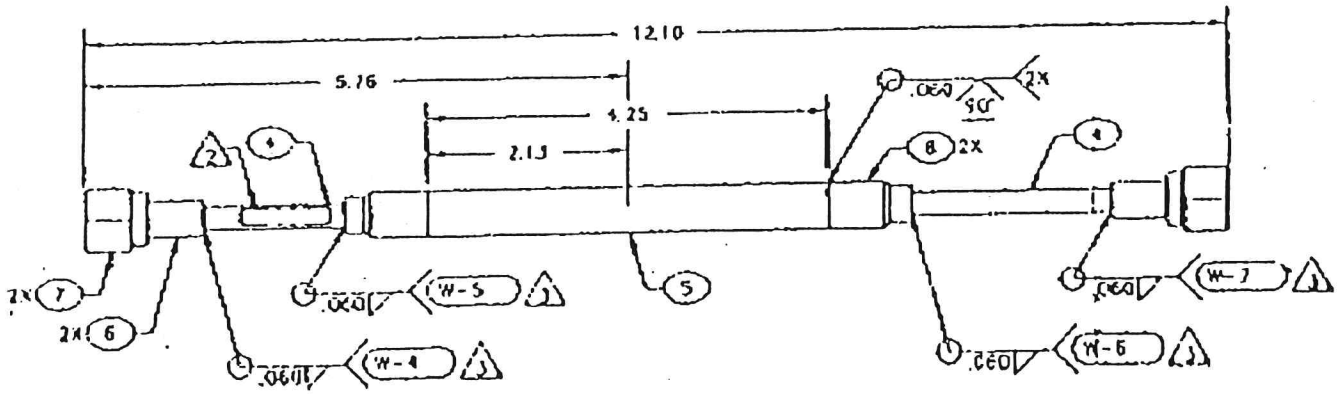


Figure 4. NPR-1A spool piece.

replaced every 8.3 seconds.

The shielding material used for the top and side walls of the cavity was tungsten alloy having a density of 17 g/cm^3, and lead having a nominal density of 11 g/cm^3 was used for the bottom of the cavity. The top surface of the spool piece cavity was 5.08 cm thick, the two side walls of the cavity that the spool piece passed through were 5.72 cm thick, the collimator and the wall in which the collimator was located were each 5.08 cm thick, and the bottom surface of the shield cavity was 20.3 cm thick. Three tungsten collimators having right-circular cylinder aperatures with diameters of 0.64, 2.54, and 6.35 cm were fabricated; however, only the collimator having the 6.35-cm diameter aperature was used during the NPR-1A Fuel Test. In addition, a solid block of tungsten having the same outside dimensions as the collimators was fabricated and used during the collection of background spectra.

The FPMS on-line gamma-ray spectrometer was configured the same as the ATR remote stack gamma-ray spectrometer that has been in routine use monitoring the ATR stack effluent for 3 years. The FPMS spectrometer used similar hardware and software.

A block diagram of the FMPS gamma-ray spectrometer and NaI(Tl) scintillation detector electronics is shown in Figure 5. The following are the primary hardware components that comprised the FPMS gamma-ray spectrometer:

1. A Canberra Nuclear model 7905-30 intrinsic germanium detector and associated shielding assembly and electronics. The detector preamplifier and the Canberra Nuclear ND583 analog to digital converter (ADC) incorporated electronics that allowed the use of a patented technique of pulse injection with susequent removal[8] to provide real-time validation of spectral data.

2. An ultrastable, dual amplitude pulser and a pulse control and separation logic interface. The pulser and pulser interface module were fabricated in-house by EG&G Idaho.

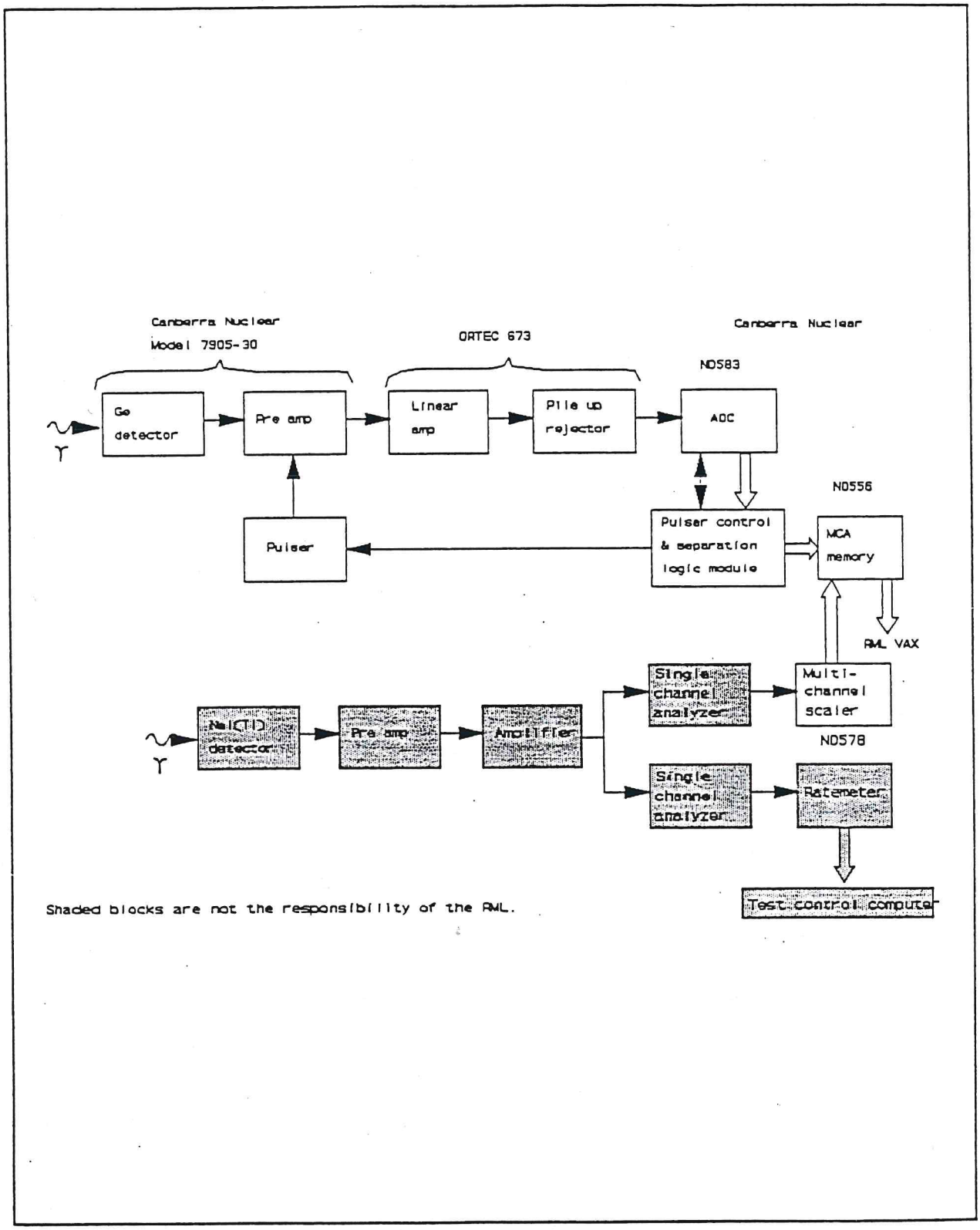


Figure 5. Block diagram of the FMPS electronics.

3. A Canberra Nuclear model ND556 acquisition interface module (AIM) provided the multichannel analyzer (MCA) used for storing gamma-ray spectral data. The ND556 AIM can control the operation of two 16,384-channel MCAs. During the NPR-1A Fuel Test the AIM was configured to provide one 8,192-channel MCA for acquisition of gamma-ray spectral data and one 16,384-channel MCA operating in the multichannel scaling (MCS) mode to acquire gross count rate data from the NaI(Tl) scintillation detector.

4. An Ethernet communications link between the FPMS AIM at the ATR and computers on the Radiation Measurements Laboratory (RML) Ethernet network.

5. A MicroVAX II computer located at the RML. This computer was used to control the operation of the FPMS gamma-ray spectrometer, store spectral data, and automatically analyze spectra and store the analytical results for later retrieval.

6. An operator terminal located at the RML.

7. A data inquiry terminal located in the ATR control room.

The dual amplitude pulser was used to provide, within each acquired gamma-ray spectrum, electronic pulser data that in turn was used to monitor the performance of the spectrometer and determine spectrum-specific energy calibrations and corrections for spectrometer dead time and pulse pile-up losses. The pulser operates as follows.[8] Electronic pulses of two different amplitudes and similar repetition rates are injected into the preamplifier of the spectrometer, are processed through the same electronics used to process gamma-ray event pulses, and are then stored in buffers in the gamma-ray spectrum. Any electronic drift that affects the storage location of a gamma-ray event similarly affects the known amplitudes of the low and high amplitude pulser events allowing an accurate determination of the energy calibration of the spectrum. Likewise, any perturbation that results in losses of gamma-ray events is reflected in similar losses of pulser events.

3.1 Calibration

Because no radioactive gas-filled standard identical to the spool piece was available, special procedures were required to determine the absolute counting efficiency of the FPMS gamma-ray spectrometer. A primary spool piece calibration standard was made by fabricating a simulated spool piece body and filling it with a mixed-radionuclide solution obtained from the National Institute of Standards and Technology (NIST). A secondary calibration standard was made by filling a second simulated spool piece body with a ^{232}U solution. Counting efficiencies determined using these liquid-filled spool piece calibration standards were then corrected for differences in gamma-ray self attenuation between the calibration standards and the actual spool piece using the results of point kernel calculations.

Because the NIST and ^{232}U reference solutions were provided as 4 M hydrochloric acid (HCl) and HCl is corrosive to stainless steel, calibration pool piece bodies were fabricated from zirconium components resistant to attack by HCl. Each calibration spool piece body consisted of a 21.7-cm long section of 12.7-mm od x 1.19-mm wall (0.5-inch od x 0.047-inch wall) R60702 zirconium tube. (The original R60702 zirconium tube had a 1.65-mm wall thickness and was reamed out to increase the inside diameter). One end of the tube was sealed with a 9.5-mm thick solid zirconium plug that was welded to the tube. A 5.46-cm long zirconium plug having a small diameter hole passing through it was inserted into the other end of the tube prior to filling with reference solution. Thus, the inside diameter of each spool piece calibration body was 10.3 mm over a length of 15.2 cm. (The dimensions specified for the actual spool piece were 10.2 mm over a length of 15.2 cm.) In each case, the undiluted reference solution was pipetted into the calibration spool piece body through a small diameter tube inserted through the port in the longer end plug. Each calibration spool piece body was completely filled with reference solution and following filling was sealed using a Swagelok zirconium tube cap.

The primary spool piece calibration standard contained SRM 4276C Mixed-Radionuclide Solution Standard obtained from NIST. A copy of the

certificate for the SRM 4276C reference material is provided in Appendix A, Table A-1. The NIST SRM 4276C reference solution contains radionuclides that emit X-rays and gamma rays over the energy range 27.4 to 1596.5 keV. Since the noble gas isotopes of interest emit gamma rays having energies greater than 2 MeV, a secondary spool piece calibration standard was prepared using a solution of ^{232}U in equilibrium with its daughters, which provided gamma-rays having energies between about 238 and 2614 keV.

Prior to performing meaurements of absolute counting efficiency, the correct operation of the FPMS gamma-ray spectrometer was certified following RML procedure Unit 1, "Procedure for the Installation or Replacement of a Component in a Gamma-ray Spectrometer System". Energy calibration measurements were then performed according to RML procedure RML-17, "Procedure for Gamma-Ray Energy Calibration, Calibration Standard Check, and Instrument Background Check for Ge Detector Based Spectrometers" using a disk source of electroplated ^{232}U in equilibrium with its daughters. The particular energy calibration check source used throughout the NPR-1A Fuel Test was Th-#9, one of the check sources belonging to the RML. During all energy calibration measurements the Th-#9 disk source was positioned in the same location inside the shallow groove in one face of the solid tungsten collimator block used during the collection of background spectra.

The ^{232}U check source emits gamma rays with energies of 238.632, 583.191, 860.564, 1620.735, and 2614.533 keV. Each ^{232}U check source spectrum was analyzed using the RML "PEQQ" software routine which determines the centroids of all five photopeaks and performs a least-squares quadratic fit of the peak positions to their known energies to determine the intercept and coefficients of a quadratic energy calibration function. It also performs a linear fit of the photopeak centroids to peak width to determine the coefficient and intercept of a linear width function. "PEQQ" then calculates the equivalent energies of the lower and higher pulsers based upon their positions in their respective buffers. These pulser equivalent energies are written to the spectrometer parameter block for use with all subsequent spectra.

The Th-#9 ^{232}U check source was analyzed periodically during the course of performing counting efficiency calibration measurements and was also measured periodically during the course of the NPR-1A Fuel Test. In addition to determining the coefficients of energy and peak width functions and pulser equivalent energies, the "PEQQ" program calculated an activity for each of the five ^{232}U daughter photopeaks. The latter results were used to monitor the stability of the counting efficiency of the spectrometer over time. The results of each energy and calibration check measurement performed using the Th-#9 source were automatically stored in a Quality Assurance (QA) file in the VAX computer. This QA file is provided in Appendix A, Table A-2.

The absolute counting efficiency of the FPMS gamma-ray spectrometer was measured using each of the 3 different sized collimator aperatures. These measurements were performed from September 15 through September 18, 1991, prior to the installation of the spool piece that was installed throughout the NPR-1A Fuel Test. In each case, the spool piece calibration standard was positioned to exactly duplicate the position of the actual spool piece in the spool piece cavity. The bottom surface of the Swagelok end-cap was pushed against the outer wall of the spool piece cavity so that the activity in the standard was symmetrically distributed on either side of the longitudinal centerline of the collimator aperature. Any shield pieces removed from the roof of the spool piece cavity in order to install the spool piece calibration standard were replaced prior to initiating spectrum accumulation.

Spectra of the spool piece calibration calibration standards were collected using counting times long enough to assure that the count rate in each gamma-ray photopeak was quantified to an uncertainty equal to or less than $\pm$ 3% at the one-sigma level. Each spool piece standard was measured twice using the 6.35-cm diameter collimator aperature. Due to the longer counting times required to achieve a $\pm$ 3% uncertainty when collecting spectra using the 2.54- and 0.635-cm diameter collimator aperatures, each spool piece standard was normally only analyzed one time using the these two smaller diameter aperatures. However, as was previously mentioned, only the 6.35-cm diameter aperature was used during the NPR-1A Fuel Test.

All counting efficiency calibration spectra were analyzed using the "VAXGAP" gamma-ray spectrum analysis code[9,10] that was developed at the INEL and has been in routine use at the RML for several years. The "VAXGAP" code is the same code that was also later used to analyze fission gas spectra collected during the NPR-1A Fuel Test. The full-energy peak counting efficiency of the FPMS gamma-ray spectrometer for the spool piece calibration standard filled with the NIST SRM 4276C reference solution was determined for each collimator aperature size using RML procedure DM-12, "Detection Efficiency Curve/Table Generation on the RML VAX Computer." In each case, counting efficiencies for the NIST liquid standard were calculated as counts per gamma per ml of solution over the energy range 50 to 1600 keV. Spectral analysis results for the spool piece standard filled with the ^{232}U solution were then used to extend the efficiency curves to energies above 1600 keV. Counting efficiencies determined for the spool piece standard filled with NIST reference solution were used to calculate the source strength of the ^{232}U solution in the second spool piece standard using the measured count rates of the 238.63, 583.19 and 860.56 keV ^{232}U daughter photopeaks. The counting efficiency at 2614.53 keV was then calculated for each collimator aperature by dividing the count rate in the 2614.53 keV ^{232}U daughter photopeak by the source strength of the ^{232}U solution. For each collimator aperature size, the combined data were then used to generate an efficiency table for the liquid-filled spool piece covering the energy range 50 to 3000 keV.

To obtain counting efficiencies of the FPMS spectrometer for the gas-filled spool piece, measured counting efficiencies for the liquid-filled spool piece were corrected using the results of point kernel calculations of uncollided gamma-ray flux[11] performed using the Los Alamos computer code "QAD". Both the gas-filled stainless steel spool piece and the liquid-filled zirconium spool piece were acurrately modeled taking into account the actual dimensions and compositions of the spool piece bodies. Using a source strength of one gamma per cm^3 at each energy, the uncollided gamma-ray flux was calculated at a point midway between the ends of the spool piece 10 cm from the longitudinal centerline of the spool piece. The ratio of the uncollided gamma-ray flux from the liquid-filled spool piece to the uncollided gamma-ray flux from the gas-filled spool piece was calculated at 19 different gamma-ray energies

from 50 to 3000 keV. The results are presented in Appendix A, Table A-3. The counting efficiency of the FPMS spectrometer for the actual gas-filled, stainless steel spool piece was calculated by dividing the counting efficiency results for the zirconium, liquid-filled spool piece by the ratio of uncollided fluxes at each gamma-ray energy. As shown in Table A-3, above an energy of 400 keV, the difference in self-attenuation between liquid- and gas-filled spool pieces was negligible. The counting efficiency curve and a listing of counting efficiency values for the stainless steel, gas-filled spool piece for the case of the 6.35-cm diameter collimator aperature are provided in Appendix A, Figure A-1 and Table A-4, respectively. This particular counting efficiency table was designated table number 1191. Similar counting efficiency tables for the 2.54- and 0.635-cm diameter aperatures were designated tables 1192 and 1193.

3.2 Operation

The FPMS gamma-ray spectrometer was controlled by a MicroVAX II computer located in the RML via an Ethernet communications link between the MicroVAX II and the FPMS AIM. The program "RCA", which is the same program that has been used to operate the ATR remote stack effluent gamma-ray spectrometer for over 3 years, was used to operate the FPMS gamma-ray spectrometer. The "RCA" computer program and instructions as to its use are described in reference (12). Some minor modifications of the "RCA" program were made to tailor the program to the FPMS. Those changes included assigning the designation "NPR" to the FPMS gamma-ray spectrometer, requiring the entry of the dwell time of the MCS used with the NaI(Tl) scintillation detector when an automatic spectrum acquisition sequence was started, and prefacing NPR-1A gamma-ray spectrum file names with the characters "PR".

Automatic spectrum acquisition was initiated using a terminal in the RML. The command "START;NPR" displayed a menu showing the operating parameters for the FPMS gamma-ray spectrometer. Those parameters included the gamma-ray spectrometer count real time, the dwell time for the NaI(Tl) MCS, and the isotope libraries, activity units, and counting efficiency table to be used for spectrum analysis. The three isotope libraries used

throughout the NPR-1A Fuel Test were (1) isotope library: "NPR_Fuel", (2) required energy library: "NPRLIM", and (3) interference library: "NPRINT". The counting efficiency table used throughout the NPR-1A Fuel Test was table 1191, the efficiency table for the 6.35-cm diameter collimator aperature. As a general rule, counting times over which spectra were collected were chosen to be long enough to assure that the random uncertainties of the concentrations of fission product noble gases were less than or equal to $\pm$ 5% at the one-sigma confidence level. A counting time of 4 hours was used during the first day of the test, October 2, 1991, but was increased to 24 hours the following day in order to meet the uncertainty criterion just mentioned. When the concentrations of the noble gases of interest increased significantly during December 1991, the count time used was reduced to 8 hours, then to 4 hours, and finally to 1 hour. Each time the gamma-ray spectrometer count time was changed, the dwell time of the NaI(Tl) scintillation detector MCS was modified according to the following formula, rounding the dwell time to the nearest tenth of a second.

$$\text{Dwell time (sec)} = \text{count time (sec)}/16{,}348 \qquad (1)$$

Thus, the MCS dwell time was set to 5.3 seconds when the spectrometer count time was 24 hours and was reset to 0.9 seconds when the spectrometer count time was reduced to 4 hours. The dwell time was set by means of a push-button dial on the front face of the Canberra Nuclear model ND578 MCS located in the FPMS instrument rack outside the ATR 1B Cubicle. Because the MCS dwell time had to be reset manually, the dwell time was normally changed a few minutes before or after the spectrometer count time was changed.

During spectrum accumulation, spectrometer dead time, elapsed live time, and real count times were displayed and updated every 10 seconds on the NPR-1A status display monitor in the RML. The number of spectra accumulated on the current date and any computer-generated messages regarding system status were also displayed on this same terminal monitor. This display monitor was checked routinely by RML and ATR personnel to verify that the FPMS was operating correctly.

An information flow diagram for the on-line FPMS gamma-ray spectrometer and NaI(Tl) scintillation detector is shown in Figure 6. Once a spectrometer count sequence was initiated using the remote spectrometer control and status terminal in the RML, the "RCA" program automatically controlled the collection of gamma-ray spectra using the parameters entered by the operator and also stored the collected spectra on disk on the MicroVAX II computer. These spectra were periodically copied to the VAX 6310 in accordance with the RML Unit Directive regarding backup of data files on RML controlled computers. On a routine basis, stored gamma-ray spectra were automatically batch-analyzed using the VAXGAP spectrum analysis program. Xerox copies of printed summaries of the concentrations of fission product radionuclides, expressed as $\mu Ci/cm^3$ at the location of the on-line spectrometer, and DOS-formatted floppy diskettes containing DOS ASCII text files of analysis results were forwarded to the NPR Programs Office following each batch analysis. A detailed desription of the procedure used to batch-analyze FPMS gamma-ray spectra and generate reports of the results is given in Appendix D of reference (2). These initial analysis results were considered preliminary as they normally received only a cursory examination prior to their transmittal to the NPR Programs Office. Spectrum analysis results were reviewed continuously throughout the NPR-1A Fuel Test, and periodically modifications were made to the spectrum analysis program and the isotope libraries used for analysis. The qualification of the spectrum analysis results was not completed until well after the NPR-1A Fuel Test was terminated.

4. GAS GRAB SAMPLING SYSTEM

A gas grab sampling system was installed in the ATR as part of the FPMS to allow the collection of samples of carrier gas for off-line analysis. As is shown in Figure 1, the gas grab sampling station was located far downstream of the FPMS gamma-ray spectrometer outside the 2D Cubicle in the ATR Second Basement. As was previously mentioned, the transport time from the fuel compacts test capsule to the gas grab sampling station was calculated to be 21.5 minutes,[5] meaning that the sampling station was 13.6 minutes downstream of the on-line gamma-ray spectrometer.

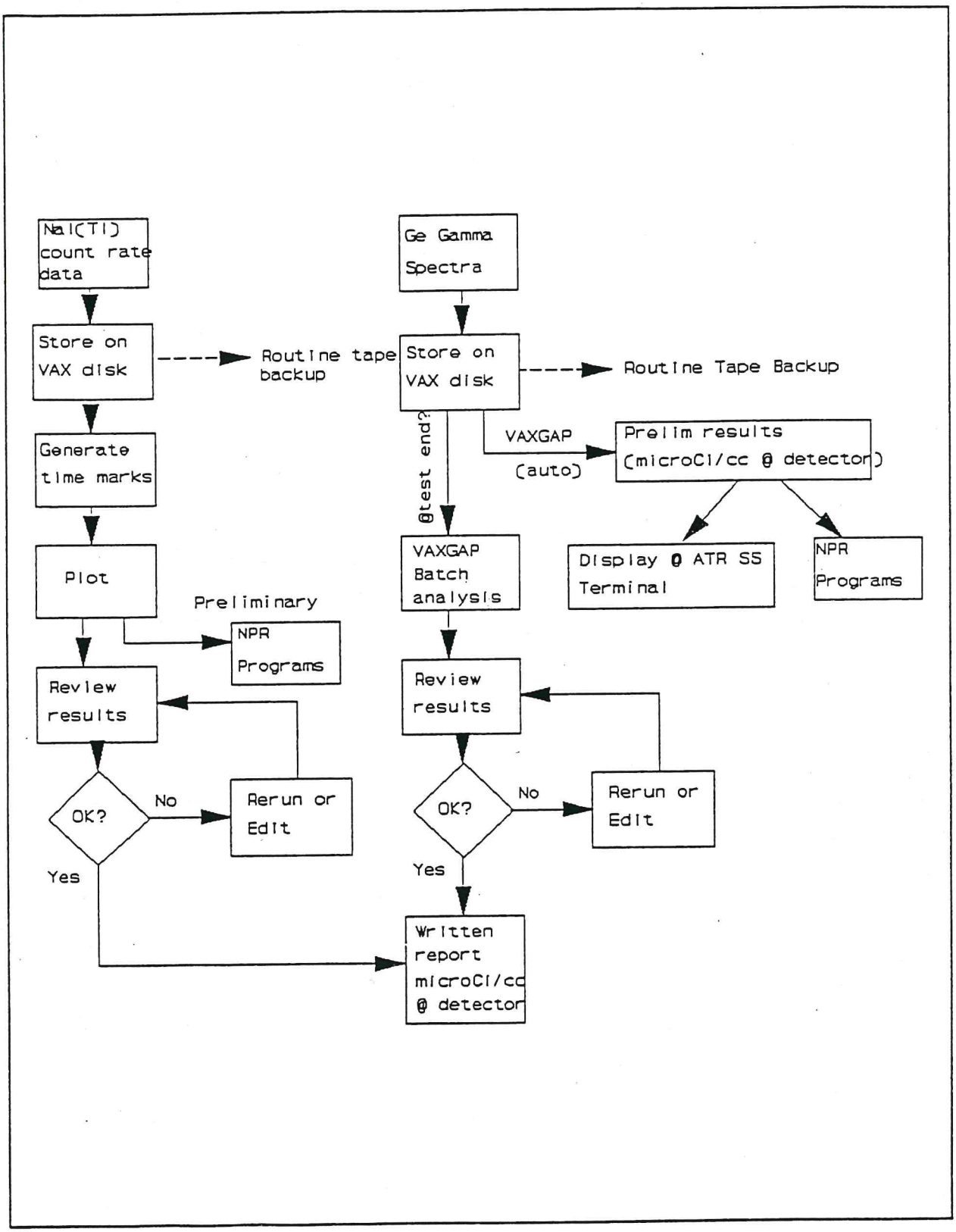


Figure 6. FPMS information flow diagram.

The following procedure was used to collect samples of the NPR-1A carrier gas. Sampling was performed by ATR personnel inside a ventillated glove-box located just outside the 2D Primary Cubicle. A standard Whitey 150 cm^3 stainless steel gas sample cylinder equipped with 6.35-mm (1/4-inch) Whitey valves was connected to a carrier gas sampling line using Swagelok fittings. Following its installation, the valves on the sample cylinder were opened and then an electrically operated solenoid valve in the 2D Primary Cubicle was repositioned to direct the flow of NPR-1A carrier gas through the sample cylinder. The flow of carrier gas through the sample cylinder was maintained for 10 minutes, a time sufficiently long to completely purge the sampling line and gas sample cylinder. Following the 10 minute purge, the valves on the sample cylinder were closed and the solenoid valve in the 2D Cubicle was reset to its bypass position. The sample cylinder was then removed from the carrier gas sampling line and placed in a yellow plastic bag. Sampling information that included the date, the time of day the sample cylinder was isolated, and the flow rates of the He and Ne carrier gases at the time of sampling was recorded on a grab sample data sheet that was forwarded to the RML with the gas sample. Gas samples were normally delivered to the RML within 30 minutes following collection.

NPR-1A gas grab samples were analyzed using the A-1 high-resolution germanium gamma-ray spectrometer located in the RML. Each sample was normally analyzed for 1 hour as soon as practical following its receipt at the RML and was reanalyzed for 16 hours after having been allowed to decay for 3 days. The second analysis was performed to better quantify the concentrations of the long-lived noble gases ^{131m}Xe and ^{133}Xe. Spectrum accumulation, storage, and analysis were performed using the VAXGAP computer program. Because the gas grab samples were discrete samples, fission product concentrations in each grab sample were decay corrected to the sample collection time and were also corrected for ingrowth of activity due to the decay of radioactive precursors between the time the sample was collected and the analysis completed. Spectra of gas grab samples were initially analyzed individually, but later were batch-analyzed using the same computer programs used to batch-analyze the on-line gamma-ray spectra.

4.1 Calibration of Off-line Spectrometer

Prior to performing measurements of absolute counting efficiency, the energy calibration of the A-1 gamma-ray spectrometer was checked following RML procedure RML-17, "Procedure for Gamma-Ray Energy Calibration, CalibrationStandard Check, and Instrument Background Check for Ge Detector Based Spectrometers" using a disk source of electroplated ^{232}U in equilibrium with its daughters. The energy calibration of the A-1 spectrometer was also periodically rechecked throughout the time the spectrometer was used to analyze NPR-1A gas grab samples.

The absolute counting efficiency of the A-1 gamma-ray spectrometer for the NPR-1A gas grab sample was initially measured using a standard prepared by Amersham Corp., Arlington Heights, IL. The standard, Amersham QCRX1296, serial number CS 488, consisted of a Whitey 150 cm^3 stainless steel gas sample cylinder supplied to Amersham by EG&G Idaho that Amersham filled with a plastic foam containing a mixture of radionuclides. The density of the foam was reported by Amersham to be 0.02 g/cm^3. The standard emitted gamma rays over the energy range 59.5 to 1836.1 keV. A copy of the Amersham certificate for the standard is provided in Appendix A, Table A-5. The standard was analyzed positioned against the endcap of the A-1 detector oriented such that the longitudinal axis of the cylinder was about 45 degrees from vertical. This was the counting geometry used to analyze all NPR-1A gas grab samples. Spectra of the gas cylinder standard were collected using counting times long enough to assure that the count rate in each gamma-ray photopeak was quantified to an uncertainty equal to or less than $\pm$ 3% at the one-sigma confidence level. All counting efficiency calibration spectra were analyzed using the VAXGAP gamma-ray spectrum analysis program.

The full-energy peak counting efficiency of the A-1 gamma-ray spectrometer for the foam-filled Amersham standard was determined using RML procedure DM-12, "Detection Efficiency Curve/Table Generation on the RML VAX Computer." Counting efficiencies were calculated as counts per gamma ray emitted. As was the case with counting efficiencies determined for the NPR-1A spool piece, corrections had to be made to take into account small differences in self-attenuation between the standard and the

actual gas grab samples. The foam-filled and gas-filled gas grab cylinders were modeled and the ratio of the uncollided gamma-ray flux from the foam-filled gas sample cylinder to the uncollided gamma-ray flux from the gas-filled gas sample cylinder at a point midway between the ends of the sample cylinder 3 cm from the longitudinal centerline of the gas sample cylinder was calculated at each of 19 gamma-ray energies spanning the range 50 to 3,000 keV. The results of the QAD point kernel calculations[13] are presented in Appendix A, Table A-6. The counting efficiency of the A-1 spectrometer for the actual gas-filled sample cylinders was calculated by dividing the counting efficiency results for the Amersham foam-filled standard by the ratio of uncollided fluxes at each gamma-ray energy. As shown in Table A-6, differences in self-attenuation between the foam- and gas-filled sample cylinders were less than 1% over the energy range 50 to 3,000 keV. The counting efficiency curve and a listing of counting efficiency values determined using the Amersham foam-filled standard are provided in Appendix A, Figure A-2 and Table A-7, respectively. This particular counting efficiency table was designated table 1197.

For reasons that will be discussed later in this report, the counting efficiency of the A-1 spectrometer for the gas grab sample cylinder was also measured using standard Whitey 150 cm^3 stainless steel gas sample cylinders filled with liquid reference solutions. The approach used was the same as that used to determine the counting efficiency of the FPMS on-line gamma-ray spectrometer for the gas-filled spool piece. One gas sample cylinder was filled with a diluted solution of Amersham mixed-radionuclide reference solution QCY.48, solution number R1/25/105, and the second was filled with a solution of ^{232}U in equilibrium with its daughters. A copy of the Amersham certificate for the QCY.48 reference solution is provided in Appendix A, Table A-8. Each liquid-filled gas cylinder standard was analyzed using the counting geometry previously described.

The full-energy peak counting efficiency of the A-1 gamma-ray spectrometer for the gas cylinder filled with Amersham reference solution QCY.48 was determined in the usual manner using RML procedure DM-12. These results were then used to calculate the source strength of the

^{232}U solution in the second gas cylinder standard following the same procedure used to calculate the source strength of the ^{232}U solution in the spool piece calibration standard. The liquid-filled gas cylinder was then also modeled and the ratio of the uncollided gamma-ray flux from the liquid-filled gas sample cylinder to the uncollided gamma-ray flux from the gas-filled gas sample cylinder at the same point previously described was calculated at each of 19 gamma-ray energies spanning the range 50 to 3,000 keV. The results of the QAD point kernel calculations[13] are presented in Appendix A, Table A-6. The counting efficiency of the A-1 spectrometer for the actual gas-filled sample cylinders was calculated by dividing the counting efficiency results for the standards filled with Amersham and ^{232}U reference solutions by the ratio of uncollided fluxes at each gamma-ray energy. As shown in Table A-6, differences in self-attenuation between the liquid- and gas-filled sample cylinders ranged from about 36% at 50 keV to about 8% at 3,000 keV. The resulting counting efficiency curve and a listing of counting efficiency values are provided in Appendix A, Figure A-3 and Table A-9. This particular counting efficiency table was designated table 1194.

Counting efficiencies determined using the foam- and liquid-filled gas cylinder calibration standards, corrected for differences in self-attenuation between each standard and the gas-filled gas cylinder, are plotted in Figure 7. Counting efficiencies plotted in Figure 7 are expressed as counts per emitted gamma ray. As shown in Figure 7, counting efficiencies determined using the Amersham CS 488 foam-filled standard are consistently lower than efficiencies at corresponding energies determined using the calibration standard filled with Amersham reference solution QCY.48. Counting efficiencies determined using the foam-filled standard are about 28% lower between 60 and 100 keV, 23% lower between 100 and 1,000 keV, and 20% lower between 1,000 and 3,000 keV. The reason the two counting efficiences are different is not known.

5. ON-LINE NAI(TL) SCINTILLATION DETECTOR

The third component of the FPMS was an Eberline RMS II NaI(Tl) count rate/exposure rate meter that served to continuously monitor gamma-ray

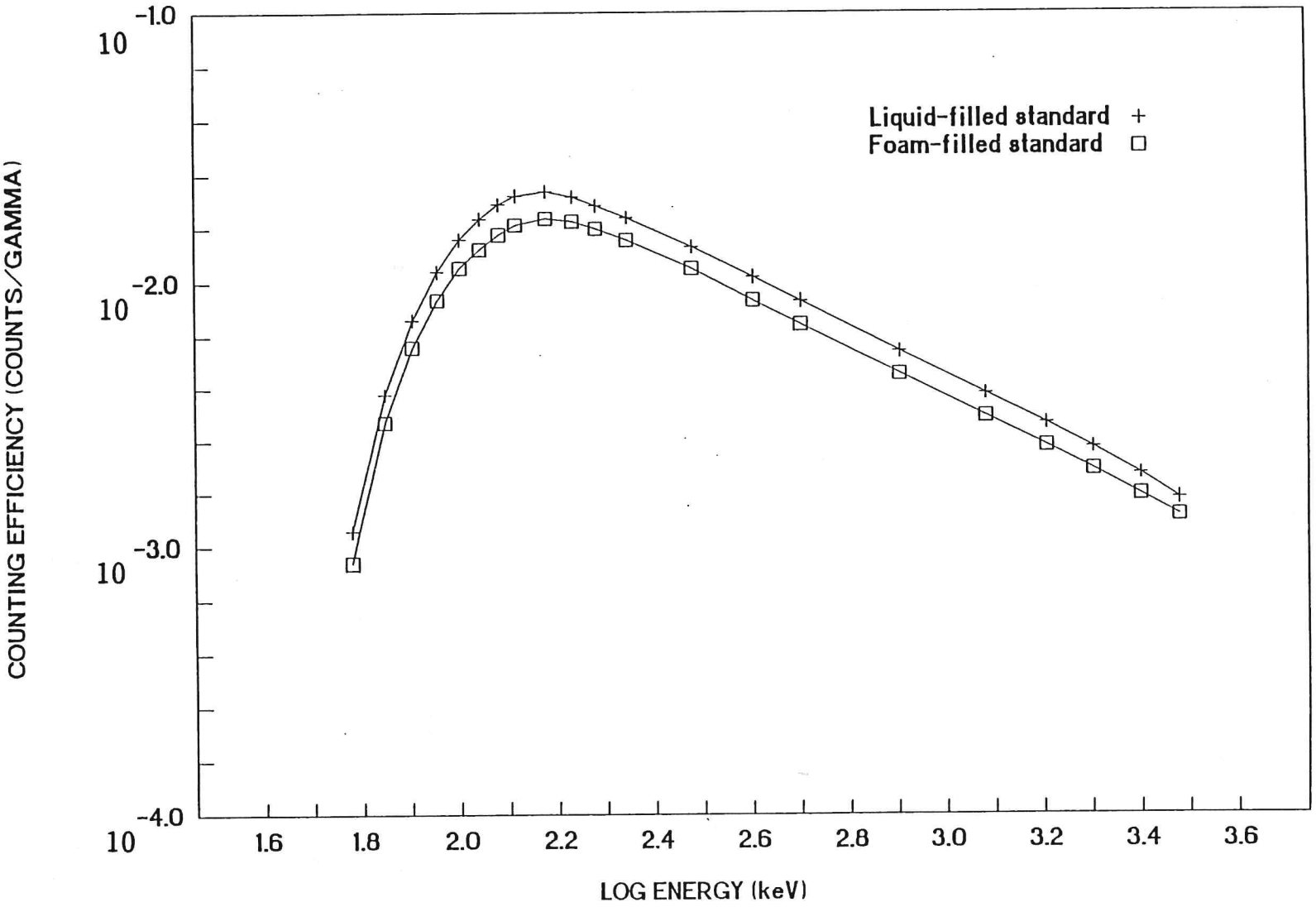


Figure 7. Comparison of counting efficiencies for off-line gamma-ray spectrometer determined using foam- and liquid-filled gas cylinder calibration standards.

fluence and exposure rate at a position on the carrier gas effluent line in close proximity to the spool piece. The NaI(Tl) scintillation detector provided a means of tracking changes in gross activity in the carrier gas line with a time resolution significantly shorter than that that could be practically achieved using the on-line gamma-ray spectrometer. It also served a safety function in the respect that the output of the exposure rate meter was routed to safety equipment that was set to automatically initiate a He dump and isolate the NPR-1A Experiment if measured exposure rates exceeded 100 mR/hr.

The RMS II system consisted of a 2.54 x 2.54 cm NaI(Tl) scintillation detector, EC1-1 exposure rate meter, and IB2 interface. The RMS II employed one preamplifier, one amplifier, and two discriminators whose energy thresholds and windows could be adjusted by the user. Binary counters on the two discriminator boards were set to divide the amplifier output count rate by two to limit the pulse rates feeding into the exposure rate meter and MCS. The output of one discriminator was fed to the EC1-1 analog exposure rate meter calibrated in mR/hr and the output of the second discriminator was routed to the Canberra Nuclear ND578 MCS in the FPMS instrument rack. The output of the MCS was fed into the 16,348-channel MCA in the FPMS AIM. This approach allowed the concurrent collection of approximately 16,000 channels of gross count rate data and 8,192 channels of spectral data in the two multichannel analyzers in the FPMS AIM.

As was previously mentioned, the MCS dwell time (i.e., the time interval over which counts were repetitively accumulated) was always set so that the maximum number of available MCA channels was used during the accumulation of any given gamma-ray spectrum. The MCS dwell time to be used for any given spectrometer count time was calculated by dividing the count time, expressed in units of seconds, by 16,348. The NaI(Tl) MCS spectrum was transferred to the MicroVAX II in the RML in conjunction with the transfer of each gamma-ray pulse-height spectrum. Both spectra were assigned the same spectrum identification number.

The NaI(Tl) detector was installed in the FPMS gamma-ray spectrometer shield adjacent to the spool piece cavity and was positioned such that the

face of the NaI(Tl) detector contacted the carrier gas effluent line, which at this location was 3-mm id stainless steel tubing. The detector was mounted vertically in the shield in a bracket that, if necessary, could be raised to reduce the gamma-ray fluence at the face of the detector. During the course of the NPR-1A Fuel Experiment the face of the detector remained in contact with the top surface of the carrier gas effluent line.

Although not a responsibility specifically delegated to the RML, prior to its installation in the FPMS shield RML personnel performed a series of measurements using the RMS II to determine the optimum discriminator thresholds and windows for use during the NPR-1A Fuel Test. Measurements of gross count rates and exposure rates were performed using a ^{137}Cs point source having a contact gamma exposure rate of 1.5 mR/hr and four different ^{152}Eu point sources with contact gamma exposure rates of about 6, 92, 120, and > 200 mR/hr.

Figure 8 is a plot of exposure rate in mR/hr versus amplifier output count rate in counts per second (cps) measured using the previously mentioned ^{137}Cs and ^{152}Eu point sources. During these particular measurements the sources were positioned 0, 5, 10, 15, and 20 cm from the front face of the NaI(Tl) detector and the count rate discriminator window was set from 200 keV to 4 MeV and the exposure rate discriminator window was set from 610 to 710 keV. Using the RMS II meter, exposure rates ranged from 0.085 to 80 mR/hr. The data plotted in Figure 8 show that at amplifier count rates above about 9,000 cps, the response of the exposure rate meter was nonlinear.

In an attempt to achieve linearity between count rate and exposure rate over the range 0 to 100 mR/hr, the width of the count rate discriminator window was set from 550 to 1,000 keV while the width of the exposure rate discriminator window was adjusted in an attempt to reach 100 mR/hr at lower count rates. The results of measurements of the ^{152}Eu point source performed using an exposure rate discriminator window of 720 to 820 keV are plotted in Figure 9. The results plotted in Figure 9 show that the response of the exposure rate meter was very linear up to 9,000 cps.

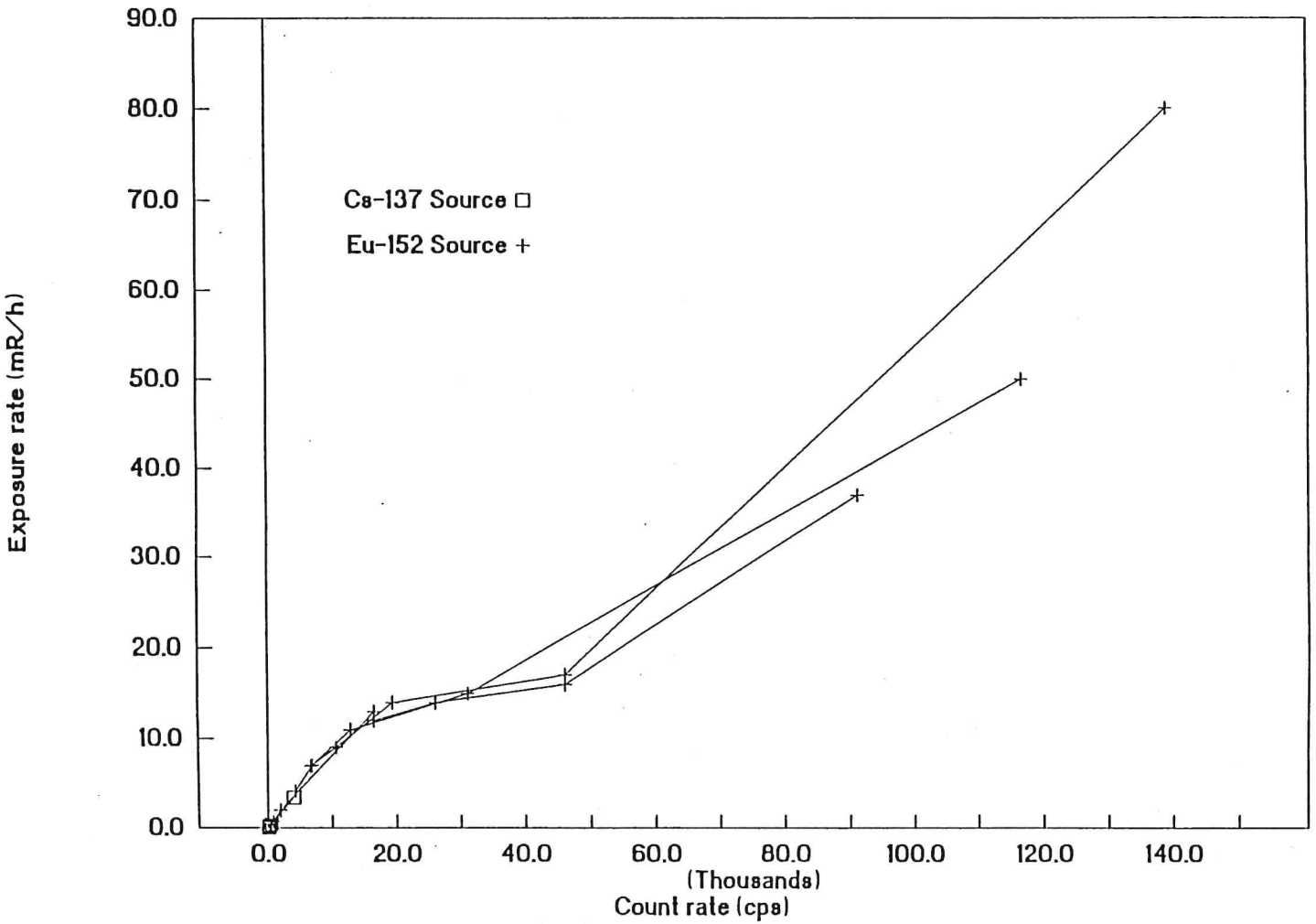


Figure 8. RMS II exposure rate versus count rate for a 200 keV to 4 MeV gross count rate discriminator window and a 610 to 710 keV exposure rate discriminator window.

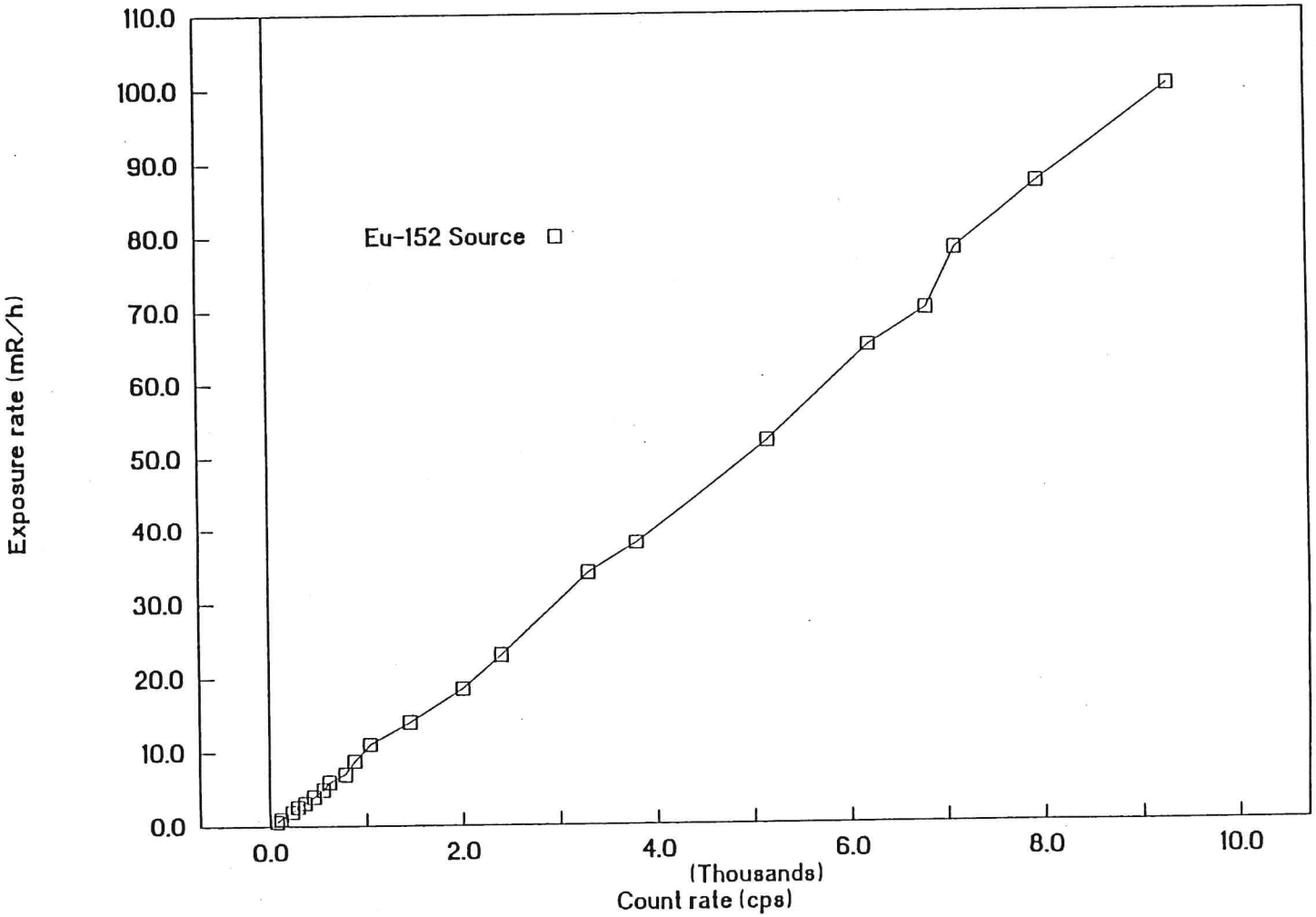


Figure 9. RMS II exposure rate versus count rate for a 550 to 1,000 keV gross count rate discriminator window and a 720 to 820 keV exposure rate discriminator window.

Measurements performed using the RMS II led to the following conclusions regarding its performance:

1. The response of the RMS II was linear from 0 to 100 mR/hr below an amplifier output count rate of about 9,000 cps.

2. The response of the RMS II exposure rate meter was linear from 0 to 100 mR/hr below an exposure rate discriminator count rate of 700 cps.

3. The count rate limitations of the RMS II discriminators and exposure rate meter required that relatively narrow discriminator windows be used to maintain linearity between count rate and exposure rate over the range 0 to 100 mR/hr.

Based on these conclusions, the RMS II gross count rate discriminator window was set from 200 to 1,200 keV and the exposure rate window was set from 400 to 500 keV following its installation in the FPMS. However, measured gross count rates averaged less than 1 cps during the first day of irradiation. Therefore, to increase count rates and thereby reduce the statistical uncertainty of the MCS gross count rate data, on October 3, 1991, the RMS II gross count rate discriminator window was reset to cover the range 200 keV to 4 MeV. The exposure rate discriminator window was left unchanged at 400 to 500 keV. These discriminator settings were those used throughout the remainder of the NPR-1A Fuel Test.

Using the VAX 6310 computer program "NPR_COUNT", the MCS spectra were individually converted to ASCII files and plotted as counts versus count time in seconds. An example of one such plot is presented in Figure 10. The date and time MCS spectrum accumulation started is shown in the heading at the top of the plot. In this particular case, the time over which MCS and pulse-height spectra were accumulated was 1 hour. The MCS dwell time used for 1-hour long counting intervals was 0.3 seconds rather than the 0.2 seconds calculated by dividing 3,600 seconds by 16,348 in order to assure that MCS data collection continued throughout the entire time that the pulse-height spectrum was being accumulated. In order to convert the MCS data to count rate, one has to divide the count data by

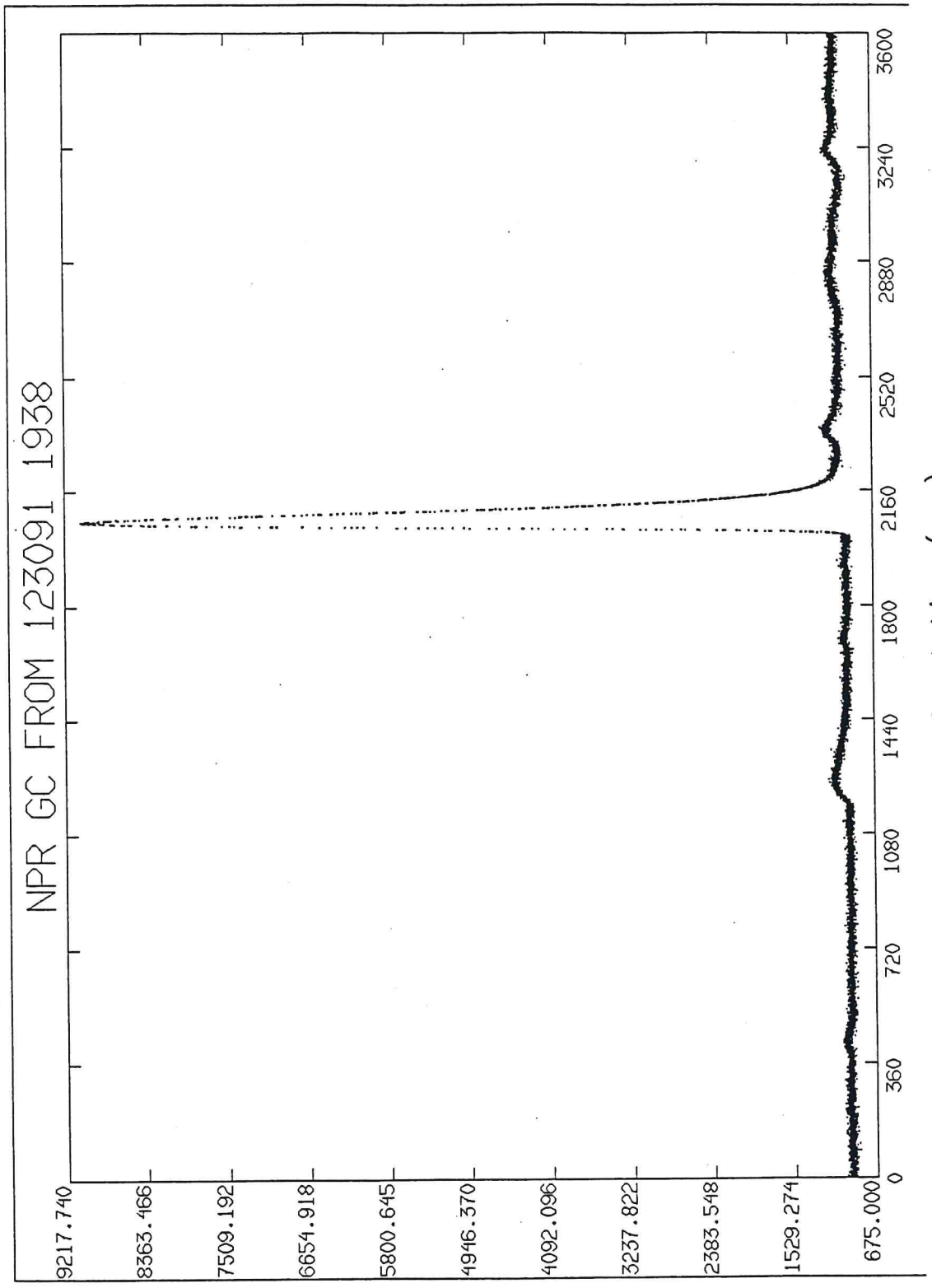


Figure 10. Example NaI(Tl) scintillation detector MCS spectrum.

the dwell time used. In the case of the example MCS spectrum plotted in Figure 10, the maximum count rate out of the gross count rate discriminator was about 30,000 cps, which corresponds to an amplifier output count rate of 60,000 cps taking into account the affect of the binary counter on the discriminator board. Thus, there were occasions when the the amplifier output count rate momentarily exceeded 9,000 cps. At these times, the amplifier and/or discriminators were probably at least partially saturated, so the actual input count rate to the amplifier when large spikes in count rate occurred was likely higher than the MCS data indicates.

The NPR_COUNT program allowed calculating and plotting the average number of counts in consecutive MCS channels. If, for example, one chose 10 channels, the program would average counts in channels 1 through 10, 2 through 11, 3 through 12, etc. and would then plot the average counts in the usual manner. This smoothing of the data was sometimes performed when count rates were very low and the data exhibited a lot of dispersion. In those cases where average counts in consecutive channels were plotted, rather than the dwell time, the product of the number of channels averaged and the dwell time was printed at the time axis origin.

Xerox copies of the plots of MCS spectra were forwarded to the NPR Programs Office on a routine basis throughout the NPR-1A Fuel Test. Following the completion of the test, the ASCII text files generated by the NPR_COUNT program were copied to floppy diskettes for future use.

6. OPERATION OF THE FPMS DURING THE TEST

A summary of the status of the ATR reactor and the FPMS during the NPR-1A Fuel Test is given in Table 2. As was previously mentioned, the irradiation of the NPR-1A fuel compacts commenced October 2, 1991 and was terminated January 3, 1992. The NPR-1A fuel compacts were irradiated during the following three ATR cycles: (1) Cycle 94B-2, October 2 through October 27, 1991, (2) Cycle 95A-1, November 11 through November 17, 1991, and (3) Cycle 95B-1, November 26, 1991 through January 3, 1992. During Cycle 94B-2, the reactor was scrammed on October 10 due to a problem with

Table 2. Status of ATR reactor and FPMS during the NPR-1A Fuel Test

Date	Time	Experiment/Reactor Status	FPMS Count Time (hr)	MCS Dwell Time (sec)
10-02-91	02:57	Started FPMS auto count sequence.	4	0.9
10-02-91	08:45	Reactor at 2.5% of full power.		
10-02-91	10:50	Reactor at 76% of full power.		
10-03-91	09:40	Changed FPMS count time and MCS dwell time.	24	5.3
10-03-91	09:45	Changed NaI gross count rate discriminator window.		
10-04-91	04:20	Isolated experiment due to high pressure indication.		
10-04-91	11:39	Restarted He carrier gas flow.		
10-04-91	12:48	Started FPMS auto count sequence.	24	5.3
10-10-91	20:00	Scrammed reactor due to problem with 2E flow controller.		
10-12-91	20:00	Began to pull reactor control rods.		
10-14-91	03:00	Scrammed reactor.		
10-17-91	07:38	Began to pull reactor control rods.		
10-17-91	15:42	Reactor at 33% of full power.		
10-17-91	18:00	Reactor at 76% of full power.		
10-17-91	18:39	Started FPMS auto count sequence.	24	5.3
10-27-91	18:00	Scrammed reactor.		
10-30-91	11:00	Removed FPMS spectrometer from shield to replace pulser.		
11-05-91	15:00	Reinstalled FPMS spectrometer in shield.		
11-07-91	15:05	Started FPMS auto count sequence.	24	5.3
11-11-91	05:27	Began to pull reactor control rods.		
11-11-91	15:00	Reactor at full power.		
11-17-91	18:00	Scrammed reactor.		
11-25-91	09:52	Started FPMS auto count sequence.	24	5.3
11-26-91	09:06	Reactor at full power.		
11-29-91	15:59	FPMS down for reasons unknown.		
11-30-91	14:29	Restarted FPMS.	24	5.3
12-01-91	14:29	FPMS down.		
12-02-91	10:36	Restarted FPMS.	24	5.3
12-05-91	22:48	FPMS down due to pulser peak shift.		
12-06-91	12:33	Restarted FPMS.	24	5.3
12-07-91	12:33	FPMS down due to a scheduled power outage at the RML.		
12-08-91	12:19	Restarted FPMS.	24	5.3
12-10-91	13:30	He dump due to high temperature alarm.		
12-12-91	17:03	Started FPMS auto count sequence.	8	1.8
12-13-91	13:17	Started FPMS auto count sequence.	4	0.9
12-30-91	10:36	Started FPMS auto count sequence.	1	0.3
01-02-92	09:56	Started FPMS auto count sequence.	2	0.5
01-03-92	09:59	Started FPMS auto count sequence.	4	0.9
01-03-92	18:00	Scrammed reactor, He dump, isolated experiment.		
01-03-92	22:37	Restarted He/Ne carrier gas flow.		
01-04-92	13:55	Isolated experiment.		
01-04-92	14:00	FPMS down due to loss of UPS power.		
01-04-92	18:47	Started FPMS auto count sequence.	24	5.3
01-06-92	08:58	Terminated FPMS measurements.		

a flow controller on the 2E Loop. The reactor was not returned to full power until October 17, 1991. As indicated in Table 2, the experiment was isolated for about 7 hours on October 4, 1991 and helium dumps occurred on December 10, 1991 and January 3, 1992.

FPMS data collection commenced at 02:57 on October 2, 1991 using a 4-hour long counting interval and a MCS dwell time of 0.9 seconds. The counting interval was increased to 24 hours on October 3 and the MCS dwell time was reset to 5.3 seconds in order to achieve an uncertainty of less than or equal to $\pm$ 5% in the concentrations of the fission product noble gases of interest. On a few occasions during the course of the test the spectrum accumulation time was momentarily reduced in order to follow changes in fission product concentrations associated with changes in reactor power or carrier gas flow. Spectrum accumulation times as short as 30 minutes were used on these occasions.

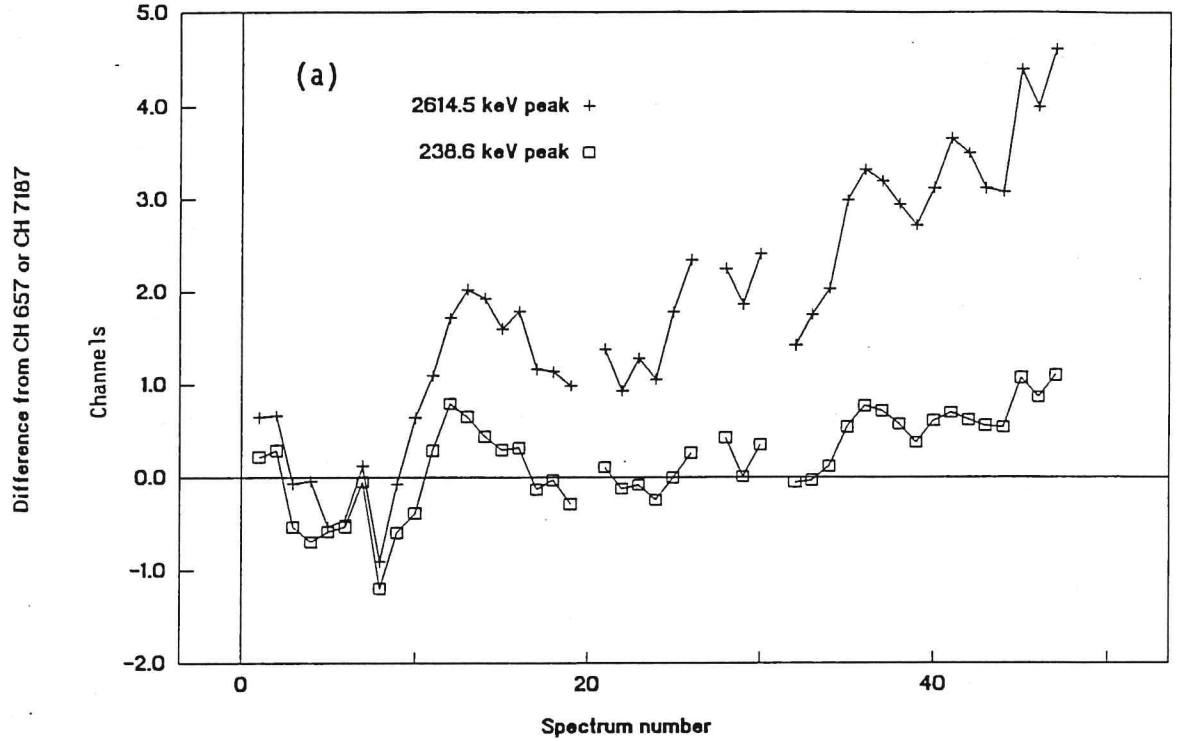
By early December concentrations of fission product noble gases had increased sufficiently to allow using a counting interval shorter than 24 hours. On December 12 the counting interval was reduced to 8 hours and the MCS dwell time was reset to 1.8 seconds. Concentrations of noble gases continued to increase, so the counting interval and MCS dwell time were reduced to 4 hours and 0.9 seconds, respectively, on December 13 and then to 1 hour and 0.3 seconds, respectively, on December 30. On January 2, 1992, the counting interval was increased to 2 hours and then on the following day it was increased to 4 hours. On January 4, the day following reactor shutdown, the counting interval was increased to 24 hours. FPMS measurements were terminated at 08:58 on January 6, 1992. During the course of the NPR-1A Fuel Test a total of 276 sets of gamma-ray pulse height and NaI(Tl) MCS spectra were collected. As one would expect based on the previous discussion, about 75% of the total number of spectra collected were obtained during December, 1991 and January, 1992.

Spectral peaks from gamma rays emitted from thorium daughters in the concrete structures in the vicinity of the FPMS spectrometer were present in collected pulse-height spectra. During the course of the NPR-1A Fuel Test, these background gamma-ray peaks were used to continuously track the energy stability of the spectrometer. Results for the period October 1

through 28, 1991 are shown in Figure 11. Changes in the locations of the centroids of the 238.6 and 2614.5 keV thorium daughter gamma-ray peaks are plotted in Figure 11a, while differences between the VAXGAP-reported energies and the known energies of the two gamma rays are plotted in Figure 11b. Although the differences between reported and known energies shown in Figure 11b were very small, based upon past experience with gamma-ray spectrometers equipped with the dual amplitude pulser, the consensus was that the energy stability of the FPMS spectrometer should have been better than it was. Therefore, the FPMS gamma-ray detector was removed from the 1B Cubicle on October 30, 1991 during the outage between the 94B-2 and 95A-1 Cycles so that the pulser installed on the detector could be replaced. The pulser was replaced and the detector was reinstalled in the FPMS shield on November 5, 1991.

A summary of information regarding the gas grab samples that were collected during the NPR-1A Fuel Test is presented in Table 3. A total of thirteen gas grab samples were collected during October 1991 and subsequently analyzed using the A-1 high-resolution gamma-ray spectrometer in the RML. With the exception of the samples collected October 2 and 25, 1991, each sample was analyzed twice, once for 1 hour soon after its collection and again for 16 hours after having been allowed to decay for between 1 and 5 days. Gas grab samples collected November 27 and December 4, 1991 were also analyzed via gamma-ray spectrometry, however, the analyses results showed that they contained no fission product noble gas activity. Apparently, sometime after October 25 the electrically operated solenoid valve in the 2D Primary Cubicle failed in the bypass position. Due to the high radiation fields in the cubicle, it was not possible to enter the cubicle during the 95B-1 Cycle to repair it. Consequently, no additional gas grab samples were collected and analyzed for concentrations of fission product noble gases.

The carrier gas sample line solenoid valve was repaired during the outage following reactor shutdown on January 3, 1992 and two additional gas grab samples were collected on January 11, 1992. These samples were forwarded to WINCO at the Idaho Chemical Processing Plant (ICPP) for analysis of CO and CO_2.



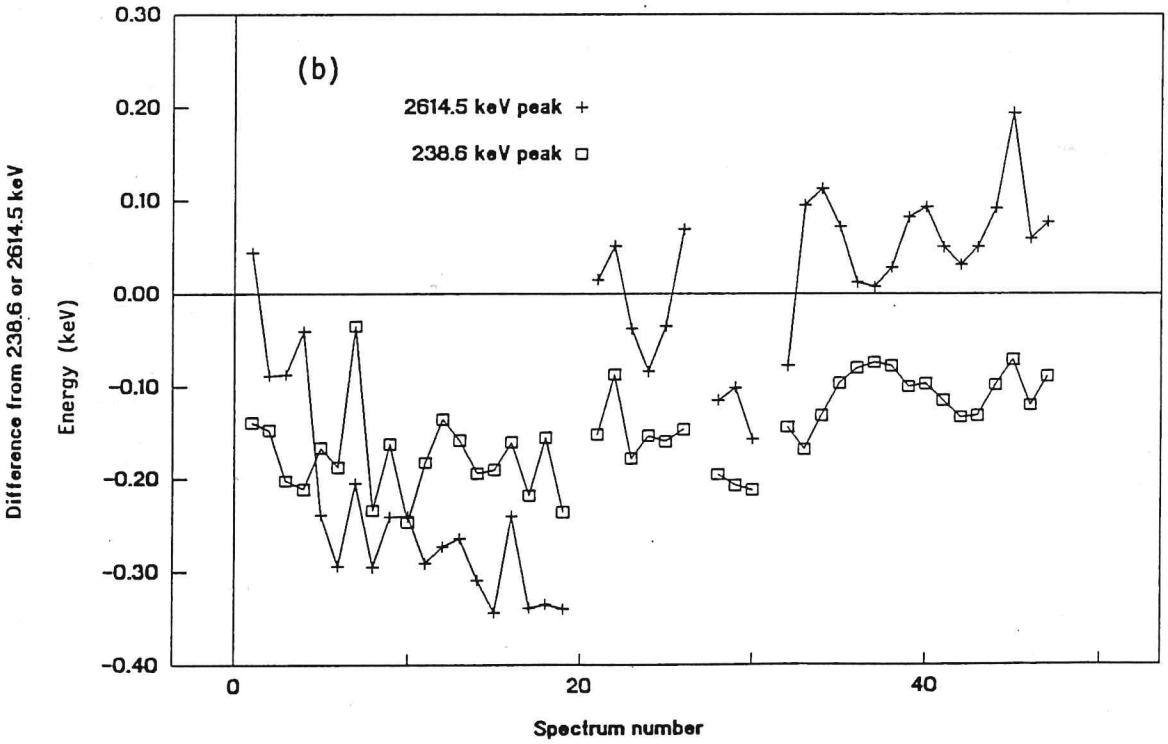


Figure 11. (a) Stability of positions of centroids of 238.6 and 2614.5 keV background spectral peaks as a function of time; (b) Stability of calculated energies of 238.6 and 2614.5 keV background spectral peaks as a function of time.

Table 3. Gas grab samples collected during the NPR-1A Fuel Test

Sample Collection Date	Sample Collection Time	Sample Count Date	Sample Count Time	Count Live Time (hr)	Spectrum ID
10-02-91	14:55	10-02-91	15:38	16	A1100291042
10-03-91	12:54	10-03-91	13:35	1	A1100391024
		10-04-91	16:01	16	A1100491025
10-04-91	14:35	10-04-91	14:56	1	A1100491022
		10-07-91	15:48	16	A1100791033
10-07-91	14:29	10-07-91	14:41	1	A1100791030
		10-10-91	15:10	16	A1101091023
10-08-91	13:58	10-08-91	14:17	1	A1100891025
		10-11-91	16:17	16	A1101191033
10-09-91	12:55	10-09-91	13:12	1	A1100991021
		10-14-91	15:22	16	A1101491031
10-10-91	13:35	10-10-91	13:45	1	A1101091021
		10-15-91	15:47	16	A1101591032
10-18-91	13:33	10-18-91	14:00	1	A1101891024
		10-21-91	15:27	16	A1102191038
10-21-91	13:55	10-21-91	14:05	1	A1102191030
		10-24-91	16:04	16	A1102491034
10-22-91	13:56	10-22-91	14:43	1	A1102291029
		10-25-91	16:00	16	A1102591025
10-23-91	13:45	10-23-91	14:05	1	A1102391031
		10-28-91	15:38	16	A1102891048
10-24-91	12:30	10-24-91	13:00	1	A1102491025
		10-29-91	15:45	16	A1102991031
10-25-91	15:00	10-30-91	15:32	16	A1103091023
11-27-91[a]	13:32	---	---	---	---
12-04-91[a]	13:35	---	---	---	---
01-11-92[b]	18:20	---	---	---	---
01-11-92[b]	19:05	---	---	---	---

a. Carrier gas sample line solenoid valve remained stuck in the bypass position, consequently, the sample was not a valid sample.
b. Sample was collected for analysis of CO and CO_2.

7. DATA QUALIFICATION

The data management plan[14] (DMP) for the NPR-1A Fuel Test describes the methods and processes required to qualify data collected during the course of the experiment. In the case of data collected using the FPMS, the DMP specifies that all on-line and off-line gamma-ray spectral data will be validated by the RML according to established validation procedures[2,8,9,10,12] and will be reviewed and validated by the RML Data Management Committee (DMC). The DMP specifies that the RML DMC will present the validated data, including a discussion of associated uncertainties, to the NPR-1A Data Review Committee (DRC) for their review and action. Specific methods and procedures used to qualify the NPR-1A spectral data are described in the following paragraphs. A discussion of uncertainties is presented in Section 8 along with the experimental results.

As was previously described, the FPMS on-line gamma-ray spectrometer and the off-line gamma-ray spectrometer used to analyze gas grab samples were calibrated with mixed-radionuclide reference materials traceable to NIST. Each spectrometer was subjected to quality assurance/quality control (QA/QC) measurements in accordance with the RML Quality Control Manual,[15] and the RML Quality Implementation Plan, which is described in RML procedure RML-24, "RML Quality Program Implementation."

In order to verify that the removal and reinstallation of the FPMS on-line gamma-ray detector during the outage following Cycle 94B-2 did not change the absolute counting efficiency of the spectrometer, the counting efficiency was remeasured on February 19, 1992, following the removal of the spool piece that was installed during the NPR-1A Fuel Test. With the 6.35-cm diameter collimator aperature installed, the NIST and ^{232}U spool piece calibration standards were each positioned in the spool piece cavity and analyzed three times. The collected gamma-ray spectra were analyzed using the VAXGAP analysis program. Following the procedures previously described, the spectrum analysis results were used to redetermine the full-energy peak counting efficiency of the spectrometer. These results were compared with counting efficiencies at corresponding gamma-ray energies that were measured in September 1991. Counting efficiencies

measured in February, 1992 were between 1% and 2% lower than counting efficiencies measured in September, 1991, so the agreement was within the statistical uncertainties of the measurements.

As one apporach to confirming the validity of the counting efficiency values used for the on-line gamma-ray spectrometer, for a given spectrum, the concentrations calculated by the VAXGAP program for all gamma rays emitted by a given radionuclide were normalized to the concentration calculated for the intensity code-1 (IC-1) gamma ray for the radionuclide. (Normally, for the purpose of analysis, the gamma ray having the highest branching ratio that was also free of interferences from other gamma rays was designated the IC-1 gamma ray. Less intense gamma rays were designated either IC-2 or IC-3, with the IC-3 gamma rays being the least intense.) The relative concentrations of ^{138}Xe and ^{138}Cs as a function of gamma-ray energy are shown in Figures 12a and 12b, respectively, for five different spectra collected during December 1991. The results presented in Figures 12a and 12b show that concentrations calculated for IC-2 and IC-3 gamma rays generally agreed with the IC-1 concentration to within $\pm$ 5% over the energy range 100 keV to 2.5 MeV. This shows that the shape of the counting efficiency curve accurately reflected the relative counting efficiency of the spectrometer as a function of gamma-ray energy.

On-line fission gas spectra were initially analyzed using an isotope library that contained data for more than 50 nuclides. A summary of the analysis results for a spectrum collected January 1, 1992 that was analyzed using this nuclide library is provided in Appendix B, Table B-1. As shown in Table B-1, a number of nuclides other than noble gases were identified as being present in the carrier gas. They included ^{99}Mo, ^{131}I, ^{92}Y, ^{129}Te, ^{116m}In, ^{131}Te, ^{133m}Te, ^{133}I, ^{132}I, ^{54}Mn, and ^{103}Ru. The VAXGAP analysis results for this spectrum and several other spectra were examined in great detail and these same spectra were also analyzed on the RML workstation using the interactive spectrum fit program "GINA". These evaluations showed unequivocally that none of the previously mentioned radionuclides were present in the carrier gas at detectable concentrations. They were being reported as present due to the fact that some very low intensity gamma rays emitted by the fission product noble

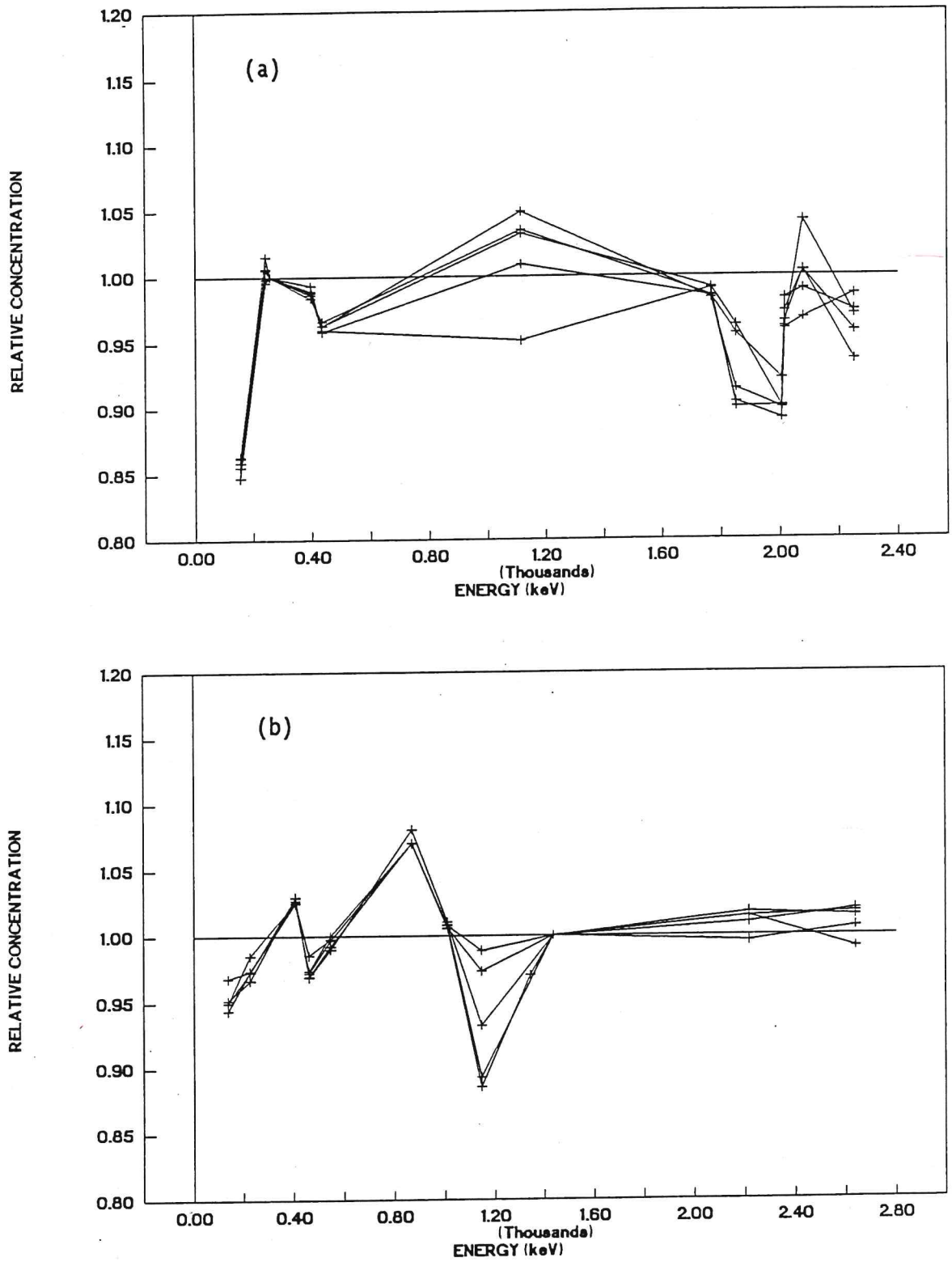


Figure 12. (a) Concentrations of Xe-138 at various gamma-ray energies relative to concentration calculated for the 254.8 keV IC-1 gamma ray; (b) Concentrations of Cs-138 at various gamma-ray energies relative to concentration calculated for the 1435.8 keV IC-1 gamma ray.

gases and a few other radionuclides, that were not included in the analysis nuclide library, have energies very close to the energies of the IC-1 gamma rays emitted by these radionuclides.

The gamma-ray interferences that were identified in a spectrum collected in January, 1992 are listed in Appendix B, Table B-2. As an example, consider ^{131}I, whose signature gamma ray has an energy of 364.483 keV. As shown in Table B-2, ^{138}Cs emits low intensity gamma rays having energies of 363.956 and 365.219 keV and ^{89}Kr emits one having an energy of 365.023 keV, and, as the count rate calculations given in Table B-2 show, together these three gamma rays account for all counts accumulated in the 364 keV photopeak. Iodine-131 was identified and quantified because these three interfering gamma rays were not listed in the isotope library used for spectrum analysis. The results given in Table B-2 show that all of the previously mentioned non-fission gas radionuclides were quantified due to interferences from low intensity gamma rays not included in the analysis isotope library.

Based upon these findings, a new spectrum analysis isotope library was generated that contained only the following 17 isotopes: ^{41}Ar, ^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{88}Rb, ^{89}Kr, ^{89}Rb, ^{90}Kr, ^{131m}Xe, ^{133}Xe, ^{135m}Xe, ^{135}Xe, ^{137}Xe, ^{137}Cs, ^{138}Xe, ^{138}Cs, and ^{139}Xe. A listing of this edited "NPR_FUEL" spectrum analysis isotope library is given in Appendix B, Table B-3. Table B-3 lists the half-life of each radionuclide and the energies, branching ratios, and intensity codes of the gamma rays emitted by each radionuclide. Several IC-2 and IC-3 gamma rays were added to the library that were not in the original library. In addition, the IC-1 gamma ray of ^{90}Kr was changed from the 1118.7 keV gamma ray to the 121.7 keV gamma ray due to the proximity of the 1118.7 keV gamma ray to the 1116.8 keV and 1119.3 keV gamma rays emitted by ^{89}Kr and ^{137}Xe, respectively. Nuclear data in all libraries used for spectrum analysis were taken from R. G. Helmer's unpublished compilation of evaluated nuclear data published in the 1986 edition of the Table of Radioactive Isotopes.[16]

All of the on-line and gas grab sample gamma-ray spectra were reanalyzed during March, 1992 using the abbreviated isotope library given in Table B-3. These spectrum analysis results were then evaluated and

verified using RML procedure DM-1, "Evaluation and Verification of Data for Radionuclide Identification/Selection". Printed summaries of the qualified spectrum analysis results were generated using the VAX "REPORT_BATCH" program, and ASCII text files of the results were made and copied to floppy diskettes for use in calculating R/B ratios.

8. EXPERIMENTAL RESULTS

As was previously discussed, concentrations of fission product noble gases in the NPR-1A carrier gas were measured continuously from October 2, 1991 through January 6, 1992 using the FPMS on-line gamma-ray spectrometer and were also measured periodically during October, 1991 via the analysis of gas grab samples. In the case of the FPMS on-line spectrometer, radionuclide concentrations reported for any given spectrum collection interval are the time-weighted average concentrations during the time the spectrum was accumulated. As is evident from the plot of MCS data shown in Figure 10, radionuclide concentrations often varied considerably during the time a given spectrum was accumulated. In the case of the gas grab samples, radionuclide concentrations reported for any given sample are simply the concentrations in the 150 cm^3 of gas collected. For a flow rate of 60 cm^3/minute, the time required to completely purge the sample cylinder was 2.5 minutes, so results for the grab samples are volume weighted average concentrations during a 2.5-minute long sampling interval.

Radionuclide concentrations measured using the FPMS on-line gamma-ray spectrometer and those determined through the analysis of gas grab samples are presented in the following sections of this report. For each of the 276 gamma-ray spectra collected using the FPMS on-line spectrometer, a plot of the corresponding NaI(Tl) detector MCS results is also presented.

8.1 Radionuclide Concentrations Determined Using the On-line Gamma-ray Spectrometer

The average concentrations of ^{41}Ar, ^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{88}Rb, ^{89}Kr, ^{89}Rb, ^{90}Kr, ^{131m}Xe, ^{133}Xe, ^{135m}Xe, ^{135}Xe, ^{137}Xe, ^{137}Cs, ^{138}Xe, ^{138}Cs,

and ^{139}Xe in the carrier gas at the location of the FPMS on-line gamma-ray spectrometer in the 1B Cubicle are presented in Appendix C, Tables C-1 through C-7 for each spectrum accumulation time interval. Each of the seven tables is prefaced with a table containing, for each gamma-ray pulse height spectrum, the collection date, spectrum file name, sample size, and the spectrum file name of the spectrum used for background subtraction. As shown in the tables, each spectrum file name consists of the prefix "PR" followed by an 8 digit identification number. The first 6 digits following the prefix correspond to the date the spectrum was stored on the MicroVAX II while the last three digits in each spectrum file name correspond to its sequence number among spectra stored on that date. Thus, a spectrum accumulated from one date to the next was always assigned an identification number corresponding to the latter date. For the purpose of analysis, a sample size of 1 cm^3 was always used because the counting efficiency of the on-line spectrometer was expressed as counts/gamma/cm^3. As shown in Table C-1, which begins on page C-4, radionuclide concentrations are listed by spectrum file name expressed as $\mu Ci/cm^3$. Concentrations are reported using scientific notation, so for example, a value of (+2.55 $\pm$ 0.01)E-02 equals 0.0255 $\pm$ 0.0001.

8.1.1 Uncertainties

The VAXGAP[9] program determines the area of a gamma-ray peak by fitting a Gaussian function to it using least squares techniques and then subtracts the spectrum background under the peak. The fitting may be performed in a nonlinear or linear manner. The nonlinear method is normally used to fit prominent spectral peaks and the linear method is used to fit less well defined peaks. In the case of well defined peaks, once the Gaussian function has been fit to the peak data, the peak area is computed as

$$\text{Area} = W \cdot H \cdot \sqrt{\frac{\pi}{4 \ln 2}} \qquad (2)$$

where

W = the Gaussian width at half-maximum, and

H = the Gaussian height.

Because the peak area is derived from two parameters (Gaussian width and height), VAXGAP calculates the estimated standard deviation in the peak area, σ_i, including a covariance term, COVAR:

$$\sigma_i = \sqrt{\frac{R^2}{m \cdot INV \cdot COVAR}} \tag{3}$$

where

m = the number of degrees of freedom,

R^2 = the sum of the squares of the residuals, and

INV = the sum of the height and width squared times their respective inverse matrix elements.

The percentage error in the peak area, PE, is then calculated as

$$PE\ (\%) = \frac{\sigma_i}{Area} \cdot 100 \tag{4}$$

For radionuclides having more than one associated gamma-ray peak, the VAXGAP program computed a single weighted average concentration value from the set of concentration values computed for all detected peaks belonging to the radionuclide. The weighted average concentration, $\overline{C}$, and the associated standard deviation, $\overline{S}$, were calculated by the VAXGAP program using the following formula.[9]

$$\overline{C} = \Sigma \frac{w_i X_i}{\Sigma w_i} \tag{5}$$

$$\overline{S} = \frac{(\Sigma w_i^2 \sigma_i^2)^{1/2}}{\Sigma w_i} \tag{6}$$

where

X_i = μCi value for gamma-ray peak i,

$\sigma_i = \frac{PE \cdot X_i}{100}$ where PE is the percentage error in X_i, and

$w_i = (\sigma_i^2 IC_i)^{-1}$ where IC_i is the intensity code of gamma-ray peak i.

As shown in Table B-3 in Appendix B, ^{41}Ar, ^{133}Xe, ^{131m}Xe, ^{135m}Xe, and ^{137}Cs each emit only one gamma ray of sufficient intensity to be of practical use in quantifying their concentrations. In the case of these five radionuclides, uncertainties given in Appendix C were calculated using Equation (3). The uncertainties in the concentrations of the remaining 12 radionuclides given in Appendix C were each calculated using Equation (6). In all cases, uncertainties given in Tables C-1 through C-7 are given at the one-sigma (68%) confidence level and represent only the uncertainties in the gamma-ray peak areas.

The total uncertainty in each concentration reported in Appendix C may be estimated taking into account uncertainties associated with the absolute counting efficiency of the spectrometer and the branching ratios of the pertinent gamma rays. The concentration for a given gamma-ray peak, C_i, expressed as $\mu Ci/cm^3$, was calculated as

$$C_i = \frac{(\text{Peak Area})_i / (\text{Live Time})}{\epsilon_i \cdot (BR_i) \cdot 3.7 \times 10^4} \qquad (7)$$

where

ϵ_i = counting efficiency at the energy of gamma-ray peak i, expressed as (counts/gamma/cm^3), and

BR_i = branching ratio of peak i gamma ray.

Therefore, the total uncertainty in the concentration calculated for gamma-ray peak i, $(\sigma_T)_i$ may be estimated using the following formula.

$$(\sigma_T)_i = C_i \cdot \sqrt{\left[\frac{\sigma_i}{(\text{Area})_i}\right]^2 + \left[\frac{\sigma_\epsilon}{\epsilon_i}\right]^2 + \left[\frac{\sigma_{BR}}{(BR)_i}\right]^2} \quad (8)$$

where

σ_i = standard deviation in area of gamma-ray peak i,

σ_ϵ = standard deviation in counting efficiency at energy of peak i, and

σ_{BR} = standard deviation in branching ratio of gamma ray at energy of peak i.

As shown in Table A-1 in Appendix A, the combined estimated uncertainties in the gamma-ray emission rates from the NIST reference solution used to prepare one of the calibration spool pieces ranged from 0.6% to 1.3%. As shown in Table A-4 in Appendix A, the standard deviations of the counting efficiency values for the counting efficiency table generated using the 6.35-cm diameter collimator aperature ranged between 2.0% and 3.0% between 86.5 and 1274.4 keV. The standard deviation of the counting efficiency at 2614.5 keV was somewhat larger, being 5.0%. Standard deviations of the counting efficiency and branching ratio for the IC-1 gamma ray of each of the 17 radionuclides of interest are provided in Table 4.

The total uncertainty in the concentration of any given radionuclide may be estimated using Equation (8), the corresponding standard deviation given in Appendix C, and the standard deviations provided in Table 4. For example, if we assume for a given spectrum the standard deviation given in Appendix C is $\pm$ 5.0% for, say, ^{85m}Kr, then by Equation (8), the total uncertainty in the concentration of ^{85m}Kr would be $\pm$ 7.7% at the one-sigma confidence level. The data presented in Table 4 show that for a $\pm$ 5% uncertainty in photopeak area, which was the maximum uncertainty desired for the fission product noble gases, total uncertainties range from $\pm$ 5.4% in the case of ^{41}Ar to $\pm$ 7.8% in the case of ^{139}Xe. As will be discussed in the following section, standard deviations in the photopeak areas of many of the noble gases were consistently well below $\pm$ 5%.

Table 4. Standard deviations of on-line spectrometer counting efficiency values and gamma-ray branching ratios for IC-1 gamma rays

Nuclide	Energy (keV)	Standard Deviation (%)	
		σ_ϵ	σ_{BR}[a]
^{41}Ar	1293.64	2.0	0.02
^{85m}Kr	151.18	2.0	2.40
^{87}Kr	402.64	2.0	4.00
^{88}Kr	2392.14	5.0	2.00
^{88}Rb	1836.08	5.0	3.60
^{89}Kr	586.00	2.0	5.50
^{89}Rb	1032.08	2.0	5.40
^{90}Kr	121.72	2.0	3.30
^{131m}Xe	163.93	2.0	2.10
^{133}Xe	80.99	3.0	1.80
^{135m}Xe	526.56	2.0	1.20
^{135}Xe	249.79	2.0	3.30
^{137}Xe	455.46	2.0	1.60
^{137}Cs	661.66	2.0	0.23
^{138}Xe	258.45	2.0	2.00
^{138}Cs	1435.80	3.0	2.00
^{139}Xe	218.65	2.0	5.60

a. From R. G. Helmer's unpublished nuclear data base.

8.1.2 Discussion of Results

Standard deviations of the concentrations of the 17 radionuclides of interest are given in Table 5 for five typical spectra collected at various times during the course of the experiment using the on-line spectrometer. (The standard deviations shown in Table 5 are standard deviations of photopeak areas.) The date each spectrum was collected and the spectrum accumulation time are also given in Table 5. As indicated in Table 5, of the 12 fission product noble gases, 7 were normally quantified with an uncertainty equal to or better than ± 7% prior to December 12, 1991. Standard deviations of the concentrations of ^{90}Kr, ^{131m}Xe, ^{133}Xe, ^{135m}Xe, and ^{139}Xe were typically greater than 50% prior to

Table 5. Standard deviations of on-line spectrometer spectral peak areas at various times during the course of the NPR-1A Fuel Test (%)

Nuclide	Standard Deviation (%)				
	11/14-15 (24 hr)	12/04-05 (24 hr)	12/12 (3.7 hr)	12/17 (4 hr)	01/01 (1 hr)
^{41}Ar	0.89	0.79	0.84	3.71	21.51
^{85m}Kr	5.28	6.76	0.71	0.42	1.72
^{87}Kr	2.53	3.16	1.55	1.90	1.85
^{88}Kr	4.32	6.95	1.17	0.67	0.74
^{88}Rb	7.73	8.42	1.61	0.96	0.70
^{89}Kr	1.48	1.54	0.65	0.25	0.26
^{89}Rb	1.20	1.27	0.84	0.40	0.34
^{90}Kr	207.56	579.04	59.39	68.11	45.89
^{131m}Xe	125.40	269.26	46.26	124.30	18.23
^{133}Xe	70.23	16856.48	1.58	1.34	2.41
^{135m}Xe	33.86	56.07	3.03	0.33	0.77
^{135}Xe	4.45	5.18	0.96	3.93	0.46
^{137}Xe	2.84	3.98	1.16	0.50	0.43
^{137}Cs	108.64	117.94	68.59	320.96	62.31
^{138}Xe	2.95	3.92	0.97	0.22	0.35
^{138}Cs	2.01	2.27	0.94	0.32	0.20
^{139}Xe	61.84	65.97	27.83	11.49	10.38

December 12 and, therefore, did not meet the detection criterion used by the RML. These five noble gases were the most difficult to detect due to their short half-lives (^{90}Kr, ^{139}Xe), low fission yields (^{131m}Xe, ^{135m}Xe), low specific activity (Xe-133), and/or absence of an intense gamma ray (^{131m}Xe).

For the purpose of reporting results, the RML considers a radionuclide concentration reportable only if its associated photopeak area standard deviation is less than $\pm$ 50%. Such a result is classified as being true-positive. For the results given in Tables C-1 through C-7, each true-positive radionuclide concentration measured using the on-line spectrometer is indicated with a "+" symbol immediately prior to the

parenthesis that preceeds the concentration value. Only the true-positive concentrations are considered meaningful; consequently, only the true-positive results should be used to calculate R/B ratios.

Concentrations of the fission product noble gases increased significantly on December 12, 1991. From this date forward, the standard deviations of the concentrations of the majority of the noble gases remained below ± 2%. Uncertainties in the concentrations of ^{90}Kr, ^{131m}Xe, and ^{139}Xe remained relativley high throughout the test.

A summary of the number of true-positive radionuclide concentrations measured during the NPR-1A Fuel Test using the on-line spectrometer is provided in Table 6. For each of the 17 radionuclides of interest, the number of true-positive concentrations measured during each of 7 different time intervals is shown in Table 6. The data presented in Table 6 show that beginning December 12, 1991, uncertainties in the concentrations of all radionuclides except ^{90}Kr, ^{131m}Xe, and ^{137}Cs remained below ± 50%. Two of the more difficult nuclides to detect, ^{133}Xe and ^{139}Xe, were quantified with uncertainties that were typically less than ± 2% and ± 10%, respectively, beginning December 12, 1991. As shown in Table 6, ^{137}Cs was detected only three times prior to January 1, 1992, but was detected in about 60% of the spectra collected during the following 48 hours. The results for the several spectra collected after the ATR reactor was shut down on January 3, 1992, which are given in Table C-7 on pages C-72 through C-77, show that ^{137}Cs was likely plated out on the inner surfaces of the spool piece. After reactor shutdown, the indicated ^{137}Cs concentration remained constant at 4×10^{-4} $\mu Ci/cm^3$.

8.2 Radionuclide Concentrations Determined Analyzing Gas Grab Samples

The concentrations of 15 of the 17 radionuclides of interest in the carrier gas at the location of the gas grab sampling station in the ATR Second Basement are presented in Appendix D, Table D-1 for each of the 13 gas grab samples collected during October, 1991. Owing to their very short half-lives, ^{90}Kr and ^{139}Xe were not detected in any of the gas grab samples analyzed. As usual, Table D-1 is prefaced with a table

Table 6. Summary of number of true-positive radionuclide concentrations measured using the on-line gamma-ray spectrometer

Nuclide	10/02-10/29	11/05-12/12	12/12-12/16	12/16-12/24	12/24-12/30	12/30-01/01	01/02-01/03
^{41}Ar	30	24	24	48	47	46	25
^{85m}Kr	25	21	24	48	47	48	25
^{87}Kr	24	24	24	48	47	48	25
^{88}Kr	25	22	24	48	47	48	25
^{88}Rb	24	21	24	48	47	48	25
^{89}Kr	25	25	24	48	47	48	25
^{89}Rb	26	24	24	48	47	48	25
^{90}Kr	4	0	8	32	36	31	24
^{131m}Xe	1	2	8	16	32	17	10
^{133}Xe	1	4	24	48	47	48	25
^{135m}Xe	26	23	24	48	47	48	25
^{135}Xe	26	18	24	48	47	48	25
^{137}Xe	25	24	24	48	47	48	25
^{137}Cs	0	1	0	0	1	1	16
^{138}Xe	27	24	24	48	47	48	25
^{138}Cs	27	24	24	48	47	48	25
^{139}Xe	19	5	24	48	47	48	25

containing, for each gamma-ray pulse height spectrum, the analysis date, spectrum file name, sample size, and the spectrum file names of the spectra used for background subtraction.

8.2.1 Uncertainties

Uncertainties given in Table D-1 for radionuclide concentrations in the gas grab samples were calculated in the manner previously described in Section 8.1.1. In all cases, uncertainties given in Table D-1 are given at the one-sigma (68%) confidence level and represent only the uncertainties in the gamma-ray peak areas.

Gamma-ray spectra of the 13 gas bomb samples were analyzed using

counting efficiency results for both the foam-filled and liquid-filled gas cylinder calibration standards. Because the counting efficiency values determined for the liquid-filled calibration standards yielded concentrations that were in better agreement with concentrations measured with the on-line spectrometer, only the concentrations determined using counting efficiency values for the liquid-filled standards are presented. (The counting efficiency data plotted in Figure 7 on page 28 and Equation (7) show that using the counting efficiency values for the foam-filled standard yielded concentrations that were about 20% higher than those determined using the results for the liquid-filled calibration standard).

As shown in Table A-8 in Appendix A, the overall uncertainties in the gamma-ray emission rates from the Amersham reference solution used to prepare one of the liquid-filled gas bomb calibration standards ranged from 0.6% to 4.2%. As shown in Table A-9 in Appendix A, the standard deviations of the counting efficiency values for the counting efficiency table generated using the Amersham and ^{232}U liquid-filled standards ranged between 1.2% and 12.7% between 59.5 and 1836.1 keV. Standard deviations of the counting efficiency and branching ratio for the IC-1 gamma ray of each of the 15 radionuclides that were detected in the gas bomb samples are given in Table 7.

The total uncertainty in the concentration of any given radionuclide may be estimated using Equation (8), the corresponding standard deviation given in Table D-1, and the standard deviations provided in Table 7. The data presented in Table 7 show that for a $\pm$ 5% uncertainty in photopeak area, total uncertainties range from $\pm$ 5.1% in the case of ^{41}Ar to $\pm$ 9.7% in the case of ^{135}Xe. As will be discussed in the following section, standard deviations in the photopeak areas of a number of the noble gases were consistently below $\pm$ 5%.

8.2.2 Discussion of Results

Standard deviations of the concentrations of the 15 radionuclides of interest are given in Table 8 for five of the gas bomb samples collected during October, 1991. The date each grab sample was collected is given in Table 8. As indicated in Table 8, ^{135m}Xe was normally quantified with

Table 7. Standard deviations of off-line gamma-ray spectrometer counting efficiency values and gamma-ray branching ratios for IC-1 gamma rays

Nuclide	Energy (keV)	Standard Deviation (%)	
		σ_ϵ	σ_{BR}[a]
^{41}Ar	1293.64	1.2	0.02
^{85m}Kr	151.18	3.0	2.40
^{87}Kr	402.64	4.4	4.00
^{88}Kr	2392.14	5.0	2.00
^{88}Rb	1836.08	2.7	3.60
^{89}Kr	586.00	3.2	5.50
^{89}Rb	1032.08	2.6	5.40
^{131m}Xe	163.93	2.5	2.10
^{133}Xe	80.99	5.0	1.80
^{135m}Xe	526.56	2.7	1.20
^{135}Xe	249.79	7.6	3.30
^{137}Xe	455.46	4.0	1.60
^{137}Cs	661.66	3.2	0.23
^{138}Xe	258.45	7.6	2.00
^{138}Cs	1435.80	2.0	2.00

a. From R. G. Helmer's unpublished nuclear data base.

an uncertainty less than ± 8%. Uncertainties for ^{133}Xe and ^{138}Xe were usually equal to or better than ± 4%, while those for ^{85m}Kr, ^{87}Kr, ^{88}Kr, and ^{135}Xe were all less than or equal to ± 2%. Standard deviations of the concentrations of ^{89}Kr, ^{131m}Xe, and ^{137}Xe were usually greater than 50%, which is not suprising given the short half-lives of ^{89}Kr and ^{137}Xe, 3.2 and 3.8 minutes, respectively, and the low branching ratio (1.92%) of the IC-1 gamma ray emitted by ^{131m}Xe. As expected, uncertainties for ^{133}Xe were much better than those obtained during October using the on-line spectrometer.

In Table 9, the concentrations of ^{41}Ar and 6 fission product noble gases determined analyzing gas grab samples are compared with corresponding concentrations determined using the on-line spectrometer for

Table 8. Standard deviations of gas grab sample spectral peak areas (%)

Nuclide	Standard Deviation (%)				
	10/07/91	10/08/91	10/09/91	10/21/91	10/22/91
^{41}Ar	0.87	1.26	1.11	1.18	1.08
^{85m}Kr	1.76	1.34	1.25	1.06	0.71
^{87}Kr	0.98	1.07	1.23	0.74	0.78
^{88}Kr	1.01	1.07	0.93	67.45	0.92
^{88}Rb	29.69	49.77	19.75	1.93	34.17
^{89}Kr	375.96	214.60	282.70	108.17	----[a]
^{89}Rb	86.34	100.71	58.98	131.52	79.83
^{131m}Xe	160.45	65.88	120.65	71.18	86.00
^{133}Xe	2.64	3.88	3.36	1.95	3.19
^{135m}Xe	6.11	7.40	7.07	5.04	9.93
^{135}Xe	1.83	2.02	1.96	1.39	1.56
^{137}Xe	61.35	99.32	135.95	527.25	----[a]
^{137}Cs	5.38	8.46	7.74	3.65	3.16
^{138}Xe	3.69	4.02	3.41	2.66	6.12
^{138}Cs	12.24	47.13	81.49	9.68	19.62

a. Not detected.

five gas grab samples collected between October 7 and 22, 1991. For the purpose of comparing concentrations, gas grab sample radionuclide concentrations were corrected for decay during the 13.6 minute transit time from the location of the on-line spectrometer in the 1B Cubicle to the gas grab sampling station in the ATR Second Basement. The on-line spectrometer spectrum accumulation time was 24 hours in each case, but based on the NaI(Tl) detector MCS spectra, fission product concentrations were reasonably constant during each 24 hour period.

The data in Table 9 show that, on these five dates, concentrations of ^{41}Ar, ^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{135m}Xe, ^{135}Xe, and ^{138}Xe determined using the two different methods generally agreed remarkably well. On average, concentrations of the four longer-lived gases- ^{41}Ar, ^{85m}Kr, ^{88}Kr, ^{135}Xe - were slightly higher and the concentrations of the three shorter-lived gases -^{87}Kr, ^{135m}Xe, and ^{138}Xe were slightly lower in

Table 9. Comparison of NPR-1A gas bomb and on-line spectrometer radionculide concentrations

NUCLIDE		T 1/2 (MIN)	Concentration (uCi/cc) GAS BOMB 100791/14:29	DECAY CORRECTED GAS BOMB 100791/14:29	ON-LINE PR100891001	RATIO (BOMB/ON-LINE)
XE	135	546.23	2.239E-05 +/- 1.83	2.278E-05 +/- 1.83	1.665E-05 +/- 10.51	1.37 +/- 0.15
KRM	85	268.80	4.866E-05 +/- 1.76	5.040E-05 +/- 1.76	4.338E-05 +/- 4.88	1.16 +/- 0.06
KR	88	170.40	1.737E-04 +/- 1.01	1.836E-04 +/- 1.01	1.364E-04 +/- 7.87	1.35 +/- 0.11
AR	41	109.60	3.854E-03 +/- 0.87	4.200E-03 +/- 0.87	3.563E-03 +/- 0.61	1.18 +/- 0.01
KR	87	76.31	1.906E-04 +/- 0.98	2.157E-04 +/- 0.98	2.148E-04 +/- 3.44	1.00 +/- 0.04
XEM	135	15.65	4.009E-05 +/- 6.11	7.322E-05 +/- 6.11	8.572E-05 +/- 5.29	0.85 +/- 0.07
XE	138	14.08	1.276E-04 +/- 3.69	2.492E-04 +/- 3.69	3.266E-04 +/- 2.32	0.76 +/- 0.03
			100891/13:58	100891/13:58	PR100991001	(BOMB/ON-LINE)
XE	135	546.23	1.812E-05 +/- 2.00	1.844E-05 +/- 2.00	1.695E-05 +/- 14.15	1.09 +/- 0.16
KRM	85	268.80	4.219E-05 +/- 1.34	4.370E-05 +/- 1.34	3.991E-05 +/- 4.30	1.09 +/- 0.05
KR	88	170.40	1.555E-04 +/- 1.07	1.643E-04 +/- 1.07	1.440E-04 +/- 7.31	1.14 +/- 0.08
AR	41	109.60	3.029E-03 +/- 1.26	3.301E-03 +/- 1.26	3.075E-03 +/- 0.53	1.07 +/- 0.01
KR	87	76.31	1.702E-04 +/- 1.07	1.926E-04 +/- 1.07	2.183E-04 +/- 3.43	0.88 +/- 0.03
XEM	135	15.65	4.093E-05 +/- 7.40	7.476E-05 +/- 7.40	8.135E-05 +/- 4.06	0.92 +/- 0.08
XE	138	14.08	1.420E-04 +/- 4.02	2.774E-04 +/- 4.02	3.143E-04 +/- 2.29	0.88 +/- 0.04
			100991/12:55	100991/12:55	PR101091001	(BOMB/ON-LINE)
XE	135	546.23	1.860E-05 +/- 1.95	1.892E-05 +/- 1.95	1.455E-05 +/- 10.79	1.30 +/- 0.14
KRM	85	268.80	4.444E-05 +/- 1.25	4.603E-05 +/- 1.25	3.878E-05 +/- 3.71	1.19 +/- 0.05
KR	88	170.40	1.541E-04 +/- 0.93	1.629E-04 +/- 0.93	1.483E-04 +/- 9.20	1.10 +/- 0.10
AR	41	109.60	2.805E-03 +/- 1.11	3.057E-03 +/- 1.11	2.679E-03 +/- 0.57	1.14 +/- 0.01
KR	87	76.31	1.756E-04 +/- 1.23	1.987E-04 +/- 1.23	2.028E-04 +/- 2.74	0.98 +/- 0.03
XEM	135	15.65	3.705E-05 +/- 7.07	6.767E-05 +/- 7.07	6.834E-05 +/- 4.35	0.99 +/- 0.08
XE	138	14.08	1.590E-04 +/- 3.41	3.106E-04 +/- 3.41	3.014E-04 +/- 1.81	1.03 +/- 0.04
			102191/13:55	102191/13:55	PR102191001	(BOMB/ON-LINE)
XE	135	546.23	3.071E-05 +/- 1.39	3.124E-05 +/- 1.39	2.243E-05 +/- 9.81	1.39 +/- 0.14
KRM	85	268.80	7.960E-05 +/- 1.06	8.244E-05 +/- 1.06	7.056E-05 +/- 3.00	1.17 +/- 0.04
KR	88	170.40	2.733E-04 +/- 3.00	2.888E-04 +/- 3.00	2.844E-04 +/- 7.00	1.02 +/- 0.08
AR	41	109.60	2.695E-03 +/- 1.18	2.937E-03 +/- 1.18	3.036E-03 +/- 0.95	0.97 +/- 0.01
KR	87	76.31	2.946E-04 +/- 0.74	3.333E-04 +/- 0.74	3.895E-04 +/- 1.73	0.86 +/- 0.02
XEM	135	15.65	5.001E-05 +/- 5.04	9.134E-05 +/- 5.04	1.327E-04 +/- 3.13	0.69 +/- 0.04
XE	138	14.08	1.465E-04 +/- 2.66	2.862E-04 +/- 2.66	4.241E-04 +/- 1.71	0.67 +/- 0.02
			102291/13:56	102291/13:56	PR102291001	(BOMB/ON-LINE)
XE	135	546.23	3.261E-05 +/- 1.54	3.318E-05 +/- 1.54	2.929E-05 +/- 8.66	1.13 +/- 0.10
KRM	85	268.80	8.837E-05 +/- 0.71	9.152E-05 +/- 0.71	7.284E-05 +/- 2.92	1.26 +/- 0.04
KR	88	170.40	3.116E-04 +/- 0.92	3.293E-04 +/- 0.92	2.775E-04 +/- 6.03	1.19 +/- 0.07
AR	41	109.60	2.966E-03 +/- 1.08	3.232E-03 +/- 1.08	2.839E-03 +/- 0.56	1.14 +/- 0.01
KR	87	76.31	3.619E-04 +/- 0.78	4.095E-04 +/- 0.78	3.660E-04 +/- 1.76	1.12 +/- 0.02
XEM	135	15.65	1.107E-04 +/- 9.93	2.022E-04 +/- 9.93	1.331E-04 +/- 2.91	1.52 +/- 0.16
XE	138	14.08	3.576E-04 +/- 6.12	6.985E-04 +/- 6.12	4.299E-04 +/- 1.97	1.62 +/- 0.10

the gas bomb samples compared to corresponding results for the on-line spectrometer. Taking into account the standard deviation of the ratio of bomb concentration to on-line spectrometer concentration, differences in the concentrations of the four longer-lived gases were never greater than about 25% and differences in the concentrations of the three shorter-lived gases were never greater than about 50%. The larger differences for the shorter-lived gases may indicate that sample collection times were not recorded accurately enough or that the actual transit time from the on-line spectrometer to the gas grab sample station was slightly longer or shorter than 13.6 minutes. In the case of ^{135m}Xe and ^{138}Xe, a one minute error in the sample collection or transit time equates to about a 5% error in their concentrations.

The slightly higher concentrations of the longer-lived radionuclides in the gas bomb samples contradicts what one would expect based upon the gas pressures measured for the two gas grab samples collected January 11, 1992. As was previously mentioned, gas pressures in both bombs were measured to be about 7.2 psia, a value only about one-half the predicted pressure of the carrier gas flowing through the spool piece. Gas pressures in the gas grab samples collected during October, 1991 were not measured, so it is impossible to know whether or not the failure of the sampling line solenoid valve during late October or November, 1991 resulted in a permanent change in carrier gas pressure at the grab sampling station.

8.3 NaI(Tl) Scintillation Detector MCS Data

MCS spectra collected during the NPR-1A Fuel Test are plotted in the 270 figures presented in Appendix E. (Owing to the large number of MCS spectra, Appendix E is presented separately in Volume II of this report.) As was previously discussed, each of the figures in Appendix E is a plot of MCS counts versus count time in seconds. To convert the results to count rate as a function of time one simply has to divide the count data by the MCS dwell time. The dwell times used during the test are listed in Table 2.

On October 3, 1991, the gross count rate discriminator window was set

from 200 keV to 4 MeV. This setting was used throughout the remainder of the test. As shown in Table B-3 in Appendix B, the only gamma rays of consequence emitted by ^{133}Xe and ^{131m}Xe have energies below 200 keV. Therefore, changes in the concentrations of these two long-lived fission gases were not reflected in the NaI(Tl) MCS data. However, the body of data presented in Appendix E shows that the MCS did accurately track gross activity in the carrier gas. For example, the MCS spectra collected October 12-13 and November 9-10, 1991 show changes in gross activity that correspond to changes in reactor power during reactor startup. As was previously discussed, fission gas concentrations increased sharply on December 12, 1991. The MCS spectrum collected from 12:18 to 17:03 on December 12, 1991 shows a pronounced spike in gross activity occurred at about 14:21 at the NaI(Tl) detector or at about 14:13 at the fuel compacts test capsule in the reactor. Prior to the spike on December 12, the MCS gross count rate averaged about 25 cps, but after the spike it leveled off at about 140 cps.

Clearly, the MCS data will be useful in determining when individual fuel particles failed; however, some limitations exist and should be taken into consideration. Using the argument that fission gases present in the carrier gas prior to the failure of any fuel particles were produced solely through the fission of tramp uranium in the fuel compacts, one can estimate the change in MCS gross activity due to the failure of a single particle if the ratio of the amount of tramp uranium to the amount of fuel in a single particle is known. If for the sake of argument we assume that the quantity of tramp uranium present in the NPR-1A fuel compacts was approximately equal to the amount of fuel in a single fuel particle, then, in the absence of fuel particle healing, one would expect that fission gas concentrations in the carrier gas would approximately double following the failure of a single particle. The failure of a second fuel particle would then result in a 50% increase in fission gas concentrations, a third particle a 33% increase, a fourth particle a 25% increase, and so forth according to a $1/(n+1)$ function. According to this argument, the failure of a 30^{th} fuel particle would result in only about a 3% change in the concentration of fission gases in the carrier gas. The greater the number of particles that failed, the more difficult the task of ascertaining the exact number that failed.

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APPENDIX A

CALIBRATION DATA FOR GAMMA-RAY SPECTROMETERS

Table A-1. NIST certificate for standard reference material 4276C.

National Institute of Standards & Technology

Certificate

Standard Reference Material 4276C
Radioactivity Standard

MIXED-RADIONUCLIDE SOLUTION STANDARD
for the
EFFICIENCY CALIBRATION OF GERMANIUM-SPECTROMETRY SYSTEMS
Antimony-125-Tellurium-125m
Europium-154
Europium-155

Source identification	SRM 4276C-97
Source description	Liquid in NIST borosilicate-glass ampoule (1)*
Solution composition	30 μg Sb^{+3} and 30 μg Eu^{+3} per gram of 4 M hydrochloric acid
Mass	5.2674 grams
Reference time	1200 EST September 1, 1988

This standard is intended for use in measuring the full-energy-peak efficiencies of spectrometry systems for x and gamma rays from 27 to 1596 keV, provided that the responses to radiations approximately 5 keV apart can be resolved. Emission rates are specified at 18 energies for photon radiations from a mixture of antimony-125-tellurium-125m, europium-154, and europium-155. Uncertainties are estimated and combined at a level corresponding to a standard deviation of the mean, with the intent that the user can propagate this uncertainty along with the other uncertainties in the spectrometer calibration. For a more conservative overall uncertainty corresponding to that given on other NIST radioactivity certificates, multiply the combined uncertainty by three.

Table 1 gives the energies, emission rates, and uncertainties for selected radiations. A footnote indicates how emission rates will change with time. If there are any changes in measured emission rates that would correspond to an emission rate 0.5 percent different from that calculated from Table 1, or in measured half lives that would cause a corresponding difference after five years, notification will be sent to purchasers of the standard.

Table 2 lists the estimates of component uncertainties which have been added in quadrature to give the combined uncertainty in each emission rate.

Notes on the use of this standard are appended. One of the tables in the supplemental notes gives relative emission rates for radiations close in energy to the certified radiations; for spectrometry systems of poorer resolution, it may be necessary to use a combined emission rate for some multiple peaks.

This Standard Reference Material was prepared in the Center for Radiation Research, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD 20899
September 1988

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

*Notes on page 4

Table A-1. (Continued)

X-Ray and Gamma-Ray Energies, Emission Rates [2,3], and Uncertainties for Standard Reference Material 4276C

Radionuclide	Photon Energy (keV)	Emission Rate ($x\ s^{-1}g^{-1}$) or ($\gamma\ s^{-1}g^{-1}$) 1200 EST September 1, 1988	Combined Estimated Uncertainty (%)*
^{125}Sb-^{125m}Te	Kα, 27.4	7.318×10^3	1.3
^{154}Eu-^{155}Eu	Kα, 42.8	4.317×10^3	1.3
^{155}Eu	86.5	1.652×10^3	0.9
^{155}Eu	105.3	1.150×10^3	1.3
^{154}Eu	123.1	6.722×10^3	0.8
^{125}Sb	176.3	8.029×10^2	0.6
^{154}Eu	247.9	1.139×10^3	0.6
^{125}Sb	427.9	3.490×10^3	0.8
^{125}Sb	463.4	1.227×10^3	0.7
^{154}Eu	591.8	8.155×10^2	0.6
^{125}Sb	600.6	2.073×10^3	0.7
^{125}Sb	636.0	1.325×10^3	0.6
^{154}Eu	723.3	3.309×10^3	0.6
^{154}Eu	873.2	2.008×10^3	0.7
^{154}Eu	996.3	1.720×10^3	0.9
^{154}Eu	1004.7	2.981×10^3	0.7
^{154}Eu	1274.4	5.746×10^3	0.5
^{154}Eu	1596.5	2.921×10^2	0.7

*Estimated total uncertainties have the significance of one standard deviation of the mean. Components of these estimates are given in Table 2.

SRM 4276C

Table A-2. Quality file for energy calibration measurement results.

THOR. CALIBRATION-RML "PEQ" 19-FEB-1992 10:04:13.03

DETECTOR SYSTEM: PR

ZERO= -0.5809
ENERGY= 0.2649+ 0.36340(X)+ 2.76121E-08(X)**2

WIDTH= 3.694+ 5.5319E-04(X)

ERROR MATRIX: 8.806596E-05 1.062876E-10 2.141012E-18 -8.882345E-08 1.123145E-11 -1.414230E-14

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
656.486	238.632	238.631	0.001	3.95
1604.496	583.191	583.195	-0.004	4.50
2367.462	860.564	860.539	0.025	4.93
4458.209	1620.735	1620.705	0.030	6.71
7190.622	2614.533	2614.536	-0.003	7.38

LOW PULSER EQUIVALENT: 257.28 HIGH PULSER EQUIVALENT: 2614.28

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
656.47	3.9	238.62	151681.	522	1.591E-02	0.3		
662.93	3.9	240.97	14245.	522	1.605E-02	1.3		
1604.50	4.5	583.19	34217.	520	5.097E-03	0.7		
2000.86	4.6	727.27	6445.	512	4.422E-03	2.1		
2367.46	4.9	860.54	3640.	520	3.681E-03	1.7		
4458.21	6.7	1620.70	663.	520	2.019E-03	4.9		
7190.58	7.5	2614.52	8595.	8	1.088E-03	1.6		
							1.088E-03	1.6

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
112591	0933	238.6	3.8	1.59E-02	0.3	522	583.2	4.4	5.07E-03	0.6	520	860.6	4.8	3.77E-03	1.7	520
120291	1023		3.9	1.62E-02	0.3	522		4.4	5.15E-03	0.6	520		4.9	3.82E-03	2.0	520
012892	1131		3.8	1.59E-02	0.3	522		4.4	5.10E-03	1.0	520		5.0	3.70E-03	1.7	520
012892	1135		3.9	1.60E-02	0.3	522		4.5	5.16E-03	0.6	520		4.8	3.74E-03	1.9	520
021992	0919		3.9	1.58E-02	0.3	522		4.5	5.13E-03	0.6	520		4.9	3.84E-03	2.5	520
021992	1004		3.9	1.59E-02	0.3	522		4.5	5.10E-03	0.7	520		4.9	3.68E-03	1.7	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET_UCURIE	%ERR	LPEQ	HPEQ
112591	0933	1620.7	6.0	2.30E-03	5.0	520	2614.5	7.3	1.09E-03	1.2	8	-1.45	0.364	1.0931E-03	1.2	257.2	2614.4
120291	1023		6.2	2.23E-03	4.4	520		7.5	1.09E-03	1.5	8	-2.12	0.363	1.0913E-03	1.5	257.2	2614.5
012892	1131		6.0	2.09E-03	4.8	520		7.5	1.10E-03	1.1	8	-1.69	0.363	1.0993E-03	1.1	257.3	2614.4
012892	1135		6.4	2.02E-03	4.8	520		7.5	1.12E-03	1.1	8	-1.51	0.363	1.1151E-03	1.1	257.2	2614.3
021992	0919		6.3	2.05E-03	6.3	520		7.5	1.09E-03	1.1	8	-0.65	0.363	1.0949E-03	1.1	257.3	2614.3
021992	1004		6.7	2.02E-03	4.9	520		7.5	1.09E-03	1.6	8	-0.58	0.363	1.0878E-03	1.6	257.3	2614.3

Table A-2. (Continued)

THO1 CALIBRATION-RML "PEQ" 28-JAN-1992 11:30:50.32

DETECTOR SYSTEM: PR

ZERO= -1.6883
ENERGY= 0.2583+ 0.36337(X)+ 2.66665E-08(X)**2

WIDTH= 3.592+ 5.4903E-04(X)

ERROR MATRIX: 1.323269E-04 1.368134E-10 2.626208E-18 -1.239303E-07 1.536860E-11 -1.786452E-14

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
657.662	238.632	238.632	0.000	3.96
1605.740	583.191	583.193	-0.002	4.43
2368.760	860.564	860.534	0.031	4.97
4459.877	1620.735	1620.766	-0.031	5.98
7192.393	2614.533	2614.532	0.001	7.56

LOW PULSER EQUIVALENT: 257.31 HIGH PULSER EQUIVALENT: 2614.44

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.64	3.8	238.62	151345.	522	1.592E-02	0.3		
664.08	3.8	240.96	13923.	522	1.573E-02	1.1		
1605.74	4.4	583.19	34184.	520	5.097E-03	1.0		
2002.17	4.5	727.28	6492.	512	4.455E-03	1.3		
2368.76	5.0	860.53	3659.	520	3.698E-03	1.7		
4459.87	6.0	1620.76	686.	520	2.085E-03	4.8		
7192.38	7.5	2614.53	8715.	8	1.099E-03	1.1		
							1.099E-03	1.1

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
110791	1442	238.6	4.0	1.57E-02	0.4	522	583.2	4.6	5.06E-03	0.7	520	860.6	5.0	3.83E-03	1.7	520
110791	1504		4.0	1.57E-02	0.3	522		4.6	5.04E-03	0.6	520		5.1	3.81E-03	1.8	520
112591	0916		3.8	1.58E-02	0.3	522		4.4	5.11E-03	0.6	520		4.9	3.79E-03	2.1	520
112591	0933		3.8	1.59E-02	0.3	522		4.4	5.07E-03	0.6	520		4.8	3.77E-03	1.7	520
120291	1023		3.9	1.62E-02	0.3	522		4.4	5.15E-03	0.6	520		4.9	3.82E-03	2.0	520
012892	1131		3.8	1.59E-02	0.3	522		4.4	5.10E-03	1.0	520		5.0	3.70E-03	1.7	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET UCURIE	%ERR	LPEQ	HPEQ
110791	1442	1620.7	6.2	2.26E-03	5.2	520	2614.5	7.5	1.12E-03	1.4	8	-1.98	0.364	1.1159E-03	1.4	257.3	2614.4
110791	1504		6.2	1.95E-03	5.6	520		7.5	1.08E-03	1.3	8	-1.97	0.364	1.0771E-03	1.3	257.3	2614.3
112591	0916		6.3	2.21E-03	5.7	520		7.4	1.09E-03	1.9	8	-1.50	0.363	1.0938E-03	1.9	257.3	2614.4
112591	0933		6.0	2.30E-03	5.0	520		7.3	1.09E-03	1.2	8	-1.45	0.364	1.0931E-03	1.2	257.2	2614.4
120291	1023		6.2	2.23E-03	4.4	520		7.5	1.09E-03	1.5	8	-2.12	0.363	1.0913E-03	1.5	257.2	2614.5
012892	1131		6.0	2.09E-03	4.8	520		7.5	1.10E-03	1.1	8	-1.69	0.363	1.0993E-03	1.1	257.3	2614.4

Table A-2. (Continued)

THO .A CALIBRATION-RML "PEQ" 25-NOV-1991 09:33:04.12

DETECTOR SYSTEM: PR

ZERO= -1.4456
ENERGY= 0.2542+ 0.36351(X)+ 2.62323E-08(X)**2

WIDTH= 3.556+ 5.1249E-04(X)

ERROR MATRIX: 9.405251E-05 1.091277E-10 2.175144E-18 -9.305547E-08 1.171019E-11 -1.445756E-14

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
657.183	238.632	238.632	0.000	3.88
1604.905	583.191	583.193	-0.002	4.40
2367.644	860.564	860.535	0.029	4.85
4457.979	1620.735	1620.764	-0.029	5.68
7189.506	2614.533	2614.532	0.001	7.31

LOW PULSER EQUIVALENT: 257.25 HIGH PULSER EQUIVALENT: 2614.38

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.16	3.8	238.62	151753.	522	1.589E-02	0.3		
663.60	3.8	240.96	13979.	522	1.573E-02	1.1		
1604.90	4.4	583.19	34097.	520	5.071E-03	0.6		
2001.20	4.6	727.29	6578.	512	4.506E-03	1.3		
2367.64	4.8	860.53	3738.	520	3.773E-03	1.7		
4457.83	6.0	1620.71	757.	520	2.302E-03	5.0		
7189.51	7.3	2614.53	8656.	8	1.093E-03	1.2		
							1.093E-03	1.2

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
110691	1320	238.6	4.0	1.59E-02	0.3	522	583.2	4.6	5.10E-03	0.6	520	860.6	5.0	3.68E-03	1.7	520
110691	1409		4.0	1.58E-02	0.4	522		4.6	5.00E-03	0.6	522		5.0	3.88E-03	1.7	520
110791	1442		4.0	1.57E-02	0.4	522		4.6	5.06E-03	0.7	520		5.0	3.83E-03	1.7	520
110791	1504		4.0	1.57E-02	0.3	522		4.6	5.04E-03	0.6	520		5.1	3.81E-03	1.8	520
112591	0916		3.8	1.58E-02	0.3	522		4.4	5.11E-03	0.6	520		4.9	3.79E-03	2.1	520
112591	0933		3.8	1.59E-02	0.3	522		4.4	5.07E-03	0.6	520		4.8	3.77E-03	1.7	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET_UCURIE	%ERR	LPEQ	HPEQ
110691	1320	1620.7	6.0	2.13E-03	5.0	520	2614.5	7.6	1.10E-03	1.5	8	-2.20	0.364	1.1036E-03	1.5	257.3	2614.4
110691	1409		5.8	2.09E-03	4.6	520		7.5	1.09E-03	1.5	8	-2.19	0.364	1.0902E-03	1.5	257.3	2614.4
110791	1442		6.2	2.26E-03	5.2	520		7.5	1.12E-03	1.4	8	-1.98	0.364	1.1159E-03	1.4	257.3	2614.4
110791	1504		6.2	1.95E-03	5.6	520		7.5	1.08E-03	1.3	8	-1.97	0.364	1.0771E-03	1.3	257.3	2614.3
112591	0916		6.3	2.21E-03	5.7	520		7.4	1.09E-03	1.9	8	-1.50	0.363	1.0938E-03	1.9	257.3	2614.4
112591	0933		6.0	2.30E-03	5.0	520		7.3	1.09E-03	1.2	8	-1.45	0.364	1.0931E-03	1.2	257.2	2614.4

Table A-2. (Continued)

THORIUM CALIBRATION-RML "PEQ" 6-NOV-1991 09:26:38.69

PR110691002

DETECTOR SYSTEM: PR

ZERO= -2.1616
ENERGY= 0.2411+ 0.36279(X)+ 2.43587E-08(X)**2

WIDTH= 3.805+ 5.4171E-04(X)

ERROR MATRIX: 1.837969E-05 2.189207E-11 4.371308E-19 -1.841762E-08 2.320684E-12 -2.902294E-15

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
659.246	238.632	238.632	0.000	4.12
1608.862	583.191	583.191	0.000	4.58
2373.193	860.564	860.553	0.011	5.00
4467.694	1620.735	1620.756	-0.021	6.68
7204.845	2614.533	2614.531	0.001	7.48

LOW PULSER EQUIVALENT: 257.49 HIGH PULSER EQUIVALENT: 2615.10

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
659.22	4.0	238.62	151415.	522	1.585E-02	0.3		
665.72	4.0	240.98	13701.	522	1.540E-02	1.1		
1608.86	4.6	583.19	34067.	520	5.067E-03	0.8		
2006.05	4.8	727.32	6488.	512	4.446E-03	1.3		
2373.19	5.0	860.55	3682.	520	3.719E-03	1.9		
4467.69	6.7	1620.76	639.	520	1.947E-03	5.0		
7204.82	7.5	2614.52	8822.	8	1.116E-03	1.1		
							1.116E-03	1.1

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
101591	0958	238.6	3.7	1.60E-02	0.5	522	583.2	4.3	5.08E-03	0.7	520	860.6	4.8	3.83E-03	1.7	520
101591	1013		3.7	1.60E-02	0.5	522		4.3	5.16E-03	0.7	520		4.7	3.78E-03	1.7	520
101691	1457		3.7	1.60E-02	0.4	522		4.3	5.17E-03	0.6	520		4.7	3.61E-03	2.4	520
101691	1511		3.7	1.60E-02	0.4	522		4.3	5.13E-03	0.6	520		4.9	3.76E-03	2.3	520
110591	1553		4.1	1.60E-02	0.7	520		4.6	5.10E-03	0.6	520		5.0	3.78E-03	1.7	520
110691	0927		4.0	1.58E-02	0.3	522		4.6	5.07E-03	0.8	520		5.0	3.72E-03	1.9	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET UCURIE	%ERR	LPEQ	HPEQ
101591	0958	1620.7	5.8	2.21E-03	6.6	520	2614.5	7.3	1.10E-03	1.1	8	-2.05	0.364	1.1046E-03	1.1	263.0	2635.3
101591	1013		6.1	2.08E-03	4.7	520		7.3	1.09E-03	1.4	8	-2.12	0.364	1.0933E-03	1.4	263.0	2635.4
101691	1457		6.7	2.19E-03	4.5	520		7.4	1.10E-03	1.4	8	-1.54	0.364	1.0971E-03	1.4	263.1	2635.6
101691	1511		5.5	1.95E-03	4.7	520		7.4	1.08E-03	1.3	8	-1.51	0.364	1.0804E-03	1.3	263.1	2635.6
110591	1553		6.8	2.15E-03	4.6	520		7.6	1.10E-03	1.5	8	-2.44	0.363	1.0978E-03	1.5	257.5	2615.1
110691	0927		6.7	1.95E-03	5.0	520		7.5	1.12E-03	1.1	8	-2.16	0.363	1.1160E-03	1.1	257.5	2615.1

Table A-2. (Continued)

THORIUM CALIBRATION-RML "PEQ" 16-OCT-1991 15:10:47.43

DETECTOR SYSTEM: PR

ZERO= -1.5088
ENERGY= 0.2648+ 0.36354(X)+ 2.69276E-08(X)**2

WIDTH= 3.420+ 5.4549E-04(X)

ERROR MATRIX: 6.359763E-06 7.359733E-12 1.466173E-19 -6.284346E-09 7.907372E-13 -9.749306E-16

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
657.166	238.632	238.632	0.000	3.78
1604.808	583.191	583.192	-0.001	4.29
2367.552	860.564	860.559	0.005	4.88
4457.520	1620.735	1620.723	0.012	5.54
7188.896	2614.533	2614.534	-0.001	7.48

LOW PULSER EQUIVALENT: 263.06 HIGH PULSER EQUIVALENT: 2635.59

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.14	3.7	238.62	151048.	522	1.602E-02	0.4		
663.57	3.7	240.96	14000.	522	1.595E-02	1.3		
1604.81	4.3	583.19	34212.	520	5.131E-03	0.6		
2001.07	4.6	727.28	6471.	512	4.462E-03	1.6		
2367.55	4.9	860.56	3709.	520	3.762E-03	2.3		
4457.52	5.5	1620.72	642.	520	1.951E-03	4.7		
7188.92	7.4	2614.54	8558.	8	1.080E-03	1.3		
							1.080E-03	1.3

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
101191	1043	238.6	3.7	1.59E-02	0.3	522	583.2	4.3	5.07E-03	1.0	520	860.6	4.5	3.76E-03	2.4	520
101591	0932		3.7	1.60E-02	0.4	522		4.3	5.10E-03	0.8	520		4.8	3.74E-03	2.0	520
101591	0958		3.7	1.60E-02	0.5	522		4.3	5.08E-03	0.7	520		4.8	3.83E-03	1.7	520
101591	1013		3.7	1.60E-02	0.5	522		4.3	5.16E-03	0.7	520		4.7	3.78E-03	1.7	520
101691	1457		3.7	1.60E-02	0.4	522		4.3	5.17E-03	0.6	520		4.7	3.61E-03	2.4	520
101691	1511		3.7	1.60E-02	0.4	522		4.3	5.13E-03	0.6	520		4.9	3.76E-03	2.3	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET UCURIE	%ERR	LPEQ	HPEQ
101191	1043	1620.7	5.8	2.21E-03	4.8	520	2614.5	7.5	1.11E-03	1.1	8	-1.83	0.364	1.1144E-03	1.1	263.0	2635.4
101591	0932		5.7	2.12E-03	4.5	520		7.3	1.10E-03	2.0	8	-2.09	0.364	1.1022E-03	2.0	263.0	2635.4
101591	0958		5.8	2.21E-03	6.6	520		7.3	1.10E-03	1.1	8	-2.05	0.364	1.1046E-03	1.1	263.0	2635.3
101591	1013		6.1	2.08E-03	4.7	520		7.3	1.09E-03	1.4	8	-2.12	0.364	1.0933E-03	1.4	263.0	2635.4
101691	1457		6.7	2.19E-03	4.5	520		7.4	1.10E-03	1.4	8	-1.54	0.364	1.0971E-03	1.4	263.1	2635.6
101691	1511		5.5	1.95E-03	4.7	520		7.4	1.08E-03	1.3	8	-1.51	0.364	1.0804E-03	1.3	263.1	2635.6

Table A-2. (Continued)

THOR...M CALIBRATION-RML "PEQ" 15-OCT-1991 09:57:55.47

DETECTOR SYSTEM: PR

ZERO= -2.0509
ENERGY= 0.2524+ 0.36351(X)+ 2.57067E-08(X)**2

WIDTH= 3.488+ 5.1639E-04(X)

ERROR MATRIX: 7.287793E-05 7.624656E-11 1.473236E-18 -6.864324E-08 8.529007E-12 -9.978112E-15

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
657.768	238.624	238.624	0.000	3.76
1605.458	583.174	583.175	-0.001	4.30
2368.181	860.530	860.511	0.019	4.81
4458.513	1620.700	1620.736	-0.036	5.78
7189.983	2614.476	2614.474	0.002	7.18

LOW PULSER EQUIVALENT: 263.00 HIGH PULSER EQUIVALENT: 2635.34

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.74	3.7	238.61	151485.	522	1.601E-02	0.5		
664.17	3.7	240.95	13996.	522	1.589E-02	1.8		
1605.46	4.3	583.17	33905.	520	5.076E-03	0.7		
2001.74	4.6	727.26	6604.	512	4.549E-03	1.3		
2368.18	4.8	860.51	3781.	520	3.834E-03	1.7		
4458.51	5.8	1620.73	725.	520	2.210E-03	6.6		
7189.96	7.3	2614.46	8735.	8	1.105E-03	1.1		
							1.105E-03	1.1

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
101191	0922	238.6	3.7	1.50E-02	0.4	522	583.2	4.3	4.85E-03	0.6	520	860.5	4.7	3.53E-03	1.8	520
101191	1001		3.7	1.59E-02	0.3	522		4.2	5.10E-03	0.6	520		4.8	3.79E-03	1.7	520
101191	1029		3.7	1.58E-02	0.3	522		4.3	5.13E-03	0.6	520		4.8	3.70E-03	1.7	520
101191	1043		3.7	1.59E-02	0.3	522		4.3	5.07E-03	1.0	520		4.5	3.76E-03	2.4	520
101591	0932		3.7	1.60E-02	0.4	522		4.3	5.10E-03	0.8	520		4.8	3.74E-03	2.0	520
101591	0958		3.7	1.60E-02	0.5	522		4.3	5.08E-03	0.7	520		4.8	3.83E-03	1.7	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET_UCURIE	%ERR	LPEQ	HPEQ
101191	0922	1620.7	6.0	2.01E-03	7.0	520	2614.5	7.3	1.04E-03	1.3	8	-1.88	0.364	1.0372E-03	1.3	263.0	2635.3
101191	1001		6.0	1.96E-03	4.8	520		7.5	1.09E-03	1.8	8	-1.90	0.364	1.0911E-03	1.8	263.0	2635.4
101191	1029		5.7	2.05E-03	5.4	520		7.3	1.08E-03	1.6	8	-1.89	0.364	1.0790E-03	1.6	263.0	2635.4
101191	1043		5.8	2.21E-03	4.8	520		7.5	1.11E-03	1.1	8	-1.83	0.364	1.1144E-03	1.1	263.0	2635.4
101591	0932		5.7	2.12E-03	4.5	520		7.3	1.10E-03	2.0	8	-2.09	0.364	1.1022E-03	2.0	263.0	2635.4
101591	0958		5.8	2.21E-03	6.6	520		7.3	1.10E-03	1.1	8	-2.05	0.364	1.1046E-03	1.1	263.0	2635.3

Table A-2. (Continued)

THOR ALIBRATION-RML "PEQ" 11-OCT-1991 10:43:00.74

DETECTOR SYSTEM: PR

ZERO= -1.8296
ENERGY= 0.2897+ 0.36353(X)+ 3.02651E-08(X)**2

WIDTH= 3.329+ 5.6336E-04(X)

ERROR MATRIX: 1.108437E-04 1.340308E-10 2.701783E-18 -1.118666E-07 1.415764E-11 -1.784801E-14

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
657.410	238.624	238.623	0.001	3.74
1605.045	583.174	583.178	-0.004	4.30
2367.654	860.530	860.498	0.032	4.55
4457.606	1620.700	1620.682	0.018	5.79
7188.731	2614.476	2614.479	-0.003	7.43

LOW PULSER EQUIVALENT: 263.02 HIGH PULSER EQUIVALENT: 2635.40

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.39	3.7	238.61	150203.	522	1.587E-02	0.3		
663.80	3.7	240.94	13778.	522	1.563E-02	1.2		
1605.05	4.3	583.17	33865.	520	5.065E-03	1.0		
2001.23	4.5	727.24	6552.	512	4.509E-03	1.5		
2367.68	4.5	860.50	3717.	520	3.765E-03	2.4		
4457.61	5.8	1620.68	725.	520	2.205E-03	4.8		
7188.72	7.5	2614.47	8826.	8	1.114E-03	1.1		
							1.114E-03	1.1

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
093091	1053	238.6	3.7	1.63E-02	0.3	522	583.2	4.3	5.20E-03	0.6	520	860.5	4.8	3.94E-03	1.7	520
093091	1124		3.7	1.63E-02	0.5	522		4.3	5.21E-03	0.8	522		4.9	3.93E-03	1.7	520
101191	0922		3.7	1.50E-02	0.4	522		4.3	4.85E-03	0.6	520		4.7	3.53E-03	1.8	520
101191	1001		3.7	1.59E-02	0.3	522		4.2	5.10E-03	0.6	520		4.8	3.79E-03	1.7	520
101191	1029		3.7	1.58E-02	0.3	522		4.3	5.13E-03	0.6	520		4.8	3.70E-03	1.7	520
101191	1043		3.7	1.59E-02	0.3	522		4.3	5.07E-03	1.0	520		4.5	3.76E-03	2.4	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET UCURIE	%ERR	LPEQ	HPEQ
093091	1053	1620.7	5.7	2.30E-03	4.4	520	2614.5	7.2	1.11E-03	1.1	8	-1.83	0.364	1.1100E-03	1.1	263.0	2635.1
093091	1124		5.6	2.12E-03	4.5	520		7.3	1.11E-03	1.8	8	-1.85	0.364	1.1121E-03	1.8	263.0	2635.1
101191	0922		6.0	2.01E-03	7.0	520		7.3	1.04E-03	1.3	8	-1.88	0.364	1.0372E-03	1.3	263.0	2635.3
101191	1001		6.0	1.96E-03	4.8	520		7.5	1.09E-03	1.8	8	-1.90	0.364	1.0911E-03	1.8	263.0	2635.4
101191	1029		5.7	2.05E-03	5.4	520		7.3	1.08E-03	1.6	8	-1.89	0.364	1.0790E-03	1.6	263.0	2635.4
101191	1043		5.8	2.21E-03	4.8	520		7.5	1.11E-03	1.1	8	-1.83	0.364	1.1144E-03	1.1	263.0	2635.4

Table A-2. (Continued)

THORI. .ALIBRATION-RML "PEQ" 11-OCT-1991 10:01:17.46

DETECTOR SYSTEM: PR

ZERO= -1.9002
ENERGY= 0.2847+ 0.36353(X)+ 2.88157E-08(X)**2

WIDTH= 3.401+ 5.6946E-04(X)

ERROR MATRIX: 2.878220E-05 3.480011E-11 7.035501E-19 -2.905834E-08 3.678034E-12 -4.636115E-15

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
657.497	238.624	238.624	0.000	3.74
1605.125	583.174	583.174	0.000	4.25
2367.812	860.530	860.518	0.012	4.83
4457.896	1620.700	1620.731	-0.031	6.02
7188.994	2614.476	2614.474	0.002	7.44

LOW PULSER EQUIVALENT: 263.02 HIGH PULSER EQUIVALENT: 2635.35

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.48	3.7	238.61	149955.	522	1.587E-02	0.3		
663.93	3.7	240.96	13696.	522	1.557E-02	1.1		
1605.13	4.2	583.17	34021.	520	5.095E-03	0.6		
2001.40	4.6	727.27	6501.	512	4.478E-03	1.8		
2367.81	4.8	860.52	3737.	520	3.787E-03	1.7		
4457.90	6.0	1620.73	644.	520	1.958E-03	4.8		
7188.97	7.5	2614.47	8645.	8	1.091E-03	1.8		
							1.091E-03	1.8

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
091791	1307	238.6	3.6	1.62E-02	0.3	522	583.2	4.2	5.16E-03	0.6	520	860.5	4.7	3.78E-03	2.0	520
092791	1049		3.6	1.62E-02	0.3	522		4.2	5.16E-03	0.6	520		4.7	3.78E-03	2.0	520
093091	1053		3.7	1.63E-02	0.3	522		4.3	5.20E-03	0.6	520		4.8	3.94E-03	1.7	520
093091	1124		3.7	1.63E-02	0.5	522		4.3	5.21E-03	0.8	522		4.9	3.93E-03	1.7	520
101191	0922		3.7	1.50E-02	0.4	522		4.3	4.85E-03	0.6	520		4.7	3.53E-03	1.8	520
101191	1001		3.7	1.59E-02	0.3	522		4.2	5.10E-03	0.6	520		4.8	3.79E-03	1.7	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET UCURIE	%ERR	LPEQ	HPEQ
091791	1307	1620.7	5.8	2.13E-03	5.1	520	2614.5	7.1	1.09E-03	1.5	8	-2.46	0.364	1.0946E-03	1.5	262.1	2628.2
092791	1049		5.8	2.12E-03	5.5	520		7.1	1.09E-03	1.5	8	-2.45	0.364	1.0947E-03	1.5	262.1	2628.2
093091	1053		5.7	2.30E-03	4.4	520		7.2	1.11E-03	1.1	8	-1.83	0.364	1.1100E-03	1.1	263.0	2635.1
093091	1124		5.6	2.12E-03	4.5	520		7.3	1.11E-03	1.8	8	-1.85	0.364	1.1121E-03	1.8	263.0	2635.1
101191	0922		6.0	2.01E-03	7.0	520		7.3	1.04E-03	1.3	8	-1.88	0.364	1.0372E-03	1.3	263.0	2635.3
101191	1001		6.0	1.96E-03	4.8	520		7.5	1.09E-03	1.8	8	-1.90	0.364	1.0911E-03	1.8	263.0	2635.4

Table A-2. (Continued)

THORIUM CALIBRATION-RML "PEQ" 30-SEP-1991 11:24:33.09

DETECTOR SYSTEM: PR

ZERO= -1.8504
ENERGY= 0.2928+ 0.36361(X)+ 2.91250E-08(X)**2

WIDTH= 3.456+ 5.2368E-04(X)

ERROR MATRIX: 3.030938E-04 3.573400E-10 7.152957E-18 -3.021526E-07 3.811455E-11 -4.744341E-14

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
657.285	238.624	238.625	-0.001	3.73
1604.700	583.174	583.172	0.002	4.30
2367.215	860.530	860.514	0.016	4.88
4457.081	1620.700	1620.815	-0.115	5.61
7187.310	2614.476	2614.466	0.010	7.27

LOW PULSER EQUIVALENT: 262.98 HIGH PULSER EQUIVALENT: 2635.10

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.26	3.7	238.62	153547.	522	1.627E-02	0.5		
663.68	3.7	240.95	14306.	522	1.629E-02	1.7		
1604.70	4.3	583.17	34708.	522	5.208E-03	0.8		
2000.90	4.5	727.27	6476.	512	4.470E-03	1.3		
2367.21	4.9	860.51	3872.	520	3.933E-03	1.7		
4457.08	5.6	1620.81	696.	520	2.122E-03	4.5		
7187.31	7.3	2614.46	8786.	8	1.112E-03	1.8		
							1.112E-03	1.8

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
091691	1557	238.6	3.6	1.58E-02	0.3	522	583.2	4.2	5.07E-03	0.6	520	860.5	4.6	3.68E-03	1.7	520
091791	1251		3.7	1.62E-02	0.3	522		4.3	5.16E-03	0.7	520		4.7	3.76E-03	1.7	520
091791	1307		3.6	1.62E-02	0.3	522		4.2	5.16E-03	0.6	520		4.7	3.78E-03	2.0	520
092791	1049		3.6	1.62E-02	0.3	522		4.2	5.16E-03	0.6	520		4.7	3.78E-03	2.0	520
093091	1053		3.7	1.63E-02	0.3	522		4.3	5.20E-03	0.6	520		4.8	3.94E-03	1.7	520
093091	1124		3.7	1.63E-02	0.5	522		4.3	5.21E-03	0.8	522		4.9	3.93E-03	1.7	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET UCURIE	%ERR	LPEQ	HPEQ
091691	1557	1620.7	5.9	2.14E-03	4.6	520	2614.5	7.4	1.10E-03	1.6	8	-2.31	0.364	1.1043E-03	1.6	262.1	2628.2
091791	1251		6.3	2.29E-03	4.7	520		7.5	1.12E-03	1.1	8	-3.51	0.364	1.1238E-03	1.1	262.0	2627.9
091791	1307		5.8	2.13E-03	5.1	520		7.1	1.09E-03	1.5	8	-2.46	0.364	1.0946E-03	1.5	262.1	2628.2
092791	1049		5.8	2.12E-03	5.5	520		7.1	1.09E-03	1.5	8	-2.45	0.364	1.0947E-03	1.5	262.1	2628.2
093091	1053		5.7	2.30E-03	4.4	520		7.2	1.11E-03	1.1	8	-1.83	0.364	1.1100E-03	1.1	263.0	2635.1
093091	1124		5.6	2.12E-03	4.5	520		7.3	1.11E-03	1.8	8	-1.85	0.364	1.1121E-03	1.8	263.0	2635.1

Table A-2. (Continued)

5850

THORIUM CALIBRATION-RML "PEQ" 27-SEP-1991 10:49:40.39

DETECTOR SYSTEM: PR

ZERO= -2.4507
ENERGY= 0.2698+ 0.36357(X)+ 2.71022E-08(X)**2

WIDTH= 3.396+ 5.2248E-04(X)

ERROR MATRIX: 1.423716E-05 1.619981E-11 3.215247E-19 -1.395391E-08 1.752508E-12 -2.142526E-15

CHANNEL	ENERGY	CAL. ENG	D-ENG	WIDTH
658.013	238.624	238.624	0.000	3.70
1605.538	583.174	583.174	0.000	4.25
2368.172	860.530	860.527	0.003	4.66
4458.036	1620.700	1620.724	-0.024	5.75
7188.978	2614.476	2614.474	0.002	7.13

LOW PULSER EQUIVALENT: 262.08 HIGH PULSER EQUIVALENT: 2628.18

RESULTS OF PEAK ANALYSIS. THORIUM SOURCE 9

CENTROID	WIDTH	ENERGY	AREA	FLAGS	MICROCURRIES	%ERROR	NET MICROCURRIES	%ERROR
657.99	3.6	238.61	152933.	522	1.620E-02	0.3		
664.40	3.6	240.94	14203.	522	1.616E-02	1.3		
1605.54	4.2	583.17	34380.	520	5.159E-03	0.6		
2001.76	4.5	727.26	6616.	512	4.568E-03	1.3		
2368.17	4.7	860.52	3722.	520	3.782E-03	2.0		
4458.03	5.8	1620.72	696.	520	2.125E-03	5.5		
7188.98	7.1	2614.47	8639.	8	1.095E-03	1.5		
							1.095E-03	1.5

QUALITY FILE ENTRIES

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG
091591	1710	238.6	3.6	1.64E-02	0.3	522	583.2	4.2	5.26E-03	0.6	512	860.5	4.7	3.85E-03	1.8	512
091691	1128		3.6	1.55E-02	0.4	522		4.2	4.96E-03	0.6	520		4.5	3.56E-03	1.8	520
091691	1557		3.6	1.58E-02	0.3	522		4.2	5.07E-03	0.6	520		4.6	3.68E-03	1.7	520
091791	1251		3.7	1.62E-02	0.3	522		4.3	5.16E-03	0.7	520		4.7	3.76E-03	1.7	520
091791	1307		3.6	1.62E-02	0.3	522		4.2	5.16E-03	0.6	520		4.7	3.78E-03	2.0	520
092791	1049		3.6	1.62E-02	0.3	522		4.2	5.16E-03	0.6	520		4.7	3.78E-03	2.0	520

DATE	TIME	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ENERGY	WIDTH	UCURIES	%ERR	FLAG	ZERO	GAIN	NET UCURIE	%ERR	LPEQ	HPEQ
091591	1710	1620.7	5.9	2.18E-03	4.9	512	2614.5	7.3	1.13E-03	1.4	0	-2.57	0.364	1.1323E-03	1.4	262.1	2628.2
091691	1128		6.2	2.06E-03	5.0	520		7.4	1.06E-03	1.5	8	-2.92	0.364	1.0571E-03	1.5	262.1	2628.2
091691	1557		5.9	2.14E-03	4.6	520		7.4	1.10E-03	1.6	8	-2.31	0.364	1.1043E-03	1.6	262.1	2628.2
091791	1251		6.3	2.29E-03	4.7	520		7.5	1.12E-03	1.1	8	-3.51	0.364	1.1238E-03	1.1	262.0	2627.9
091791	1307		5.8	2.13E-03	5.1	520		7.1	1.09E-03	1.5	8	-2.46	0.364	1.0946E-03	1.5	262.1	2628.2
092791	1049		5.8	2.12E-03	5.5	520		7.1	1.09E-03	1.5	8	-2.45	0.364	1.0947E-03	1.5	262.1	2628.2

Table A-3. Ratio of QAD-calculated uncollided gamma-ray flux from a liquid-filled and gas-filled NPR-1A spool piece.

Energy	Ratio of QAD results for uncollided flux			
	liq tube case 1 / gas tube case 2	liq bomb case 3 / gas bomb case 5	liq bomb case 3 / foam bomb case 4	foam bomb case 4 / gas bomb case 5
3000. keV	1.0114E+00	9.2900E-01	9.3041E-01	9.9848E-01
2500. keV	1.0108E+00	9.2073E-01	9.2232E-01	9.9828E-01
2000. keV	1.0102E+00	9.1262E-01	9.1429E-01	9.9817E-01
1500. keV	1.0089E+00	8.9910E-01	9.0104E-01	9.9785E-01
1000. keV	1.0062E+00	8.7811E-01	8.8048E-01	9.9731E-01
900. keV	1.0052E+00	8.7184E-01	8.7432E-01	9.9716E-01
800. keV	1.0043E+00	8.6563E-01	8.6823E-01	9.9701E-01
700. keV	1.0026E+00	8.5719E-01	8.5995E-01	9.9680E-01
600. keV	1.0009E+00	8.4886E-01	8.5177E-01	9.9659E-01
500. keV	9.9759E-01	8.3817E-01	8.4127E-01	9.9632E-01
400. keV	9.9142E-01	8.2468E-01	8.2802E-01	9.9597E-01
300. keV	9.7809E-01	8.0607E-01	8.0971E-01	9.9550E-01
200. keV	9.3094E-01	7.8135E-01	7.8543E-01	9.9481E-01
100. keV	6.0980E-01	7.3784E-01	7.4262E-01	9.9355E-01
90. keV	4.8823E-01	7.2900E-01	7.3389E-01	9.9334E-01
80. keV	3.9191E-01	7.2038E-01	7.2536E-01	9.9313E-01
. keV	2.3651E-01	7.0558E-01	7.1070E-01	9.9279E-01
. keV	1.4407E-01	6.9167E-01	6.9694E-01	9.9245E-01
50. keV	4.4450E-02	6.6686E-01	6.7225E-01	9.9198E-01

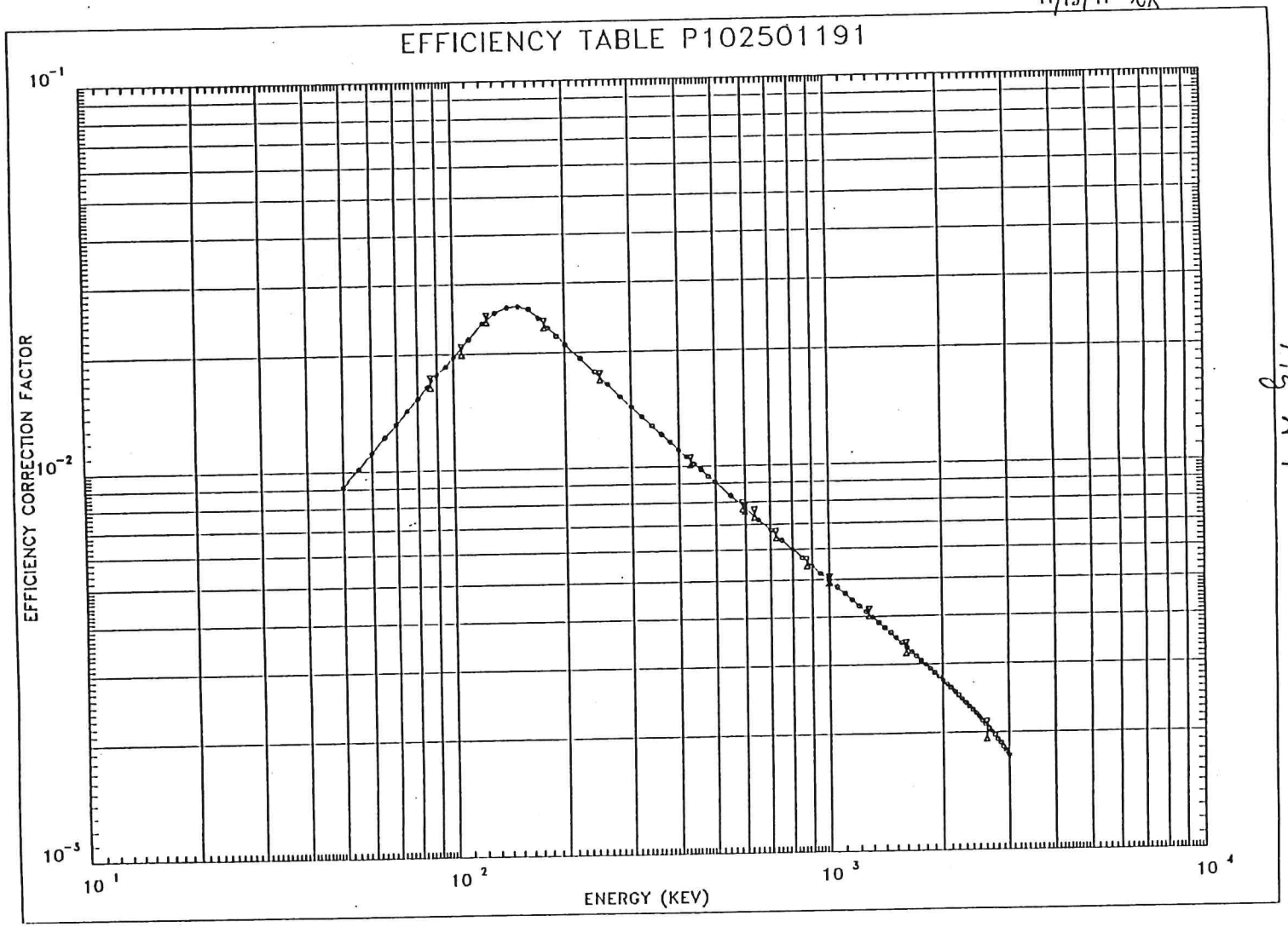

Figure A-1. Absolute counting efficiency (counts/gamma/cm^3) versus gamma-ray energy (keV) for the NPR-1A gas-filled spool piece.

Table A-4. Absolute counting efficiency values (counts/gamma/cm^3) as a function of gamma-ray energy for the NPR-1A gas-filled spool piece (Efficiency Table 1191).

MCA: P1 DISTANCE: 0250 TABLE: 1191
DETECTOR: NPR1 DATE CREATED: 11/15/91
NPR-1 NPR FPMS SPOOL PIECE-GAS (CORR.) 12CM SRM4276C

ENERGY	EFFICIENCY	ENERGY	EFFICIENCY
50.0	9.1224E-03	55.0	1.0144E-02
60.0	1.1171E-02	65.0	1.2266E-02
70.0	1.3255E-02	75.0	1.4350E-02
80.0	1.5443E-02	85.0	1.6496E-02
90.0	1.7656E-02	95.0	1.8539E-02
100.0	1.9569E-02	110.0	2.1745E-02
120.0	2.3867E-02	130.0	2.5398E-02
140.0	2.6151E-02	150.0	2.6312E-02
160.0	2.5839E-02	170.0	2.4538E-02
180.0	2.3168E-02	190.0	2.2033E-02
200.0	2.0952E-02	220.0	1.9228E-02
240.0	1.7750E-02	260.0	1.6439E-02
280.0	1.5296E-02	300.0	1.4356E-02
320.0	1.3518E-02	340.0	1.2796E-02
360.0	1.2149E-02	380.0	1.1577E-02
400.0	1.1045E-02	420.0	1.0572E-02
440.0	1.0138E-02	460.0	9.7476E-03
480.0	9.3906E-03	500.0	9.0580E-03
550.0	8.3346E-03	600.0	7.7240E-03
650.0	7.1990E-03	700.0	6.7481E-03
750.0	6.3555E-03	800.0	6.0103E-03
850.0	5.7063E-03	900.0	5.4354E-03
950.0	5.1912E-03	1000.0	4.9726E-03
1050.0	4.7734E-03	1100.0	4.5912E-03
1150.0	4.4238E-03	1200.0	4.2671E-03
1250.0	4.1220E-03	1300.0	3.9863E-03
1350.0	3.8589E-03	1400.0	3.7400E-03
1450.0	3.6277E-03	1500.0	3.5214E-03
1550.0	3.4214E-03	1600.0	3.3273E-03
1650.0	3.2386E-03	1700.0	3.1546E-03
1750.0	3.0752E-03	1800.0	2.9990E-03
1850.0	2.9249E-03	1900.0	2.8553E-03
1950.0	2.7883E-03	2000.0	2.7243E-03
2050.0	2.6634E-03	2100.0	2.6045E-03
2150.0	2.5470E-03	2200.0	2.4908E-03
2250.0	2.4368E-03	2300.0	2.3850E-03
2350.0	2.3363E-03	2400.0	2.2873E-03
2450.0	2.2392E-03	2500.0	2.1919E-03
2550.0	2.1452E-03	2600.0	2.0983E-03
2650.0	2.0530E-03	2700.0	2.0092E-03
2750.0	1.9650E-03	2800.0	1.9205E-03
2850.0	1.8791E-03	2900.0	1.8363E-03
2950.0	1.7924E-03	3000.0	1.7522E-03

HISTORY COMMENTS:
THE EXPERIMENTAL DATA IS THE EFFICIENCIES THAT

RESULTED FROM ANALYZING THE LIQUID STD WITH THE

WHEELERS ATTENUATION CORRECTIONS.

Table A-4. (Continued)

EFFICIENCY TABLE NUMBER: P102501191 CONTINUED

EXPERIMENTAL DATA:

ENERGY	EFFICIENCY	ERROR	ENERGY	EFFICIENCY	ERROR
86.5	1.6926E-02	3.0	105.3	2.0375E-02	2.5
123.1	2.4539E-02	2.0	176.0	2.3600E-02	2.0
247.9	1.7257E-02	2.0	430.0	1.0294E-02	2.0
591.8	7.8218E-03	2.0	600.6	7.7097E-03	2.0
636.0	7.4647E-03	2.0	723.3	6.5645E-03	2.0
873.2	5.5361E-03	2.0	996.3	4.9815E-03	2.0
1004.7	4.9732E-03	2.0	1274.4	4.1001E-03	2.0
1596.5	3.3249E-03	3.0	2614.5	2.0299E-03	5.0

Table A-5. Amersham certificate for foam-filled gas cylinder standard QCRX1296, serial number CS 488.

Servicecentren
Darmstädter Landstr. 92 6000 Frankfurt/M. Tel. (0 69) 62 10 62 - 65
Sidas GmbH Königin-Elisabeth-Str. 7 1000 Berlin 19 Tel. (0 30) 3 02 60 51

Amersham

Amersham Buchler GmbH & Co KG Postfach 11 49 W-3300 Braunschweig
Amersham Corporation
2636 S. Clearbrook Drive
Arlington Heights, IL 60005

USA-Arlington Heights, IL

Certificate no. 620778
of sealed radioactive sources

Radionuclide: Am-241, Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Sr-85, Cs-137, Y-88, Co-60

Product code: QCRX1296 to drawing VZ-1518/E

Description:
Activity: Am-241, Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Sr-85, Cs-137, Y-88 and Co-60 as chloride, incorporated in plastic (density approx. 0.02 g/cm³), solid
Capsule: 150 ml gas container, lid sealed with epoxy

Integrity: ISO / DIN

Special form:

Additional details:

Testing for leakage and contamination: Each source was tested individually in compliance with BS.5288 and found sealed and free of contamination.

Serial number	Activity nominal / measured	Date	Leakage test type: A	Leakage test type:	Contamination test type: A
1 off					
CS 488	270 nCi Am-241 1259 nCi Cd-109 44.5 nCi Co-57 40.7 nCi Ce-139 33.4 nCi Hg-203 134 nCi Sn-113 93.8 nCi Sr-85 255 nCi Cs-137 265 nCi Y-88 284 nCi Co-60	1 Oct 1991 12.00 GMT	16 Oct 1991		16 Oct 1991

Notes:

Traceability: This product satisfies the quality assurance requirements of USNRC Regulatory Guide 4.15 Revision 1, February 19, 1979, for achieving NIST traceability, as defined in th NCRP 58 (1985), through Amersham's participation in the USCEA/NIST Measurements Assurance Program of the Nuclear Power Industry.

Overall uncertainty: ± 7 %.

Amersham Buchler

i. A. Wenk

Braunschweig, 16 October 1991 Dor/AM

Sitz Braunschweig Registergericht Braunschweig, HRA 8621
Persönlich haftende Gesellschafterin: Amersham Buchler GmbH, Sitz Braunschweig
Registergericht Braunschweig, HRB 638 Geschäftsführer: Reinhard W. Muth
Vorsitzender des Aufsichtsrates: Wolfgang Busselberg

Deutsche Bank AG Braunschweig, BLZ 270 700 30,
Konto 0 168 815
Postgiroamt Hannover: BLZ 250 100 30, Konto 313330 - 300

4417/391 R1000

Table A-6. Ratio of QAD-calculated uncollided gamma-ray flux from a liquid-filled and gas-filled 150 cm^3 gas sample cylinder.

Energy	Ratio of QAD results for uncollided flux		
	LIQ case 3a / case 5a GAS	LIQ case 3a / case 4a FOAM	FOAM case 4a / case 5a GAS
3000. keV	9.2184E-01	9.2336E-01	9.9835E-01
2500. keV	9.1279E-01	9.1450E-01	9.9813E-01
2000. keV	9.0388E-01	9.0575E-01	9.9793E-01
1500. keV	8.8906E-01	8.9122E-01	9.9757E-01
1000. keV	8.6606E-01	8.6865E-01	9.9702E-01
900. keV	8.5920E-01	8.6192E-01	9.9685E-01
800. keV	8.5241E-01	8.5524E-01	9.9669E-01
700. keV	8.4317E-01	8.4618E-01	9.9645E-01
600. keV	8.3408E-01	8.3725E-01	9.9622E-01
500. keV	8.2239E-01	8.2576E-01	9.9592E-01
400. keV	8.0766E-01	8.1131E-01	9.9550E-01
300. keV	7.8738E-01	7.9134E-01	9.9499E-01
200. keV	7.6033E-01	7.6476E-01	9.9420E-01
100. keV	7.1187E-01	7.1705E-01	9.9277E-01
90. keV	7.0205E-01	7.0733E-01	9.9253E-01
80. keV	6.9270E-01	6.9807E-01	9.9231E-01
70. keV	6.7721E-01	6.8274E-01	9.9190E-01
60. keV	6.6315E-01	6.6879E-01	9.9157E-01
50. keV	6.3921E-01	6.4495E-01	9.9111E-01

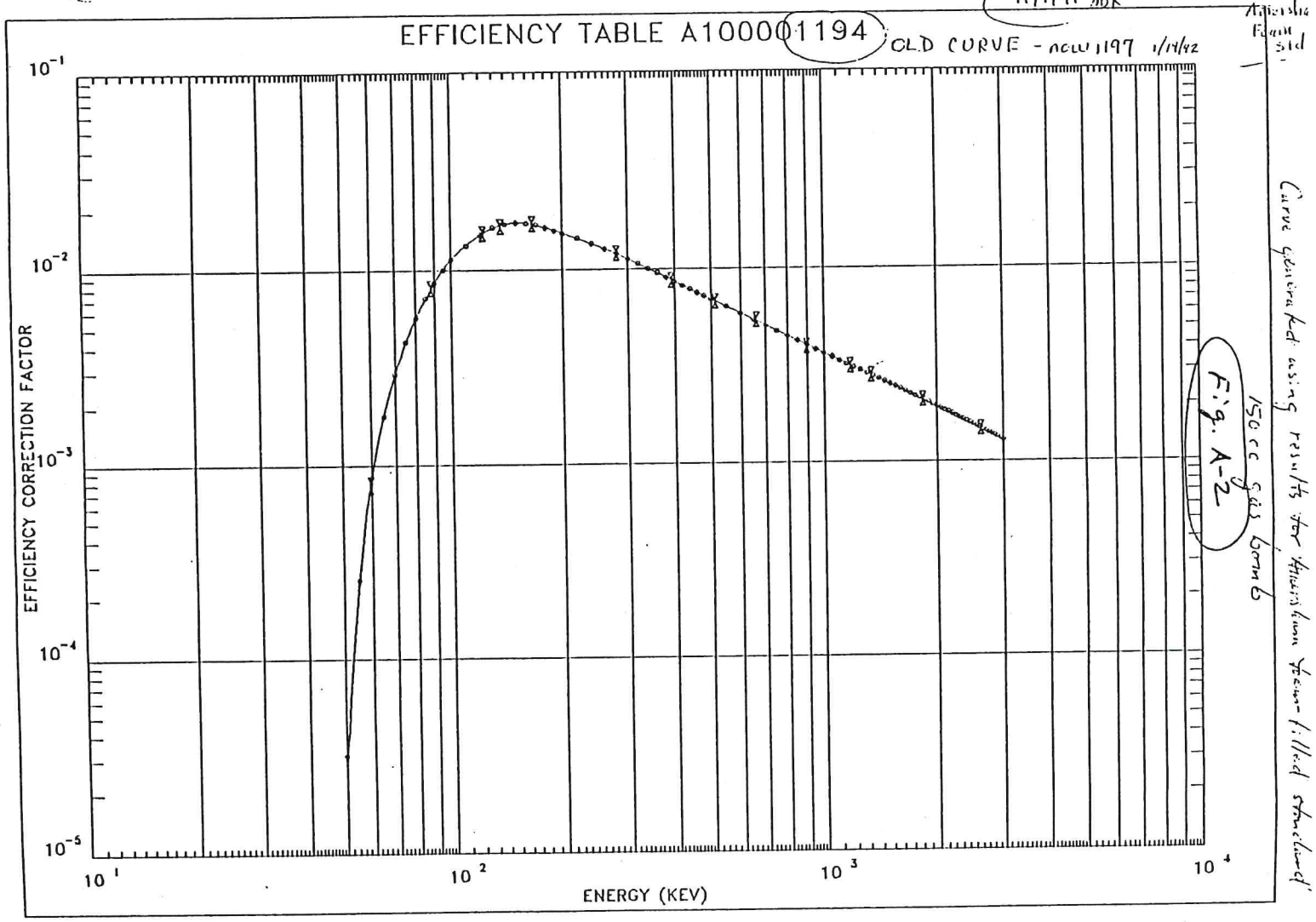

Figure A-2. Absolute counting efficiency (counts/gamma) versus gamma-ray energy (keV) for the NPR-1A gas grab sample cylinder determined using the Amersham foam-filled calibration standard CS 488 (Efficiency Table 1197).

Table A-7. Absolute counting efficiency values (counts/gamma) as a function of gamma-ray energy for the NPR-1A gas grab sample cylinder determined using the Amersham foam-filled calibration standard CS 488 (Efficiency Table 1197).

MCA: A1 DISTANCE: 0000 TABLE:
DETECTOR: PG8 DATE CREATED: 11/01/91
PG8 NPR 150ML GAS SMPL CYLNDR. 0CM. AMSM CS488 CORRECTED TO GAS

ENERGY	EFFICIENCY	ENERGY	EFFICIENCY
50.0	3.2024E-05	55.0	2.5261E-04
60.0	8.7180E-04	65.0	1.8031E-03
70.0	2.9671E-03	75.0	4.2918E-03
80.0	5.7122E-03	85.0	7.1708E-03
90.0	8.6175E-03	95.0	1.0009E-02
100.0	1.1310E-02	110.0	1.3283E-02
120.0	1.5025E-02	130.0	1.6358E-02
140.0	1.7064E-02	150.0	1.7306E-02
160.0	1.7222E-02	170.0	1.6830E-02
180.0	1.6293E-02	190.0	1.5775E-02
200.0	1.5276E-02	220.0	1.4334E-02
240.0	1.3462E-02	260.0	1.2658E-02
280.0	1.1947E-02	300.0	1.1246E-02
320.0	1.0602E-02	340.0	1.0016E-02
360.0	9.4884E-03	380.0	9.0123E-03
400.0	8.5820E-03	420.0	8.1928E-03
440.0	7.8393E-03	460.0	7.5154E-03
480.0	7.2220E-03	500.0	6.9512E-03
550.0	6.3620E-03	600.0	5.8673E-03
650.0	5.4447E-03	700.0	5.0814E-03
750.0	4.7646E-03	800.0	4.4889E-03
850.0	4.2434E-03	900.0	4.0260E-03
950.0	3.8314E-03	1000.0	3.6579E-03
1050.0	3.5011E-03	1100.0	3.3566E-03
1150.0	3.2248E-03	1200.0	3.1036E-03
1250.0	2.9918E-03	1300.0	2.8882E-03
1350.0	2.7920E-03	1400.0	2.7025E-03
1450.0	2.6188E-03	1500.0	2.5395E-03
1550.0	2.4651E-03	1600.0	2.3946E-03
1650.0	2.3272E-03	1700.0	2.2637E-03
1750.0	2.2027E-03	1800.0	2.1458E-03
1850.0	2.0910E-03	1900.0	2.0390E-03
1950.0	1.9891E-03	2000.0	1.9417E-03
2050.0	1.8960E-03	2100.0	1.8520E-03
2150.0	1.8103E-03	2200.0	1.7694E-03
2250.0	1.7301E-03	2300.0	1.6922E-03
2350.0	1.6565E-03	2400.0	1.6215E-03
2450.0	1.5882E-03	2500.0	1.5569E-03
2550.0	1.5261E-03	2600.0	1.4968E-03
2650.0	1.4675E-03	2700.0	1.4400E-03
2750.0	1.4137E-03	2800.0	1.3876E-03
2850.0	1.3628E-03	2900.0	1.3388E-03
2950.0	1.3152E-03	3000.0	1.2922E-03

HISTORY COMMENTS:
AMERSHAM MIX CS-488 IN FOAM. PREPARED BY AMERSHAM.

THIS EFFICIENCY CURVE HAS BEEN CORRECTED FROM FOAM TO

A GAS WITH FLOYD WHEELER'S CORRECTIONS.

Table A-7. (Continued)

EFFICIENCY TABLE NUMBER: A100001194 CONTINUED

EXPERIMENTAL DATA:

ENERGY	EFFICIENCY	ERROR	ENERGY	EFFICIENCY	ERROR
59.5	7.9430E-04	6.1	88.0	8.0607E-03	5.2
122.1	1.5304E-02	5.0	136.5	1.6560E-02	5.0
165.9	1.7022E-02	5.0	279.2	1.2031E-02	5.0
391.7	8.6854E-03	5.0	514.0	6.7712E-03	5.1
661.7	5.4106E-03	5.0	898.0	3.9581E-03	5.0
1173.2	3.1454E-03	5.0	1332.5	2.8149E-03	5.0
1836.0	2.1027E-03	5.0	2614.5	1.4850E-03	5.0

Table A-8. Amersham certificate for mixed-radionuclide reference solution QCY.48, number R1/25/105.

Amersham International plc
Amersham Laboratories

R1/25/105 NB9402 1-800-323-0668
QCY.48 5.4 μC; Ask for Cindy..

NAMAS
CALIBRATION No. 0146

Certificate of calibration of mixed radionuclide gamma-ray reference solution

M-25089

Description

Product code: QCY.48 Solution number: R1/25/105

This mixed radionuclide gamma-ray reference standard consists of a solution in 4M HCl of the ten radionuclides listed below.

Measurement and Accuracy

Reference time: 1200 GMT on 1 February 1991

Mass of solution: 5.3518 grams Density: 1.0630 g/ml at 20°C

Parent radionuclide	Gamma-ray energy (keV)	Gamma-rays per second per gram of solution	Random uncertainty	Systematic uncertainty	Overall uncertainty
Americium-241	59.54	1125	± 0.2 %	± 2.0 %	± 2.2 %
Cadmium-109	88.03	639	± 0.2 %	± 3.0 %	± 3.2 %
Cobalt-57	122.1	587	± 0.2 %	± 1.7 %	± 1.9 %
Cerium-139	165.9	706	± 0.4 %	± 1.5 %	± 1.9 %
Mercury-203	279.2	1989	± 0.2 %	± 2.0 %	± 2.2 %
Tin-113	391.7	1022	± 0.2 %	± 4.0 %	± 4.2 %
Strontium-85	514.0	3960	± 0.4 %	± 1.8 %	± 2.2 %
Caesium-137	661.7	2435	± 0.2 %	± 2.8 %	± 3.0 %
Yttrium-88	898.0	6234	± 0.2 %	± 3.6 %	± 3.8 %
Cobalt-60	1173	3359	± 0.1 %	± 0.5 %	± 0.6 %
Cobalt-60	1333	3361	± 0.1 %	± 0.5 %	± 0.6 %
Yttrium-88	1836	6607	± 0.2 %	± 2.5 %	± 2.7 %

Purity

At the reference time the solution also contained the following impurities:

Cerium-141 equal to 0.18 becquerels (0.0048 nanocuries) per gram.

Cobalt-56 less than 0.1 becquerels (0.0027 nanocuries) per gram.

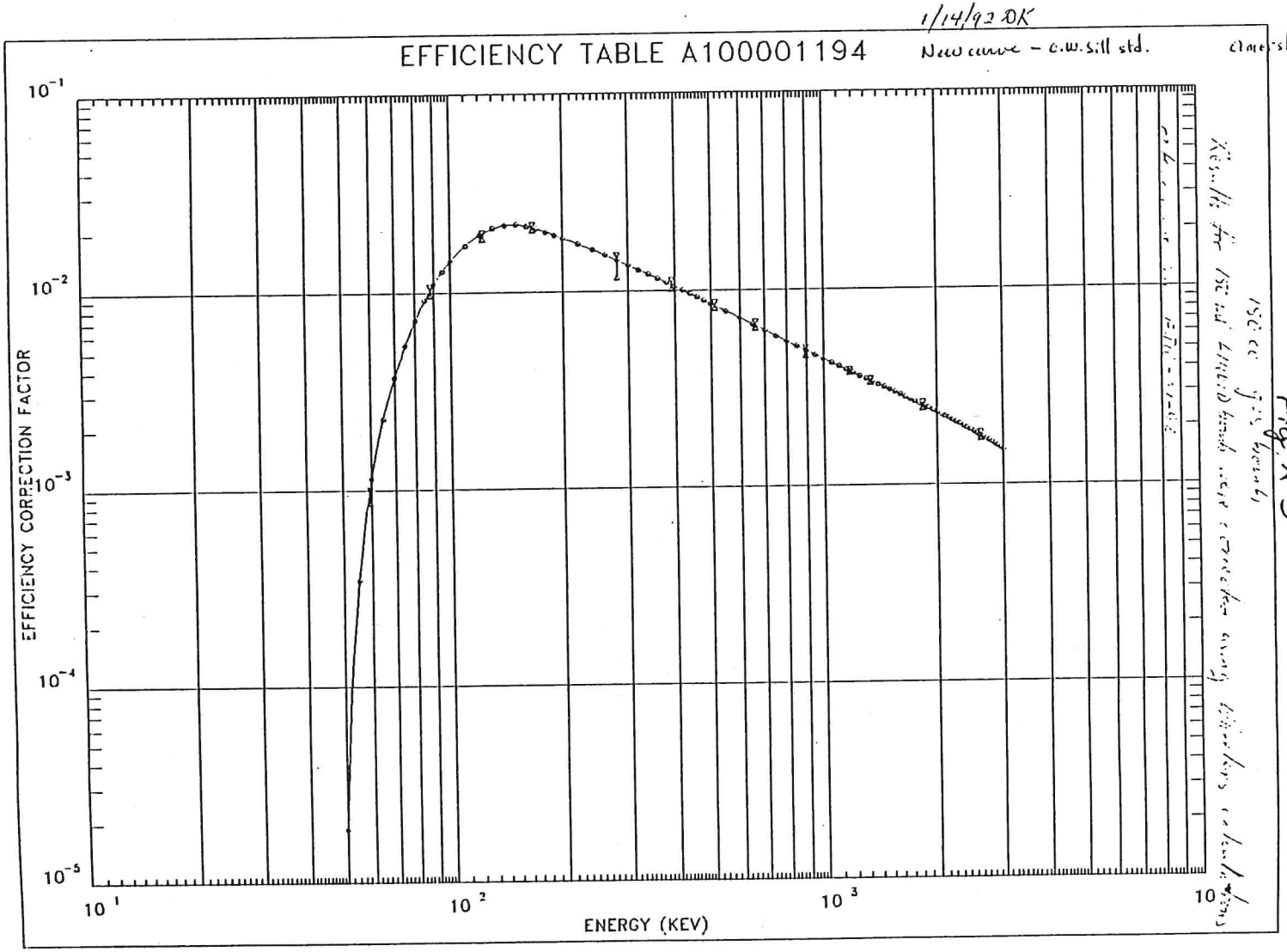

Figure A-3. Absolute counting efficiency (counts/gamma) versus gamma-ray energy (keV) for the NPR-1A gas grab sample cylinder determined using the gas cylinder calibration standard filled with Amersham reference solution QCY.48, number R1/25/105 (Efficiency Table 1194).

Table A-9. Absolute counting efficiency values (counts/gamma) as a function of gamma-ray energy for the NPR-1A gas grab sample cylinder determined using the gas cylinder calibration standard filled with Amersham reference solution QCY.48, number R1/25/105 (Efficiency Table 1194).

MCA: A1 DISTANCE: 0000 TABLE: 1194 LIQUID STND
DETECTOR: PG8 DATE CREATED: 01/14/92
PG8 NPR 150ML GAS SMPL CYLNDR. 0CM. AMSHM/CWS SOLN CORR TO GAS

ENERGY	EFFICIENCY	ENERGY	EFFICIENCY
50.0	1.8788E-05	55.0	3.4580E-04
60.0	1.1414E-03	65.0	2.3122E-03
70.0	3.7716E-03	75.0	5.4399E-03
80.0	7.2444E-03	85.0	9.1190E-03
90.0	1.1005E-02	95.0	1.2769E-02
100.0	1.4410E-02	110.0	1.7214E-02
120.0	1.9504E-02	130.0	2.1008E-02
140.0	2.1760E-02	150.0	2.1863E-02
160.0	2.1521E-02	170.0	2.0803E-02
180.0	2.0023E-02	190.0	1.9309E-02
200.0	1.8630E-02	220.0	1.7370E-02
240.0	1.6269E-02	260.0	1.5242E-02
280.0	1.4317E-02	300.0	1.3485E-02
320.0	1.2748E-02	340.0	1.2076E-02
360.0	1.1485E-02	380.0	1.0941E-02
400.0	1.0446E-02	420.0	9.9957E-03
440.0	9.5813E-03	460.0	9.2050E-03
480.0	8.8486E-03	500.0	8.5295E-03
550.0	7.8114E-03	600.0	7.2085E-03
650.0	6.6871E-03	700.0	6.2349E-03
750.0	5.8338E-03	800.0	5.4894E-03
850.0	5.1840E-03	900.0	4.9111E-03
950.0	4.6695E-03	1000.0	4.4546E-03
1050.0	4.2593E-03	1100.0	4.0811E-03
1150.0	3.9193E-03	1200.0	3.7720E-03
1250.0	3.6356E-03	1300.0	3.5107E-03
1350.0	3.3931E-03	1400.0	3.2828E-03
1450.0	3.1799E-03	1500.0	3.0848E-03
1550.0	2.9944E-03	1600.0	2.9084E-03
1650.0	2.8273E-03	1700.0	2.7497E-03
1750.0	2.6754E-03	1800.0	2.6050E-03
1850.0	2.5373E-03	1900.0	2.4740E-03
1950.0	2.4119E-03	2000.0	2.3518E-03
2050.0	2.2946E-03	2100.0	2.2399E-03
2150.0	2.1868E-03	2200.0	2.1361E-03
2250.0	2.0858E-03	2300.0	2.0385E-03
2350.0	1.9922E-03	2400.0	1.9475E-03
2450.0	1.9039E-03	2500.0	1.8619E-03
2550.0	1.8213E-03	2600.0	1.7822E-03
2650.0	1.7443E-03	2700.0	1.7074E-03
2750.0	1.6714E-03	2800.0	1.6359E-03
2850.0	1.6015E-03	2900.0	1.5676E-03
2950.0	1.5342E-03	3000.0	1.5018E-03

HISTORY COMMENTS:
C.W.SILL PREPARED AMERSHAM MIX STANDARD IN WATER

AND PUT IT IN 150ML NPR GAS SAMPLE CYLINDER. THIS

CALIBRATION IS TO REPLACE THE AMRSM FOAM STANDARD

Table A-9. (Continued)

EFFICIENCY TABLE NUMBER: A100001194 CONTINUED

EXPERIMENTAL DATA:

ENERGY	EFFICIENCY	ERROR	ENERGY	EFFICIENCY	ERROR
59.5	9.3300E-04	7.0	88.0	1.0140E-02	4.5
122.1	1.9260E-02	3.0	165.9	2.1110E-02	2.5
279.2	1.3410E-02	12.7	391.7	1.0730E-02	4.4
514.0	8.3560E-03	2.7	661.7	6.6420E-03	3.2
898.0	4.8600E-03	3.9	1173.2	3.8500E-03	1.2
1332.5	3.4300E-03	1.2	1836.1	2.5580E-03	2.7
2614.5	1.7710E-03	3.0			

APPENDIX B

NPR-1A SPECTRUM ANALYSIS ISOTOPE LIBRARY

Table B-1. January 1991 spectrum analysis results for on-line spectrometer spectrum number PR010192005.

No.	NUCLIDE	HALF-LIFE (MIN)	IC-1 ENERGY (KeV)	BR (%)	TRANSIT TIME IN HALF-LIVES	CORR. COUNT RATE (CPS)	EFF. (C/G/ML)	010192005 (1 HR RT) (uCi/cc)	NUCLIDE
11.	89 KR	3.1600E+00	585.996	16.40	2.53E+00	5.36E+01	7.885E-03	1.112E+00	89 KR
44.	133 XE	7.5513E+03	80.989	38.00	1.06E-03	2.30E+02	1.560E-02	1.047E+00	133 XE
48.	138 XE	1.4080E+01	258.446	31.50	5.68E-01	1.98E+02	1.653E-02	1.028E+00	138 XE
16.	89 RB	1.5200E+01	1032.077	58.00	5.26E-01	1.02E+02	4.843E-03	9.813E-01	89 RB
51.	138 CS	3.2200E+01	1435.798	76.30	2.48E-01	9.16E+01	3.658E-03	8.755E-01	138 CS
47.	137 XE	3.8180E+00	455.459	31.20	2.10E+00	9.93E+01	9.830E-03	8.747E-01	137 XE
15.	88 RB	1.7800E+01	1836.077	22.40	4.49E-01	9.08E+00	2.945E-03	3.713E-01	88 RB
20.	99 MO	3.9557E+03	739.508	12.30	2.02E-03	1.08E+01	6.440E-03	3.690E-01	99 MO
9.	87 KR	7.6310E+01	402.637	49.60	1.05E-01	8.32E+01	1.098E-02	3.636E-01	87 KR
10.	88 KR	1.7040E+02	2392.137	34.60	4.69E-02	1.04E+01	2.295E-03	3.491E-01	88 KR
45.	135 XEM	1.5650E+01	526.563	81.20	5.11E-01	1.58E+02	8.657E-03	3.041E-01	135 XEM
4.	83 BR	1.4340E+02	529.651	1.30	5.58E-02	9.65E-01	8.613E-03	2.328E-01	83 BR
46.	135 XE	5.4623E+02	249.792	90.10	1.46E-02	7.30E+01	1.708E-02	1.280E-01	135 XE
8.	85 KRM	2.6880E+02	151.181	75.10	2.98E-02	7.98E+01	2.629E-02	1.093E-01	85 KRM
42.	131 XEM	1.7137E+04	163.932	1.92	4.67E-04	7.85E-01	2.543E-02	4.345E-02	131 XEM
14.	86 RB	2.6842E+04	1076.687	8.78	2.98E-04	5.42E-01	4.673E-03	3.566E-02	86 RB
37.	131 I	1.1550E+04	364.483	81.60	6.93E-04	5.36E+00	1.200E-02	1.477E-02	131 I
19.	92 Y	2.1240E+02	934.526	13.90	3.77E-02	3.98E-01	5.261E-03	1.471E-02	92 Y
29.	129 TE	6.9600E+01	459.520	7.70	1.15E-01	3.99E-01	9.757E-03	1.434E-02	129 TE
49.	139 XE	6.6133E-01	218.650	52.00	1.21E+01	4.30E+00	1.934E-02	1.156E-02	139 XE
23.	116 INM	5.4150E+01	2112.320	15.60	1.48E-01	1.02E-01	2.591E-03	6.863E-03	116 INM
31.	131 TE	2.5000E+01	149.717	68.90	3.20E-01	4.25E+00	2.632E-02	6.332E-03	131 TE
33.	133 TEM	5.5400E+01	912.584	63.00	1.44E-01	6.95E-01	5.371E-03	5.547E-03	133 TEM
39.	133 I	1.2480E+03	529.852	86.30	6.41E-03	9.65E-01	8.613E-03	3.507E-03	133 I
7.	87 BR	9.2817E-01	1419.793	32.00	8.62E+00	1.42E-01	3.695E-03	3.252E-03	87 BR
38.	132 I	1.3704E+02	772.682	76.20	5.84E-02	2.63E-01	6.193E-03	1.506E-03	132 I
2.	54 MN	4.4972E+05	834.843	100.00	1.78E-05	1.28E+01	5.793E-03	1.386E-03	54 MN
34.	133 TE	1.2450E+01	312.175	72.60	6.43E-01	3.71E-01	1.383E-02	9.992E-04	133 TE
50.	137 CS	1.5910E+07	661.660	85.20	5.03E-07	1.48E-01	7.087E-03	6.643E-04	137 CS
22.	103 RU	5.6527E+04	497.054	89.50	1.42E-04	2.92E+01	9.090E-03	1.803E-04	103 RU
26.	126 SB	1.7857E+04	666.370	99.70	4.48E-04	2.89E-02	7.045E-03	1.114E-04	126 SB
41.	135 I	3.9300E+02	1260.420	28.60	2.04E-02	-5.98E-03	4.093E-03	-1.380E-04	135 I
21.	99 TCM	3.6042E+02	140.511	89.00	2.22E-02	-1.83E-01	2.617E-02	-2.127E-04	99 TCM
13.	91 KR	1.4283E-01	108.811	43.50	5.60E+01	-1.04E-01	2.149E-02	-3.009E-04	91 KR
40.	134 I	5.2600E+01	884.127	64.90	1.52E-01	-5.23E-02	5.516E-03	-3.951E-04	134 I
24.	122 SB	3.8880E+03	564.090	70.60	2.06E-03	-8.50E-02	8.151E-03	-3.995E-04	122 SB
27.	127 SB	5.5440E+03	685.728	35.30	1.44E-03	-6.67E-02	6.871E-03	-7.433E-04	127 SB
3.	60 CO	2.7727E+06	1332.502	100.00	2.89E-06	-1.17E-01	3.903E-03	-8.095E-04	60 CO
32.	132 TE	4.6920E+03	228.260	88.20	1.71E-03	8.54E+00	1.862E-02	-1.099E-03	132 TE
25.	125 SB	1.4511E+06	427.875	29.40	5.51E-06	-1.70E-01	1.040E-02	-1.505E-03	125 SB
18.	90 RB	2.5500E+00	831.662	27.80	3.14E+00	-2.38E-01	5.814E-03	-3.979E-03	90 RB
52.	139 BA	8.4600E+01	165.853	22.00	9.46E-02	9.39E+00	2.507E-02	-4.057E-03	139 BA
35.	134 TE	4.1800E+01	565.994	18.30	1.91E-01	-3.60E-01	8.127E-03	-6.546E-03	134 TE
6.	85 BR	2.8700E+00	802.406	2.56	2.79E+00	-2.19E-01	5.995E-03	-3.857E-02	85 BR
17.	90 RBM	4.3000E+00	2752.631	11.90	1.86E+00	NA	1.963E-03	NA	90 RBM
1.	41 AR	1.0960E+02	1293.640	99.20	7.30E-02	NA	4.003E-03	NA	41 AR
5.	84 BR	3.1800E+01	1897.720	13.40	2.52E-01	NA	NA	NA	84 BR
30.	131 TEM	1.8000E+03	852.235	20.60	4.44E-03	NA	NA	NA	131 TEM
36.	135 TE	3.2000E-01	603.501	81.30	2.50E+01	NA	NA	NA	135 TE
12.	90 KR	5.3867E-01	1118.719	36.20	1.49E+01	6.05E-02	4.527E-03	NA	90 KR
43.	133 XEM	3.1507E+03	233.207	10.30	2.54E-03	NA	NA	NA	133 XEM
28.	129 TEM	4.8383E+04	105.283	0.15	1.65E-04	NA	NA	NA	129 TEM

Table B-2. Contributions to IC-1 photopeak count rates from interfering gamma rays.

FILE NAME: "NPR_F5" NPR_FUEL LIBRARY

No.	NUCLIDE	HALF-LIFE (MIN)	IC-1 ENERGY (KeV)	DELTA ENERGY (KeV)	BR (%)	PR010192005 (uCi/cc)	CORR. COUNT RATE (CPS)	EFF. (C/G/ML)
	131 I		80.185	-0.804	2.6300	1.477E-02	2.24E-01	1.560E-02
44.	133 XE	7.551E+03	80.989 *		38.0000	1.047E+00	2.30E+02 *	1.560E-02
	139 XE		103.816	-1.467	0.2912	1.156E-02	2.58E-02	2.073E-02
28.	129 TEM	4.838E+04	105.283 *		0.1470	NA	NA *	2.073E-02
	138 CS		107.865	-0.946	0.0560	8.755E-01	3.90E-01	2.149E-02
13.	91 KR	1.428E-01	108.811 *		43.5000	-3.009E-04	-1.04E-01 *	2.149E-02
	99 MO		140.474	-0.037	91.0000	3.690E-01	3.25E+02	2.617E-02
21.	99 TCM	3.604E+02	140.511 *		89.0000	-2.127E-04	-1.83E-01 *	2.617E-02
31.	131 TE	2.500E+01	149.717 *	-1.464	68.9000	6.332E-03	4.25E+00 *	2.632E-02
8.	85 KRM	2.688E+02	151.181 *	1.464	75.1000	1.093E-01	7.98E+01 *	2.629E-02
42.	131 XEM	1.714E+04	163.932 *	-1.921	1.9200	4.345E-02	7.85E-01 *	2.543E-02
52.	139 BA	8.460E+01	165.853 *	1.921	22.0000	-4.057E-03	9.39E+00 *	2.507E-02
	88 KR		165.924	0.071	3.1040	3.491E-01	1.01E+01	2.507E-02
49.	139 XE	6.613E-01	218.650 *		52.0000	1.156E-02	4.30E+00 *	1.934E-02
	89 KR		220.974	2.324	19.9000	1.112E+00	1.58E+02	1.934E-02
	138 CS		227.715	-0.545	1.5110	8.755E-01	9.11E+00	1.862E-02
32.	132 TE	4.692E+03	228.260 *		88.2000	-1.099E-03	8.54E+00 *	1.862E-02
43.	133 XEM	3.151E+03	233.207		10.3000	NA	NA	1.824E-02
46.	135 XE	5.462E+02	249.792 *		90.1000	1.280E-01	7.30E+01 *	1.708E-02
	129 TE		250.576	0.784	0.3827	1.434E-02	3.47E-02	1.708E-02
48.	138 XE	1.408E+01	258.446		31.5000	1.028E+00	1.98E+02	1.653E-02
	88 KR		311.722	-0.453	0.1073	3.491E-01	1.92E-01	1.383E-02
34.	133 TE	1.245E+01	312.175 *		72.6000	9.992E-04	3.71E-01 *	1.383E-02
	138 CS		363.956	-0.527	0.2442	8.755E-01	9.49E-01	1.200E-02
37.	131 I	1.155E+04	364.483 *		81.6000	1.477E-02	5.36E+00 *	1.200E-02
	89 KR		365.023	0.540	0.8955	1.112E+00	4.42E+00	1.200E-02
	138 CS		365.219	0.736	0.1908	8.755E-01	7.42E-01	1.200E-02
	138 XE		401.455	-1.182	2.1740	1.028E+00	9.08E+00	1.098E-02
	89 KR		402.369	-0.268	0.3164	1.112E+00	1.43E+00	1.098E-02
9.	87 KR	7.631E+01	402.637 *		49.6000	3.636E-01	8.32E+01 *	1.098E-02
	139 XE		427.393	-0.482	0.0572	1.156E-02	2.54E-03	1.040E-02
25.	125 SB	1.451E+06	427.875 *		29.4000	-1.505E-03	-1.70E-01 *	1.040E-02
	139 XE		454.581	-0.878	0.1820	1.156E-02	7.65E-03	9.830E-03
47.	137 XE	3.818E+00	455.459 *		31.2000	8.747E-01	9.93E+01 *	9.830E-03

Table B-2. (Continued)

No.	NUCLIDE	HALF-LIFE (MIN)	IC-1 ENERGY (KeV)	DELTA ENERGY (KeV)	BR (%)	PR010192005 (uCi/cc)	CORR. COUNT RATE (CPS)	EFF. (C/G/ML)
29.	129 TE	6.960E+01	459.520		7.7000	1.434E-02	3.99E-01	9.757E-03
22.	103 RU	5.653E+04	497.054 *		89.5000	1.803E-04	2.92E+01 *	9.090E-03
	89 KR		497.595	0.541	6.6070	1.112E+00	2.47E+01	9.090E-03
	89 KR		498.478	1.424	1.1340	1.112E+00	4.24E+00	9.090E-03
45.	135 XEM	1.565E+01	526.563		81.2000	3.041E-01	1.58E+02	8.657E-03
4.	83 BR	1.434E+02	529.651 *	-0.201	1.3000	2.328E-01	9.65E-01 *	8.613E-03
39.	133 I	1.248E+03	529.852 *	0.201	86.3000	3.507E-03	9.65E-01 *	8.613E-03
	138 XE		530.160	0.308	0.2520	1.028E+00	8.26E-01	8.613E-03
	89 RB		562.634	-1.456	0.0464	9.813E-01	1.37E-01	8.151E-03
24.	122 SB	3.888E+03	564.090 *		70.6000	-3.995E-04	-8.50E-02 *	8.151E-03
	139 XE		565.551	-0.443	0.0572	1.156E-02	1.99E-03	8.127E-03
35.	134 TE	4.180E+01	565.994 *		18.3000	-6.546E-03	-3.60E-01 *	8.127E-03
	138 XE		585.851	-0.145	0.0189	1.028E+00	5.67E-02	7.885E-03
11.	89 KR	3.160E+00	585.996 *		16.4000	1.112E+00	5.36E+01 *	7.885E-03
	88 KR		603.239	-0.262	0.0415	3.491E-01	4.12E-02	7.685E-03
36.	135 TE	3.200E-01	603.501 *		81.3000	NA	NA *	7.685E-03
	89 KR		660.676	-0.984	0.0478	1.112E+00	1.39E-01	7.087E-03
50.	137 CS	1.591E+07	661.660 *		85.2000	6.643E-04	1.48E-01 *	7.087E-03
	89 KR		665.877	-0.493	0.1134	1.112E+00	3.29E-01	7.045E-03
	88 KR		666.051	-0.319	0.0865	3.491E-01	7.87E-02	7.045E-03
26.	126 SB	1.786E+04	666.370 *		99.7000	1.114E-04	2.89E-02 *	7.045E-03
	138 CS		683.573	-2.155	0.1084	8.755E-01	2.41E-01	6.871E-03
27.	127 SB	5.544E+03	685.728 *		35.3000	-7.433E-04	-6.67E-02 *	6.871E-03
	89 KR		687.253	1.525	0.0697	1.112E+00	1.97E-01	6.871E-03
	89 KR		738.513	-0.995	4.1790	1.112E+00	1.11E+01	6.440E-03
20.	99 MO	3.956E+03	739.508 *		12.3000	3.690E-01	1.08E+01 *	6.440E-03
38.	132 I	1.370E+02	772.682 *		76.2000	1.506E-03	2.63E-01 *	6.193E-03
	139 XE		773.168	0.486	0.0884	1.156E-02	2.34E-03	6.193E-03
	138 CS		773.248	0.566	0.2327	8.755E-01	4.67E-01	6.193E-03
	88 KR		774.160	1.478	0.0969	3.491E-01	7.75E-02	6.193E-03
	89 RB		801.604	-0.802	0.0174	1.112E+00	4.29E-02	5.995E-03
	139 XE		801.721	-0.685	0.5200	1.156E-02	1.33E-02	5.995E-03
	129 TE		802.112	-0.294	0.1917	1.434E-02	6.10E-03	5.995E-03
6.	85 BR	2.870E+00	802.406 *		2.5600	-3.857E-02	-2.19E-01 *	5.995E-03
	138 CS		802.586	0.180	0.0382	8.755E-01	7.41E-02	5.995E-03

Table B-2. (Continued)

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No.	NUCLIDE	HALF-LIFE (MIN)	IC-1 ENERGY (KeV)	DELTA ENERGY (KeV)	BR (%)	PR010192005 (uCi/cc)	CORR. COUNT RATE (CPS)	EFF. (C/G/ML)
18.	90 RB	2.550E+00	831.662 *		27.8000	-3.979E-03	-2.38E-01 *	5.814E-03
	139 XE		832.474	0.812	0.0988	1.156E-02	2.46E-03	5.814E-03
2.	54 MN	4.497E+05	834.843 *		100.0000	1.386E-03	1.28E+01 *	5.793E-03
	88 KR		834.859	0.016	12.9800	3.491E-01	9.71E+00	5.793E-03
	89 KR		835.723	0.880	1.0950	1.112E+00	2.61E+00	5.793E-03
	87 KR		836.433	1.590	0.7688	3.636E-01	5.99E-01	5.793E-03
	138 XE		851.223	-1.012	0.0693	1.028E+00	1.50E-01	5.694E-03
30.	131 TEM	1.800E+03	852.235 *		20.6000	NA	NA *	5.694E-03
	88 KR		883.085	-1.042	0.0415	3.491E-01	2.96E-02	5.516E-03
40.	134 I	5.260E+01	884.127 *		64.9000	-3.951E-04	-5.23E-02 *	5.516E-03
	138 XE		912.571	-0.013	0.3276	1.028E+00	6.69E-01	5.371E-03
33.	133 TEM	5.540E+01	912.584 *		63.0000	5.547E-03	6.95E-01 *	5.371E-03
	92 Y		912.811	0.227	0.6300	1.471E-02	1.84E-02	5.371E-03
	137 XE		933.745	-0.781	0.0842	8.747E-01	1.43E-01	5.261E-03
	89 KR		933.822	-0.705	0.0378	1.112E+00	8.18E-02	5.261E-03
19.	92 Y	2.124E+02	934.526 *		13.9000	1.471E-02	3.98E-01 *	5.261E-03
	138 CS		934.984	0.458	0.1808	8.755E-01	3.08E-01	5.261E-03
16.	89 RB	1.520E+01	1032.077		58.0000	9.813E-01	1.02E+02	4.843E-03
	138 XE		1076.615	-0.072	0.0882	1.028E+00	1.57E-01	4.673E-03
	89 KR		1076.641	-0.046	0.2348	1.112E+00	4.51E-01	4.673E-03
14.	86 RB	2.684E+04	1076.687 *		8.7800	3.566E-02	5.42E-01 *	4.673E-03
	89 KR		1116.796	-1.923	1.6520	1.112E+00	3.08E+00	4.527E-03
12.	90 KR	5.387E-01	1118.719 *		36.2000	NA	6.05E-02 *	4.527E-03
	137 XE		1119.304	0.585	0.1070	8.747E-01	1.57E-01	4.527E-03
	139 XE		1259.254	-1.166	0.4836	1.156E-02	8.47E-03	4.093E-03
41.	135 I	3.930E+02	1260.420 *		28.6000	-1.380E-04	-5.98E-03 *	4.093E-03
1.	41 AR	1.096E+02	1293.640		99.2000	NA	NA	4.003E-03
3.	60 CO	2.773E+06	1332.502		100.0000	-8.095E-04	-1.17E-01	3.903E-03
7.	87 BR	9.282E-01	1419.793 *		32.0000	3.252E-03	1.42E-01 *	3.695E-03
	89 RB		1419.805	0.012	0.0928	9.813E-01	1.24E-01	3.695E-03
	89 KR		1421.611	1.818	0.2229	1.112E+00	3.39E-01	3.695E-03
	139 XE		1434.234	-1.564	0.1560	1.156E-02	2.44E-03	3.658E-03
51.	138 CS	3.220E+01	1435.798 *		76.3000	8.755E-01	9.16E+01 *	3.658E-03
15.	88 RB	1.780E+01	1836.077 *		22.4000	3.713E-01	9.08E+00 *	2.945E-03
	89 KR		1837.646	1.569	0.1174	1.112E+00	1.42E-01	2.945E-03

Table B-2. (Continued)

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No.	NUCLIDE	HALF-LIFE (MIN)	IC-1 ENERGY (KeV)	DELTA ENERGY (KeV)	BR (%)	PR010192005 (uCi/cc)	CORR. COUNT RATE (CPS)	EFF. (C/G/ML)
	139 XE		1895.885	-1.835	0.5720	1.156E-02	6.99E-03	2.858E-03
5.	84 BR	3.180E+01	1897.720 *		13.4000	NA	NA *	2.858E-03
	89 KR		1898.600	0.880	0.0299	1.112E+00	3.51E-02	2.858E-03
	88 RB		2111.402	-0.918	0.1300	3.713E-01	4.63E-02	2.591E-03
23.	116 INM	5.415E+01	2112.320 *		15.6000	6.863E-03	1.02E-01 *	2.591E-03
	138 CS		2113.609	1.289	0.0206	8.755E-01	1.73E-02	2.591E-03
10.	88 KR	1.704E+02	2392.137 *		34.6000	3.491E-01	1.04E+01 *	2.295E-03
	137 XE		2393.545	1.408	0.0811	8.747E-01	6.03E-02	2.295E-03
	89 KR		2751.053	-1.578	0.1234	1.112E+00	9.97E-02	1.963E-03
17.	90 RBM	4.300E+00	2752.631 *		11.9000	NA	NA *	1.963E-03
	139 XE		2754.132	1.501	0.0624	1.156E-02	5.24E-04	1.963E-03

Table B-3. NPR-1A spectrum analysis isotope library.

Z	A	ID	HALF LIFE	ENERGY	BR		I-CODE
18	41	AR	1.82667 H	1293.6400	9.92E+01	± 0.02%	1
36	90	KR	32.32000 S	121.7190	3.62E+01	3.3%	1
				234.4322	2.46E+00		2
				242.1779	9.23E+00		2
				249.3230	1.27E+00		2
				433.4497	1.21E+00		2
				492.6179	1.12E+00		3
				539.4855	2.86E+01		2
				554.3762	4.71E+00		2
				619.0703	1.01E+00		3
				731.2928	1.38E+00		2
				941.8035	1.24E+00		2
				1118.7194	3.62E+01		2
				1423.7694	2.73E+00		2
				1537.8191	8.98E+00		2
				1552.1633	2.04E+00		2
				1658.1976	1.23E+00		2
				1779.9926	6.23E+00		2
				2127.5254	1.28E+00		2
36	88	KR	2.84000 H	122.3023	1.97E-01		3
				165.9245	3.10E+00		2
				196.3389	2.60E+01		2
				362.2630	2.25E+00		2
				788.3153	5.33E-01		3
				834.8587	1.30E+01		2
				985.8127	1.32E+00		2
				1141.4043	1.28E+00		2
				1250.7506	1.12E+00		2
				1369.4159	1.48E+00		2
				1518.4169	2.15E+00		2
				1529.7651	1.09E+01		2
				2029.8834	4.53E+00		2
				2035.4558	3.74E+00		2
				2195.8037	1.32E+01		2
				2231.7898	3.39E+00		2
				2392.1375	3.46E+01	2.0%	1
36	85	KRM	4.48000 H	151.1809	7.51E+01	2.4%	1
				304.8568	1.37E+01		2
36	89	KR	3.16000 M	197.2817	1.81E+00		3
				220.9741	1.99E+01		2
				345.1641	1.17E+00		3
				356.1947	4.12E+00		2
				369.4584	1.37E+00		3
				402.3690	3.16E-01		3

Table B-3. (Continued)

Z	A	ID	HALF LIFE	ENERGY	BR		I-CODE
36	89	KR	3.16000 M	411.5917	2.55E+00		2
				490.9570	3.20E-01		3
				497.7242	7.74E+00		2
				577.1678	5.61E+00		2
				585.9959	1.64E+01	5.5%	1
				660.6765	4.78E-02		4
				696.3801	1.77E+00		3
				738.5132	4.18E+00		2
				776.6127	1.11E+00		3
				835.7230	1.10E+00		3
				867.2463	5.89E+00		2
				904.4658	7.14E+00		2
				1107.9684	2.90E+00		2
				1116.7964	1.65E+00		3
				1273.9202	1.35E+00		3
				1324.5039	3.05E+00		2
				1472.9863	6.85E+00		2
				1501.1827	1.31E+00		3
				1530.3679	3.30E+00		2
				1533.8975	5.09E+00		2
				1693.9564	4.36E+00		2
				1837.6465	1.17E-01		4
				1903.5444	1.03E+00		3
				2012.4221	1.55E+00		3
				2866.3772	1.73E+00		3
36	87	KR	1.27183 H	402.6372	4.96E+01	4.0%	1
				673.9084	1.89E+00		3
				845.5031	7.34E+00		2
				1175.4850	1.11E+00		3
				1740.6395	2.04E+00		3
				2011.9063	2.88E+00		3
				2554.9182	9.23E+00		2
				2558.0820	3.92E+00		3
37	89	RB	15.20000 M	272.6467	1.41E+00		3
				289.9887	5.39E-01		3
				657.8970	9.98E+00		2
				947.8834	9.22E+00		2
				1032.0773	5.80E+01	5.4%	1
				1248.2798	4.26E+01		2
				1538.2642	2.55E+00		2
				2007.7014	2.38E+00		2
				2196.1489	1.33E+01		2
				2570.3223	9.86E+00		2
				2707.3914	2.03E+00		2
37	88	RB	17.80000 M	898.0646	1.47E+01		2
				1836.0770	2.24E+01	3.6%	1
				2677.9158	2.05E+00		2
54	133	XE	5.2440 D	80.9894	3.80E+01	1.8%	1
54	139	XE	39.68000 S	121.6237	3.59E-01		4

Table B-3. (Continued)

Z	A	ID	HALF LIFE	ENERGY	BR		I-CODE
54	139	XE	39.68000 S	174.9815	1.85E+01		2
				218.6504	5.20E+01	5.6%	1
				225.4392	2.70E+00		3
				289.8163	8.53E+00		2
				296.6051	2.02E+01		2
				393.6316	6.24E+00		2
				491.4924	1.34E+00		3
				613.1157	5.10E+00		3
				723.9975	1.67E+00		3
				732.5092	1.63E+00		3
				788.0963	3.13E+00		3
				1345.0065	1.06E+00		3
				1670.4485	1.04E+00		3
54	138	XE	14.08000 M	153.9039	5.95E+00		2
				242.6559	3.50E+00		2
				258.4458	3.15E+01	2.0%	1
				396.5595	6.30E+00		2
				401.4551	2.17E+00		3
				434.6144	2.03E+01		2
				1114.2732	1.47E+00		3
				1141.6691	5.13E-01		3
				1768.3940	1.67E+01		2
				1850.8787	1.42E+00		3
				2004.7804	5.36E+00		2
				2015.9421	1.23E+01		2
				2079.2937	1.44E+00		3
				2252.3279	2.29E+00		3
54	131	XEM	11.9000 D	163.9316	1.92E+00	2.1%	1
54	135	XE	9.10400 H	249.7924	9.01E+01	3.3%	1
				608.1845	2.90E+00		3
54	137	XE	3.81800 M	455.4591	3.12E+01	1.6%	1
				1119.3037	1.07E-01		4
54	135	XEM	15.65000 M	526.5628	8.12E+01	1.2%	1
55	138	CS	32.20000 M	138.0396	1.49E+00		3
				227.7152	1.51E+00		3
				408.9480	4.66E+00		2
				462.7822	3.08E+01		2
				546.9872	1.08E+01		2
				871.7288	5.12E+00		2
				1009.7675	2.98E+01		2
				1147.2708	1.24E+00		3
				1343.5464	1.14E+00		3
				1435.7979	7.63E+01	2.0%	1
				2217.8428	1.52E+01		2

Table B-3. (Continued)

Z	A	ID	HALF LIFE		ENERGY	BR	I-CODE
55	138	CS	32.20000	M	2639.4424	7.63E+00	2
55	137	CS	30.2500	Y	661.6600	8.52E+01	0.2% 1
							0.23%

APPENDIX C

RADIONUCLIDE CONCENTRATIONS DETERMINED USING THE ON-LINE GAMMA-RAY SPECTROMETER

GAMMA-RAY ANALYSIS SUMMARY 1

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

COLLECTION PERIOD:
100291 TO 102991

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

25-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY Chas V Wilson

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
100291 TO 102991

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR100291002	100291	PR100291002	1.00	PR100191001
PR100291003	100291	PR100291003	1.00	PR100191001
PR100291004	100291	PR100291004	1.00	PR100191001
PR100391001	100291	PR100391001	1.00	PR100191001
PR100391002	100391	PR100391002	1.00	PR100191001
PR100491001	100391	PR100491001	1.00	PR100191001
PR100491002	100491	PR100491002	1.00	PR100191001
PR100491003	100491	PR100491003	1.00	PR100191001
PR100491004	100491	PR100491004	1.00	PR100191001
PR100591001	100491	PR100591001	1.00	PR100191001
PR100691001	100591	PR100691001	1.00	PR100191001
PR100791001	100691	PR100791001	1.00	PR100191001
PR100891001	100791	PR100891001	1.00	PR100191001
PR100991001	100891	PR100991001	1.00	PR100191001
PR101091001	100991	PR101091001	1.00	PR100191001
PR101191001	101091	PR101191001	1.00	PR100191001
PR101191006	101191	PR101191006	1.00	PR100191001
PR101191007	101191	PR101191007	1.00	PR100191001
PR101291001	101191	PR101291001	1.00	PR100191001
PR101391001	101291	PR101391001	1.00	PR100191001
PR101491001	101391	PR101491001	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR101591001	101491	PR101591001	1.00	PR100191001
PR101591005	101591	PR101591005	1.00	PR100191001
PR101691001	101591	PR101691001	1.00	PR100191001
PR101691002	101691	PR101691002	1.00	PR100191001
PR101691005	101691	PR101691005	1.00	PR100191001
PR101791001	101691	PR101791001	1.00	PR100191001
PR101791002	101791	PR101791002	1.00	PR100191001
PR101791003	101791	PR101791003	1.00	PR100191001
PR101891001	101791	PR101891001	1.00	PR100191001
PR101991001	101891	PR101991001	1.00	PR100191001
PR102091001	101991	PR102091001	1.00	PR100191001
PR102191001	102091	PR102191001	1.00	PR100191001
PR102291001	102191	PR102291001	1.00	PR100191001
PR102391001	102291	PR102391001	1.00	PR100191001
PR102491001	102391	PR102491001	1.00	PR100191001
PR102591001	102491	PR102591001	1.00	PR100191001
PR102691001	102591	PR102691001	1.00	PR100191001
PR102791001	102691	PR102791001	1.00	PR100191001
PR102891002	102891	PR102891002	1.00	PR100191001
PR102991001	102891	PR102991001	1.00	PR100191001
PR103091001	102991	PR103091001	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
100291 TO 102991

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR100291002	+(+1.62 +/- .11)E-04	(+2.09 +/- 17.)E-07	(+4.09 +/- 4.4)E-06	(-3.61 +/- 6.5)E-06	(+2.80 +/- 14.)E-06
PR100291003	+(+1.23 +/- .00)E-01	(-8.84 +/- 9.3)E-06	(+3.77 +/- 3.3)E-05	(+8.05 +/- 15.)E-06	(-6.54 +/- 2.1)E-05
PR100291004	+(+1.26 +/- .01)E-01	(+3.99 +/- 9.3)E-06	(+5.40 +/- 3.6)E-05	+(+1.57 +/- .41)E-04	(+9.09 +/- 24.)E-06
PR100391001	+(+3.64 +/- .01)E-02	+(+5.40 +/- .29)E-05	+(+2.48 +/- .16)E-04	+(+2.06 +/- .13)E-04	+(+1.66 +/- .19)E-04
PR100391002	+(+1.71 +/- .02)E-02	+(+3.36 +/- 1.1)E-05	+(+2.09 +/- .30)E-04	+(+1.72 +/- .47)E-04	+(+2.49 +/- .62)E-04
PR100491001	+(+1.11 +/- .01)E-02	+(+5.05 +/- .18)E-05	+(+2.31 +/- .06)E-04	+(+1.96 +/- .10)E-04	+(+1.79 +/- .15)E-04
PR100491002	+(+9.22 +/- .35)E-04	+(+1.97 +/- .67)E-05	(-4.92 +/- ***)E-07	(+2.36 +/- 2.8)E-05	(+4.86 +/- 3.5)E-05
PR100491003	+(+2.44 +/- .02)E-01	+(+7.01 +/- .46)E-04	+(+2.04 +/- .16)E-03	+(+1.91 +/- .12)E-03	+(+2.66 +/- .33)E-03
PR100491004	+(+1.22 +/- .02)E-02	+(+5.89 +/- 1.6)E-05	+(+3.05 +/- .69)E-04	+(+1.76 +/- .81)E-04	+(+1.11 +/- .18)E-03
PR100591001	+(+7.32 +/- .03)E-03	+(+5.09 +/- .26)E-05	+(+2.41 +/- .06)E-04	+(+1.82 +/- .09)E-04	+(+1.60 +/- .14)E-04
PR100691001	+(+5.44 +/- .02)E-03	+(+4.49 +/- .19)E-05	+(+2.54 +/- .06)E-04	+(+1.72 +/- .10)E-04	+(+1.66 +/- .14)E-04
PR100791001	+(+4.25 +/- .02)E-03	+(+4.54 +/- .16)E-05	+(+2.18 +/- .06)E-04	+(+1.65 +/- .11)E-04	+(+1.55 +/- .14)E-04
PR100891001	+(+3.56 +/- .02)E-03	+(+4.34 +/- .21)E-05	+(+2.15 +/- .07)E-04	+(+1.36 +/- .10)E-04	+(+1.71 +/- .14)E-04
PR100991001	+(+3.08 +/- .02)E-03	+(+3.99 +/- .17)E-05	+(+2.18 +/- .07)E-04	+(+1.44 +/- .09)E-04	+(+1.35 +/- .11)E-04
PR101091001	+(+2.68 +/- .02)E-03	+(+3.88 +/- .14)E-05	+(+2.03 +/- .05)E-04	+(+1.48 +/- .09)E-04	+(+1.19 +/- .14)E-04
PR101191001	+(+4.26 +/- .02)E-03	+(+1.33 +/- .12)E-05	+(+7.47 +/- .60)E-05	+(+4.52 +/- .82)E-05	+(+3.31 +/- 1.3)E-05
PR101191006	(-1.31 +/- ***)E-08	(+7.21 +/- 14.)E-07	(+4.19 +/- 4.4)E-06	(-2.02 +/- 11.)E-06	(-1.20 +/- 1.4)E-05
PR101191007	(-1.08 +/- 5.8)E-06	(+3.42 +/- 2.8)E-06	(-5.77 +/- 74.)E-07	(-7.83 +/- 32.)E-06	(-2.15 +/- 3.7)E-05
PR101291001	(-1.27 +/- 1.4)E-06	(-1.54 +/- .83)E-06	(+3.23 +/- 2.5)E-06	(-3.00 +/- 6.9)E-06	(-1.68 +/- .86)E-05
PR101391001	+(+2.81 +/- .02)E-03	+(+4.57 +/- .17)E-05	+(+2.15 +/- .05)E-04	+(+1.63 +/- .08)E-04	+(+1.64 +/- .13)E-04
PR101491001	+(+5.08 +/- .03)E-03	+(+6.29 +/- .30)E-05	+(+3.02 +/- .10)E-04	+(+2.60 +/- .13)E-04	+(+2.21 +/- .15)E-04

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR101591001	+(+9.27 +/- 1.7)E-06	(-3.99 +/- 8.4)E-07	(+2.68 +/- 2.5)E-06	(-9.69 +/- 6.7)E-06	(-1.22 +/- .90)E-05
PR101591005	(+2.01 +/- 28.)E-07	(-4.22 +/- 17.)E-07	(+7.73 +/- 5.2)E-06	(-1.49 +/- 14.)E-06	(+3.47 +/- 17.)E-06
PR101691001	(+1.05 +/- 18.)E-07	(+4.82 +/- ***)E-08	(+8.74 +/- 4.7)E-06	(-3.59 +/- 8.5)E-06	(-4.39 +/- 13.)E-06
PR101691002	(+1.87 +/- 2.6)E-06	(-4.03 +/- 13.)E-07	(+7.08 +/- 5.0)E-06	(-1.69 +/- 9.7)E-06	(-9.00 +/- 11.)E-06
PR101691005	(-4.45 +/- ***)E-08	(-1.82 +/- 1.1)E-06	(+2.31 +/- 33.)E-07	(-1.12 +/- 9.0)E-06	(-6.47 +/- 11.)E-06
PR101791001	(-2.59 +/- 1.9)E-06	(-7.33 +/- 11.)E-07	(+7.37 +/- 36.)E-07	(-1.72 +/- .75)E-05	(+4.71 +/- 12.)E-06
PR101791002	(+5.39 +/- 55.)E-07	(+2.13 +/- 2.4)E-06	(-7.53 +/- 90.)E-07	(-2.53 +/- 31.)E-06	(-1.12 +/- 3.6)E-05
PR101791003	+(+8.38 +/- .49)E-05	(-1.03 +/- 1.2)E-06	(+3.84 +/- 5.7)E-06	(-3.70 +/- 8.7)E-06	(-2.39 +/- 11.)E-06
PR101891001	+(+3.34 +/- .02)E-03	+(+6.64 +/- .20)E-05	+(+3.71 +/- .07)E-04	+(+2.79 +/- .11)E-04	+(+2.74 +/- .15)E-04
PR101991001	+(+3.65 +/- .02)E-03	+(+8.06 +/- .22)E-05	+(+3.94 +/- .07)E-04	+(+3.18 +/- .11)E-04	+(+3.00 +/- .16)E-04
PR102091001	+(+3.24 +/- .02)E-03	+(+7.75 +/- .22)E-05	+(+3.75 +/- .07)E-04	+(+2.94 +/- .12)E-04	+(+2.95 +/- .16)E-04
PR102191001	+(+3.04 +/- .03)E-03	+(+7.06 +/- .21)E-05	+(+3.89 +/- .07)E-04	+(+2.84 +/- .12)E-04	+(+2.73 +/- .14)E-04
PR102291001	+(+2.84 +/- .02)E-03	+(+7.28 +/- .21)E-05	+(+3.66 +/- .07)E-04	+(+2.78 +/- .12)E-04	+(+2.65 +/- .17)E-04
PR102391001	+(+2.73 +/- .02)E-03	+(+7.16 +/- .21)E-05	+(+3.64 +/- .07)E-04	+(+2.90 +/- .10)E-04	+(+2.56 +/- .17)E-04
PR102491001	+(+3.24 +/- .03)E-03	+(+7.00 +/- .22)E-05	+(+3.65 +/- .08)E-04	+(+2.65 +/- .11)E-04	+(+2.88 +/- .15)E-04
PR102591001	+(+2.34 +/- .02)E-03	+(+7.00 +/- .20)E-05	+(+3.57 +/- .09)E-04	+(+2.69 +/- .11)E-04	+(+2.48 +/- .19)E-04
PR102691001	+(+2.10 +/- .01)E-03	+(+6.74 +/- .31)E-05	+(+3.33 +/- .11)E-04	+(+2.47 +/- .11)E-04	+(+2.34 +/- .14)E-04
PR102791001	+(+2.16 +/- .01)E-03	+(+6.56 +/- .20)E-05	+(+3.23 +/- .07)E-04	+(+2.37 +/- .10)E-04	+(+2.60 +/- .15)E-04
PR102891002	(+1.73 +/- 1.7)E-06	(-1.43 +/- .97)E-06	(+2.58 +/- 2.9)E-06	(+7.14 +/- 78.)E-07	(-1.72 +/- 1.0)E-05
PR102991001	(-2.43 +/- 14.)E-07	(-1.59 +/- 1.0)E-06	(+3.40 +/- 3.3)E-06	(-4.55 +/- 7.0)E-06	(-1.57 +/- .91)E-05
PR103091001	(+4.95 +/- 15.)E-07	(-9.78 +/- 8.9)E-07	(+2.11 +/- 2.8)E-06	(-4.50 +/- 6.8)E-06	(-9.36 +/- 9.8)E-06

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR100291002	(-1.90 +/- 1.3)E-05	(+7.18 +/- 5.0)E-06	(-4.74 +/- 3.6)E-06	(+2.21 +/- 8.3)E-05	(+4.47 +/- 5.6)E-06

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR100291003	(-9.53 +/- 8.8)E-05	(-9.01 +/- 7.7)E-05	(-6.34 +/- 22.)E-06	(+2.68 +/- 3.7)E-04	(-6.86 +/- 3.1)E-05
PR100291004	+(+5.23 +/- .53)E-04	+(+3.29 +/- .31)E-04	(-6.53 +/- 21.)E-06	(-4.19 +/- 3.7)E-04	(-2.45 +/- 3.1)E-05
PR100391001	+(+1.17 +/- .02)E-03	+(+1.00 +/- .01)E-03	(-1.42 +/- 6.6)E-06	(-1.67 +/- 1.5)E-04	(+1.43 +/- 1.8)E-05
PR100391002	+(+1.21 +/- .06)E-03	+(+9.49 +/- .46)E-04	(+3.33 +/- 1.8)E-05	(+1.03 +/- 3.6)E-04	(+2.79 +/- 25.)E-06
PR100491001	+(+8.71 +/- .13)E-04	+(+7.44 +/- .09)E-04	(+7.41 +/- 4.0)E-06	(-8.08 +/- 7.0)E-05	(-1.92 +/- 6.3)E-06
PR100491002	(-1.42 +/- 2.7)E-05	(+1.03 +/- 1.4)E-05	(+1.48 +/- .78)E-05	(-1.75 +/- ***)E-06	(+5.21 +/- 11.)E-06
PR100491003	(+9.21 +/- 5.1)E-04	+(+8.60 +/- 2.9)E-04	(-4.13 +/- 8.4)E-05	(-2.93 +/- 1.5)E-03	(+2.58 +/- 1.3)E-04
PR100491004	+(+1.08 +/- .09)E-03	+(+6.55 +/- .71)E-04	(+4.99 +/- 26.)E-06	(-8.28 +/- 5.0)E-04	(-4.21 +/- 3.7)E-05
PR100591001	+(+1.02 +/- .01)E-03	+(+8.98 +/- .10)E-04	(+4.72 +/- 3.8)E-06	(-1.31 +/- .85)E-04	+(+1.43 +/- .64)E-05
PR100691001	+(+9.77 +/- .10)E-04	+(+8.49 +/- .09)E-04	(+6.95 +/- 3.6)E-06	(-1.52 +/- .68)E-04	(+8.42 +/- 7.1)E-06
PR100791001	+(+9.25 +/- .09)E-04	+(+8.05 +/- .09)E-04	+(+9.89 +/- 3.8)E-06	(-3.92 +/- 7.1)E-05	(-3.21 +/- 3.9)E-06
PR100891001	+(+9.29 +/- .11)E-04	+(+7.89 +/- .11)E-04	(+5.14 +/- 4.1)E-06	(-7.17 +/- 6.1)E-05	(-3.03 +/- 6.5)E-06
PR100991001	+(+8.79 +/- .10)E-04	+(+7.68 +/- .08)E-04	(+6.04 +/- 3.2)E-06	(-8.63 +/- 8.1)E-05	(-6.91 +/- 7.5)E-06
PR101091001	+(+8.53 +/- .09)E-04	+(+7.26 +/- .09)E-04	(+3.08 +/- 3.4)E-06	(+4.43 +/- 4.5)E-05	(-7.80 +/- 55.)E-07
PR101191001	+(+3.25 +/- .08)E-04	+(+2.74 +/- .07)E-04	(-2.83 +/- 30.)E-07	(+1.02 +/- .54)E-04	(-4.28 +/- 6.1)E-06
PR101191006	(-5.96 +/- 81.)E-06	(-4.06 +/- 3.3)E-06	(+6.15 +/- 3.7)E-06	(-1.38 +/- 5.4)E-05	(+2.01 +/- 5.4)E-06
PR101191007	(-7.39 +/- 17.)E-06	(-6.18 +/- 78.)E-07	(+1.15 +/- .69)E-05	(-1.89 +/- 1.0)E-04	(-6.68 +/- 8.1)E-06
PR101291001	(+2.18 +/- 6.8)E-06	(+9.11 +/- 24.)E-07	(-1.23 +/- 1.8)E-06	(+4.91 +/- 3.6)E-05	(+8.44 +/- ***)E-09
PR101391001	+(+7.75 +/- .09)E-04	+(+6.76 +/- .08)E-04	(+2.38 +/- 3.6)E-06	(-9.97 +/- 6.3)E-05	(+8.95 +/- 5.8)E-06
PR101491001	+(+1.03 +/- .01)E-03	+(+9.66 +/- .11)E-04	(+8.19 +/- 7.1)E-06	(-1.68 +/- .95)E-04	(-2.66 +/- 7.9)E-06
PR101591001	(+1.16 +/- 6.7)E-06	(+3.86 +/- 2.4)E-06	(-7.32 +/- 19.)E-07	(+3.65 +/- 3.3)E-05	(+2.37 +/- 3.7)E-06
PR101591005	(-4.73 +/- 13.)E-06	(+4.43 +/- 4.2)E-06	(-2.67 +/- 3.6)E-06	(+3.40 +/- 6.5)E-05	(-5.70 +/- 6.0)E-06
PR101691001	(-1.32 +/- 1.2)E-05	(+9.59 +/- 30.)E-07	(+2.61 +/- 28.)E-07	(+2.41 +/- 4.4)E-05	(-2.79 +/- 4.6)E-06

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR101691002	(-6.64 +/- ***)E-07	(+5.87 +/- 3.2)E-06	(-2.17 +/- ***)E-08	(+9.48 +/- 5.6)E-05	(+4.78 +/- 5.7)E-06
PR101691005	(-6.88 +/- 8.7)E-06	(+3.05 +/- 3.0)E-06	(-2.08 +/- 2.7)E-06	(+7.35 +/- 4.6)E-05	(+1.14 +/- 4.7)E-06
PR101791001	(-2.96 +/- 9.2)E-06	(+1.92 +/- 31.)E-07	(-5.53 +/- 2.3)E-06	(+1.60 +/- 4.5)E-05	(+4.28 +/- 4.8)E-06
PR101791002	(-3.56 +/- 1.7)E-05	(+1.07 +/- 7.6)E-06	+(+1.24 +/- .61)E-05	(-2.29 +/- 9.0)E-05	(-7.32 +/- 7.6)E-06
PR101791003	+(+4.08 +/- 1.1)E-05	+(+1.38 +/- .41)E-05	(-5.91 +/- 25.)E-07	(+1.98 +/- 4.5)E-05	(-1.36 +/- 5.2)E-06
PR101891001	+(+1.26 +/- .01)E-03	+(+1.09 +/- .01)E-03	(+4.14 +/- 4.8)E-06	(-6.54 +/- 9.5)E-05	(-4.01 +/- 9.0)E-06
PR101991001	+(+1.41 +/- .01)E-03	+(+1.27 +/- .01)E-03	(+3.20 +/- 4.9)E-06	(-2.18 +/- .98)E-04	(+4.62 +/- 7.3)E-06
PR102091001	+(+1.34 +/- .01)E-03	+(+1.19 +/- .01)E-03	(+5.08 +/- 4.7)E-06	(-9.31 +/- 8.8)E-05	(-2.47 +/- 8.4)E-06
PR102191001	+(+1.32 +/- .01)E-03	+(+1.16 +/- .01)E-03	(+7.32 +/- 4.7)E-06	(-7.19 +/- 8.4)E-05	(-1.13 +/- .97)E-05
PR102291001	+(+1.33 +/- .01)E-03	+(+1.16 +/- .01)E-03	(+5.68 +/- 4.9)E-06	(-1.55 +/- .89)E-04	(+4.71 +/- 8.7)E-06
PR102391001	+(+1.31 +/- .01)E-03	+(+1.14 +/- .01)E-03	+(+9.78 +/- 4.6)E-06	+(+2.34 +/- .86)E-04	(+7.09 +/- 8.0)E-06
PR102491001	+(+1.28 +/- .01)E-03	+(+1.13 +/- .01)E-03	(+1.09 +/- 4.5)E-06	(-2.13 +/- 1.1)E-04	(-3.61 +/- 7.1)E-06
PR102591001	+(+1.26 +/- .01)E-03	+(+1.09 +/- .01)E-03	(+7.58 +/- 4.3)E-06	(-7.10 +/- ***)E-05	(+7.20 +/- 6.8)E-06
PR102691001	+(+1.21 +/- .01)E-03	+(+1.07 +/- .01)E-03	(+7.41 +/- 4.3)E-06	(-1.10 +/- .77)E-04	(-7.20 +/- 9.4)E-06
PR102791001	+(+1.18 +/- .01)E-03	+(+1.04 +/- .01)E-03	+(+1.21 +/- .43)E-05	(-6.63 +/- 8.5)E-05	(+2.45 +/- 67.)E-07
PR102891002	(+1.00 +/- 1.2)E-05	(+2.17 +/- 27.)E-07	(-3.00 +/- 2.2)E-06	(+5.46 +/- 4.6)E-05	(+2.08 +/- 4.1)E-06
PR102991001	(+9.06 +/- 6.7)E-06	(+3.24 +/- 2.5)E-06	(-1.58 +/- 2.2)E-06	(+4.05 +/- 3.4)E-05	(-9.97 +/- 44.)E-07
PR103091001	(+1.82 +/- 9.2)E-06	(+7.57 +/- 24.)E-07	(-1.39 +/- 2.0)E-06	(+2.94 +/- 4.0)E-05	(+4.44 +/- 35.)E-07

ID	XE 135	XEM 135	XE 137	CS 137	XE 138
PR100291002	(-1.60 +/- 1.7)E-06	(-5.40 +/- 32.)E-07	(-1.29 +/- .68)E-05	(-3.42 +/- 35.)E-07	(-4.35 +/- 4.9)E-06
PR100291003	(-1.85 +/- 1.8)E-05	(+2.79 +/- 3.0)E-05	(-1.10 +/- 5.0)E-05	(+2.57 +/- 1.9)E-05	(+1.47 +/- 5.3)E-05
PR100291004	(+1.67 +/- 1.5)E-05	(+3.42 +/- 2.1)E-05	+(+4.12 +/- .53)E-04	(+2.61 +/- 2.4)E-05	+(+2.73 +/- .37)E-04

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	XE 138
PR100391001	+(+1.60 +/- .37)E-05	+(+9.52 +/- .66)E-05	+(+4.98 +/- .17)E-04	(+7.60 +/- 5.7)E-06	+(+4.10 +/- .11)E-04
PR100391002	+(+2.76 +/- 1.3)E-05	+(+1.19 +/- .20)E-04	+(+4.61 +/- .52)E-04	(-1.31 +/- 2.3)E-05	+(+3.37 +/- .28)E-04
PR100491001	+(+2.80 +/- .26)E-05	+(+1.07 +/- .06)E-04	+(+3.52 +/- .13)E-04	(+1.66 +/- 3.3)E-06	+(+2.99 +/- .06)E-04
PR100491002	+(+1.78 +/- .64)E-05	(-9.06 +/- 69.)E-07	(+1.71 +/- 1.8)E-05	(+9.27 +/- 7.0)E-06	(+1.23 +/- 14.)E-06
PR100491003	+(+2.56 +/- .51)E-04	+(+2.96 +/- .88)E-04	(+3.10 +/- 2.0)E-04	(+6.76 +/- 9.7)E-05	+(+1.17 +/- .16)E-03
PR100491004	+(+4.12 +/- 1.6)E-05	+(+1.31 +/- .37)E-04	+(+2.31 +/- 1.0)E-04	(-3.31 +/- 2.6)E-05	+(+4.26 +/- .77)E-04
PR100591001	+(+2.02 +/- .20)E-05	+(+1.10 +/- .04)E-04	+(+4.20 +/- .13)E-04	(-1.74 +/- 3.3)E-06	+(+3.62 +/- .06)E-04
PR100691001	+(+1.74 +/- .24)E-05	+(+1.07 +/- .04)E-04	+(+4.42 +/- .13)E-04	(+2.86 +/- 4.2)E-06	+(+3.42 +/- .08)E-04
PR100791001	+(+1.88 +/- .22)E-05	+(+9.26 +/- .47)E-05	+(+4.16 +/- .10)E-04	(-3.26 +/- 3.7)E-06	+(+3.37 +/- .06)E-04
PR100891001	+(+1.67 +/- .18)E-05	+(+8.57 +/- .45)E-05	+(+4.01 +/- .16)E-04	(-4.83 +/- 27.)E-07	+(+3.27 +/- .07)E-04
PR100991001	+(+1.69 +/- .24)E-05	+(+8.13 +/- .33)E-05	+(+3.73 +/- .09)E-04	(-1.15 +/- 2.6)E-06	+(+3.14 +/- .07)E-04
PR101091001	+(+1.46 +/- .16)E-05	+(+6.83 +/- .30)E-05	+(+3.78 +/- .09)E-04	(+8.97 +/- 25.)E-07	+(+3.01 +/- .05)E-04
PR101191001	+(+8.27 +/- 2.3)E-06	+(+5.21 +/- .36)E-05	+(+1.19 +/- .08)E-04	(-1.58 +/- 2.6)E-06	+(+1.20 +/- .05)E-04
PR101191006	(+9.12 +/- 19.)E-07	(+3.95 +/- 4.3)E-06	(-3.29 +/- 8.2)E-06	(+5.77 +/- 3.6)E-06	(+1.53 +/- 5.9)E-06
PR101191007	(-7.93 +/- 30.)E-07	(+4.23 +/- 5.9)E-06	(-8.85 +/- 16.)E-06	(-4.81 +/- 4.8)E-06	(-1.92 +/- .77)E-05
PR101291001	(-7.81 +/- 12.)E-07	(+2.62 +/- 1.7)E-06	(-1.15 +/- .61)E-05	(+3.84 +/- 22.)E-07	(+3.40 +/- 3.1)E-06
PR101391001	+(+9.13 +/- 2.7)E-06	+(+4.64 +/- .30)E-05	+(+3.16 +/- .09)E-04	(-2.89 +/- 2.7)E-06	+(+2.75 +/- .06)E-04
PR101491001	+(+2.40 +/- .25)E-05	+(+1.25 +/- .05)E-04	+(+3.76 +/- .11)E-04	(+4.20 +/- 3.2)E-06	+(+3.23 +/- .10)E-04
PR101591001	+(+3.34 +/- 1.1)E-06	+(+1.74 +/- .25)E-05	(-1.51 +/- .53)E-05	(+2.68 +/- 23.)E-07	(+2.32 +/- 3.0)E-06
PR101591005	(-8.94 +/- 21.)E-07	(+1.38 +/- 3.6)E-06	(-1.65 +/- .82)E-05	(-1.13 +/- 38.)E-07	(+9.39 +/- 5.9)E-06
PR101691001	(+2.66 +/- 1.4)E-06	(-2.42 +/- 2.2)E-06	(-7.00 +/- 5.8)E-06	(-9.24 +/- 28.)E-07	(-3.05 +/- 4.2)E-06
PR101691002	(-2.14 +/- 1.9)E-06	(-1.48 +/- 2.4)E-06	(-5.37 +/- 8.3)E-06	(+1.53 +/- 2.9)E-06	(+4.87 +/- 4.3)E-06
PR101691005	(-4.78 +/- 14.)E-07	(-2.27 +/- 2.2)E-06	(-1.44 +/- .78)E-05	(-5.75 +/- 28.)E-07	(+3.94 +/- 4.1)E-06

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	XE 138
PR101791001	(-7.22 +/- 16.)E-07	(-2.30 +/- 2.7)E-06	(-2.72 +/- 8.0)E-06	(-1.37 +/- 2.8)E-06	(+2.09 +/- 3.9)E-06
PR101791002	(+1.91 +/- 3.2)E-06	(-6.09 +/- 4.5)E-06	(-1.41 +/- 1.2)E-05	(+3.46 +/- 6.0)E-06	(+1.33 +/- 1.1)E-05
PR101791003	(-1.03 +/- 1.4)E-06	(+1.04 +/- 2.4)E-06	+(+1.39 +/- .64)E-05	(-1.95 +/- 27.)E-07	+(+1.29 +/- .43)E-05
PR101891001	+(+1.65 +/- .24)E-05	+(+8.34 +/- .42)E-05	+(+4.99 +/- .10)E-04	(-1.83 +/- 2.7)E-06	+(+4.32 +/- .08)E-04
PR101991001	+(+2.72 +/- .23)E-05	+(+1.44 +/- .05)E-04	+(+5.09 +/- .13)E-04	(-5.77 +/- 27.)E-07	+(+4.54 +/- .07)E-04
PR102091001	+(+2.59 +/- .23)E-05	+(+1.37 +/- .04)E-04	+(+5.02 +/- .11)E-04	(-2.48 +/- 3.3)E-06	+(+4.32 +/- .08)E-04
PR102191001	+(+2.24 +/- .22)E-05	+(+1.33 +/- .04)E-04	+(+4.77 +/- .10)E-04	(+1.44 +/- 2.8)E-06	+(+4.24 +/- .07)E-04
PR102291001	+(+2.93 +/- .25)E-05	+(+1.33 +/- .04)E-04	+(+4.73 +/- .13)E-04	(-4.03 +/- 27.)E-07	+(+4.30 +/- .08)E-04
PR102391001	+(+2.50 +/- .27)E-05	+(+1.31 +/- .04)E-04	+(+4.88 +/- .14)E-04	(-4.35 +/- 2.7)E-06	+(+4.07 +/- .08)E-04
PR102491001	+(+2.34 +/- .25)E-05	+(+1.32 +/- .04)E-04	+(+4.77 +/- .12)E-04	(-2.88 +/- 2.9)E-06	+(+3.98 +/- .07)E-04
PR102591001	+(+2.53 +/- .25)E-05	+(+1.19 +/- .04)E-04	+(+4.71 +/- .11)E-04	(-4.60 +/- 3.3)E-06	+(+4.02 +/- .07)E-04
PR102691001	+(+2.36 +/- .24)E-05	+(+1.12 +/- .04)E-04	+(+4.41 +/- .10)E-04	(+3.19 +/- 2.6)E-06	+(+3.72 +/- .07)E-04
PR102791001	+(+2.57 +/- .29)E-05	+(+1.05 +/- .04)E-04	+(+4.31 +/- .15)E-04	(+3.45 +/- 27.)E-07	+(+3.71 +/- .06)E-04
PR102891002	(+2.57 +/- 1.3)E-06	+(+6.25 +/- 2.2)E-06	(-3.89 +/- 5.1)E-06	(+8.83 +/- 26.)E-07	(+4.52 +/- 3.5)E-06
PR102991001	(+3.21 +/- ***)E-08	(-1.52 +/- 1.6)E-06	(-9.89 +/- 4.5)E-06	(-2.60 +/- ***)E-08	+(+7.97 +/- 2.9)E-06
PR103091001	(-1.66 +/- 1.1)E-06	(-2.24 +/- 18.)E-07	(-9.93 +/- 6.3)E-06	(-2.91 +/- 25.)E-07	(+3.36 +/- 3.3)E-06

ID	CS 138	XE 139
PR100291002	(-3.59 +/- 2.9)E-06	(+2.74 +/- 2.9)E-06
PR100291003	+(+2.45 +/- .97)E-05	(-1.71 +/- 1.9)E-05
PR100291004	+(+2.03 +/- .13)E-04	+(+6.10 +/- 2.5)E-05
PR100391001	+(+3.58 +/- .08)E-04	+(+2.08 +/- .72)E-05
PR100391002	+(+3.87 +/- .28)E-04	(+2.47 +/- 1.4)E-05

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	CS 138	XE 139
PR100491001	+(+2.73 +/- .05)E-04	+(+1.49 +/- .50)E-05
PR100491002	(-6.18 +/- 6.5)E-06	(-5.51 +/- 6.7)E-06
PR100491003	+(+3.71 +/- .57)E-04	(-2.91 +/- .77)E-04
PR100491004	+(+4.54 +/- .48)E-04	(+1.66 +/- 2.1)E-05
PR100591001	+(+3.15 +/- .06)E-04	+(+9.76 +/- 2.7)E-06
PR100691001	+(+2.99 +/- .05)E-04	+(+1.16 +/- .27)E-05
PR100791001	+(+2.95 +/- .05)E-04	+(+1.08 +/- .25)E-05
PR100891001	+(+2.79 +/- .05)E-04	+(+9.06 +/- 2.8)E-06
PR100991001	+(+2.74 +/- .06)E-04	+(+1.04 +/- .28)E-05
PR101091001	+(+2.67 +/- .05)E-04	+(+6.49 +/- 2.3)E-06
PR101191001	+(+1.04 +/- .04)E-04	+(+6.07 +/- 2.3)E-06
PR101191006	(-1.20 +/- 2.9)E-06	(-3.42 +/- 2.8)E-06
PR101191007	(-5.07 +/- 8.2)E-06	(-7.91 +/- 4.4)E-06
PR101291001	(-5.53 +/- 19.)E-07	(-2.19 +/- 1.8)E-06
PR101391001	+(+2.28 +/- .06)E-04	+(+6.95 +/- 2.5)E-06
PR101491001	+(+3.17 +/- .06)E-04	+(+9.57 +/- 3.7)E-06
PR101591001	(-3.93 +/- 19.)E-07	(-2.93 +/- 1.6)E-06
PR101591005	(-1.86 +/- 3.6)E-06	(-6.69 +/- 3.1)E-06
PR101691001	(-2.09 +/- 2.3)E-06	(-2.06 +/- 22.)E-07
PR101691002	(-5.42 +/- 2.6)E-06	(-3.08 +/- 2.6)E-06
PR101691005	(-2.50 +/- 2.6)E-06	(-1.61 +/- 2.2)E-06
PR101791001	(+2.20 +/- 2.9)E-06	(+1.23 +/- 2.3)E-06
PR101791002	(-3.34 +/- 7.9)E-06	(+3.60 +/- 4.8)E-06

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	CS 138	XE 139
PR101791003	+(+8.83 +/- 3.0)E-06	(-2.99 +/- 2.6)E-06
PR101891001	+(+3.70 +/- .06)E-04	(+5.08 +/- 3.0)E-06
PR101991001	+(+4.00 +/- .06)E-04	+(+7.92 +/- 3.2)E-06
PR102091001	+(+3.95 +/- .06)E-04	(+7.45 +/- 3.8)E-06
PR102191001	+(+3.78 +/- .06)E-04	+(+1.49 +/- .33)E-05
PR102291001	+(+3.68 +/- .06)E-04	+(+6.59 +/- 3.2)E-06
PR102391001	+(+3.72 +/- .06)E-04	+(+1.21 +/- .33)E-05
PR102491001	+(+3.62 +/- .06)E-04	+(+1.40 +/- .31)E-05
PR102591001	+(+3.45 +/- .05)E-04	+(+1.26 +/- .29)E-05
PR102691001	+(+3.38 +/- .06)E-04	+(+9.01 +/- 3.8)E-06
PR102791001	+(+3.26 +/- .06)E-04	(+6.38 +/- 3.3)E-06
PR102891002	(-1.45 +/- 2.5)E-06	(+6.47 +/- 20.)E-07
PR102991001	(-2.20 +/- 1.9)E-06	(-3.54 +/- 19.)E-07
PR103091001	(-3.87 +/- 1.9)E-06	(-1.37 +/- 18.)E-07

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.

GAMMA-RAY ANALYSIS SUMMARY 2

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

COLLECTION PERIOD:
110591 TO 112891

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

26-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY Alan V Wilson

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
110591 TO 112891

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR110691001	110591	PR110691001	1.00	PR100191001
PR110791001	110691	PR110791001	1.00	PR100191001
PR110891001	110791	PR110891001	1.00	PR100191001
PR110991001	110891	PR110991001	1.00	PR100191001
PR111091001	110991	PR111091001	1.00	PR100191001
PR111191001	111091	PR111191001	1.00	PR100191001
PR111291001	111191	PR111291001	1.00	PR100191001
PR111391001	111291	PR111391001	1.00	PR100191001
PR111491001	111391	PR111491001	1.00	PR100191001
PR111591001	111491	PR111591001	1.00	PR100191001
PR111691001	111591	PR111691001	1.00	PR100191001
PR111791001	111691	PR111791001	1.00	PR100191001
PR111991001	111891	PR111991001	1.00	PR100191001
PR112091001	111991	PR112091001	1.00	PR100191001
PR112191001	112091	PR112191001	1.00	PR100191001
PR112291001	112191	PR112291001	1.00	PR100191001
PR112291002	112291	PR112291002	1.00	PR100191001
PR112391001	112291	PR112391001	1.00	PR100191001
PR112491001	112391	PR112491001	1.00	PR100191001
PR112591001	112491	PR112591001	1.00	PR100191001
PR112691001	112591	PR112691001	1.00	PR100191001

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR112791001	112691	PR112791001	1.00	PR100191001
PR112791002	112791	PR112791002	1.00	PR100191001
PR112891001	112791	PR112891001	1.00	PR100191001
PR112991001	112891	PR112991001	1.00	PR100191001

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
110591 TO 112891

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR110691001	(-2.54 +/- 15.)E-07	(-1.19 +/- 1.0)E-06	(+7.59 +/- 28.)E-07	(-5.61 +/- 7.3)E-06	(-7.75 +/- 9.6)E-06
PR110791001	(-4.58 +/- 15.)E-07	(-8.99 +/- 8.4)E-07	(+1.12 +/- 2.5)E-06	(-3.36 +/- 6.6)E-06	(-1.02 +/- .89)E-05
PR110891001	(-6.36 +/- 14.)E-07	(-9.57 +/- 8.9)E-07	(+1.28 +/- 2.5)E-06	(-8.73 +/- 6.9)E-06	(-1.57 +/- .88)E-05
PR110991001	(+3.80 +/- 15.)E-07	(-9.71 +/- 8.3)E-07	(+1.99 +/- 2.5)E-06	(-1.05 +/- .64)E-05	(-1.07 +/- .88)E-05
PR111091001	(-1.60 +/- 1.4)E-06	(-1.32 +/- .87)E-06	(+2.22 +/- 2.5)E-06	(-6.06 +/- 6.6)E-06	(-2.41 +/- 8.8)E-06
PR111191001	+(+2.74 +/- .06)E-04	(+1.45 +/- 1.1)E-06	+(+2.78 +/- .36)E-05	+(+2.69 +/- .63)E-05	(+1.63 +/- 1.0)E-05
PR111291001	+(+1.45 +/- .01)E-03	+(+5.26 +/- .22)E-05	+(+2.49 +/- .06)E-04	+(+2.14 +/- .10)E-04	+(+1.97 +/- .13)E-04
PR111391001	+(+1.55 +/- .01)E-03	+(+4.77 +/- .22)E-05	+(+2.52 +/- .08)E-04	+(+1.70 +/- .09)E-04	+(+1.68 +/- .13)E-04
PR111491001	+(+1.38 +/- .01)E-03	+(+4.53 +/- .25)E-05	+(+2.40 +/- .06)E-04	+(+1.84 +/- .10)E-04	+(+1.77 +/- .13)E-04
PR111591001	+(+1.66 +/- .01)E-03	+(+4.51 +/- .24)E-05	+(+2.46 +/- .06)E-04	+(+1.91 +/- .08)E-04	+(+1.63 +/- .13)E-04
PR111691001	+(+1.38 +/- .02)E-03	+(+4.63 +/- .24)E-05	+(+2.48 +/- .08)E-04	+(+1.63 +/- .10)E-04	+(+1.54 +/- .15)E-04
PR111791001	+(+1.41 +/- .01)E-03	+(+4.97 +/- .25)E-05	+(+2.45 +/- .06)E-04	+(+1.91 +/- .09)E-04	+(+1.95 +/- .14)E-04
PR111991001	(-9.40 +/- 13.)E-07	(-7.00 +/- 9.6)E-07	(-2.49 +/- 3.1)E-06	(-3.87 +/- 7.0)E-06	(-1.49 +/- .89)E-05
PR112091001	(-1.43 +/- 1.4)E-06	(-5.65 +/- 9.1)E-07	(+3.29 +/- 3.2)E-06	(-8.93 +/- 6.5)E-06	(-7.70 +/- 8.9)E-06
PR112191001	(-9.16 +/- ***)E-08	(-1.05 +/- .84)E-06	(+3.33 +/- 3.1)E-06	(-3.02 +/- 6.5)E-06	(+3.06 +/- 9.3)E-06
PR112291001	(-2.37 +/- 1.4)E-06	(-1.46 +/- .84)E-06	(+9.24 +/- 32.)E-07	(-5.48 +/- 6.4)E-06	(-3.13 +/- 9.5)E-06
PR112291002	(+9.12 +/- 17.)E-07	(-2.38 +/- 1.3)E-06	(+3.25 +/- 4.1)E-06	(-1.96 +/- 10.)E-06	(-1.42 +/- 1.2)E-05
PR112391001	(-8.32 +/- 14.)E-07	(-6.54 +/- 8.4)E-07	(+4.30 +/- 2.6)E-06	(+2.40 +/- 66.)E-07	(-1.58 +/- .95)E-05
PR112491001	(+1.00 +/- 1.4)E-06	(-3.82 +/- 91.)E-08	(+2.64 +/- 2.7)E-06	(-9.46 +/- 7.0)E-06	(-1.34 +/- .89)E-05
PR112591001	(+2.93 +/- 15.)E-07	(-2.76 +/- 9.2)E-07	(+6.96 +/- 27.)E-07	(+6.13 +/- 9.2)E-06	(-1.92 +/- .98)E-05
PR112691001	+(+2.91 +/- .05)E-04	(+4.14 +/- ***)E-08	+(+7.80 +/- 3.3)E-06	(+3.08 +/- 7.1)E-06	(-9.68 +/- 9.8)E-06

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR112791001	+(+1.13 +/- .01)E-03	+(+1.55 +/- .14)E-05	+(+8.12 +/- .80)E-05	+(+5.36 +/- .91)E-05	+(+3.64 +/- 1.0)E-05
PR112791002	+(+7.16 +/- .14)E-04	(+6.03 +/- 3.2)E-06	+(+8.49 +/- .73)E-05	+(+5.76 +/- 1.4)E-05	(+3.57 +/- 2.0)E-05
PR112891001	+(+1.94 +/- .01)E-03	+(+4.07 +/- .25)E-05	+(+2.13 +/- .08)E-04	+(+1.52 +/- .09)E-04	+(+1.45 +/- .12)E-04
PR112991001	+(+1.14 +/- .01)E-03	+(+4.05 +/- .24)E-05	+(+1.92 +/- .08)E-04	+(+1.30 +/- .10)E-04	+(+1.42 +/- .15)E-04

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR110691001	(-6.14 +/- 7.2)E-06	(+1.93 +/- 2.5)E-06	(+8.77 +/- 25.)E-07	(+6.15 +/- 3.6)E-05	+(+3.22 +/- .47)E-05
PR110791001	(+5.16 +/- 7.6)E-06	(-2.59 +/- 25.)E-07	(+1.31 +/- 2.1)E-06	(+4.35 +/- 3.3)E-05	+(+3.35 +/- .37)E-05
PR110891001	(+4.91 +/- 7.1)E-06	(+3.21 +/- 2.4)E-06	(-1.06 +/- 1.9)E-06	(+5.10 +/- 3.4)E-05	+(+2.75 +/- .34)E-05
PR110991001	(-6.88 +/- 7.5)E-06	(+2.35 +/- 2.4)E-06	(-1.39 +/- 1.9)E-06	+(+1.07 +/- .34)E-04	+(+1.61 +/- .56)E-05
PR111091001	(+3.32 +/- 6.8)E-06	(-2.41 +/- 2.3)E-06	(-2.43 +/- 1.9)E-06	(+5.49 +/- 3.3)E-05	(-3.21 +/- 4.6)E-06
PR111191001	+(+9.85 +/- .53)E-05	+(+8.40 +/- .39)E-05	(+2.69 +/- 2.7)E-06	(+3.83 +/- 4.5)E-05	(+6.85 +/- 41.)E-07
PR111291001	+(+8.62 +/- .11)E-04	+(+7.56 +/- .08)E-04	(-1.23 +/- 5.2)E-06	(+4.25 +/- 9.5)E-05	(-1.26 +/- 1.1)E-05
PR111391001	+(+8.41 +/- .10)E-04	+(+7.62 +/- .09)E-04	(+3.76 +/- 5.9)E-06	(+2.03 +/- 11.)E-05	(-9.36 +/- 8.0)E-06
PR111491001	+(+8.21 +/- .11)E-04	+(+7.51 +/- .09)E-04	(+6.97 +/- 5.7)E-06	(-6.03 +/- ***)E-05	(-1.24 +/- .84)E-05
PR111591001	+(+8.09 +/- .12)E-04	+(+7.08 +/- .08)E-04	(-3.46 +/- 7.2)E-06	(-8.11 +/- 10.)E-05	(+9.95 +/- 7.0)E-06
PR111691001	+(+8.00 +/- .11)E-04	+(+7.04 +/- .08)E-04	(+1.63 +/- 6.8)E-06	(-7.51 +/- 11.)E-05	(-2.34 +/- 1.0)E-05
PR111791001	+(+7.82 +/- .11)E-04	+(+7.14 +/- .08)E-04	(+9.48 +/- 6.6)E-06	(+2.43 +/- 10.)E-05	(-3.34 +/- 15.)E-06
PR111991001	(+5.44 +/- 6.9)E-06	(+3.00 +/- 2.6)E-06	(-6.97 +/- 19.)E-07	+(+9.10 +/- 3.4)E-05	(-9.28 +/- 43.)E-07
PR112091001	(+9.83 +/- 6.9)E-06	(+1.60 +/- 24.)E-07	(+4.25 +/- 19.)E-07	(-4.76 +/- ***)E-07	(+3.56 +/- 37.)E-07
PR112191001	(-7.79 +/- 68.)E-07	(+7.60 +/- 24.)E-07	(-5.81 +/- ***)E-08	(+6.54 +/- 3.3)E-05	(-8.41 +/- 40.)E-07
PR112291001	(-8.81 +/- 71.)E-07	(-1.25 +/- 2.4)E-06	(-1.21 +/- 1.9)E-06	(+6.31 +/- 33.)E-06	(+2.39 +/- 3.5)E-06
PR112291002	(+4.21 +/- 11.)E-06	(-2.43 +/- 3.3)E-06	(+5.75 +/- 30.)E-07	(-2.00 +/- 5.3)E-05	(+4.68 +/- 5.1)E-06

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR112391001	(+3.95 +/- 7.6)E-06	(+3.96 +/- 24.)E-07	(-2.00 +/- 2.1)E-06	(+2.53 +/- 3.3)E-05	(+4.82 +/- 3.9)E-06
PR112491001	+(+1.55 +/- .68)E-05	(-1.64 +/- 24.)E-07	(+7.52 +/- 20.)E-07	(+4.86 +/- 3.3)E-05	(+3.82 +/- 3.5)E-06
PR112591001	(-4.36 +/- 7.3)E-06	(-7.54 +/- ***)E-08	(-1.15 +/- 2.0)E-06	(+3.17 +/- 3.8)E-05	(-9.64 +/- 38.)E-07
PR112691001	+(+4.69 +/- .44)E-05	+(+3.26 +/- .29)E-05	(+1.08 +/- 22.)E-07	(+1.61 +/- 3.7)E-05	(+3.17 +/- 44.)E-07
PR112791001	+(+3.50 +/- .07)E-04	+(+3.05 +/- .06)E-04	(+6.23 +/- 3.6)E-06	(+2.65 +/- 6.8)E-05	(-6.48 +/- 5.8)E-06
PR112791002	+(+3.71 +/- .11)E-04	+(+3.45 +/- .10)E-04	(+5.86 +/- 42.)E-07	(+6.75 +/- 7.4)E-05	(-2.56 +/- 77.)E-07
PR112891001	+(+6.91 +/- .10)E-04	+(+6.05 +/- .08)E-04	(+1.48 +/- 5.3)E-06	(+3.00 +/- 13.)E-05	(-9.38 +/- 8.2)E-06
PR112991001	+(+6.99 +/- .10)E-04	+(+6.19 +/- .07)E-04	(-6.66 +/- 56.)E-07	(+1.23 +/- 13.)E-05	(-6.49 +/- ***)E-07

ID	XE 135	XEM 135	XE 137	CS 137	XE 138
PR110691001	(-1.75 +/- 1.1)E-06	(-2.61 +/- 1.9)E-06	(-2.48 +/- 7.0)E-06	(+1.07 +/- 2.3)E-06	(+3.57 +/- 3.4)E-06
PR110791001	(-4.70 +/- 10.)E-07	(-2.51 +/- 1.8)E-06	(-3.71 +/- 6.3)E-06	(+1.01 +/- 2.3)E-06	(+5.28 +/- 32.)E-07
PR110891001	(-2.55 +/- 11.)E-07	(-9.94 +/- 17.)E-07	(-1.55 +/- .65)E-05	(-2.68 +/- 22.)E-07	(+4.60 +/- 2.9)E-06
PR110991001	(-7.73 +/- 11.)E-07	(+3.48 +/- 18.)E-07	(-7.58 +/- 4.5)E-06	(+1.38 +/- 2.4)E-06	(+2.03 +/- 3.0)E-06
PR111091001	(-4.99 +/- ***)E-09	(-2.35 +/- 1.7)E-06	(-9.04 +/- 6.0)E-06	(+1.65 +/- 23.)E-07	(+2.72 +/- 2.9)E-06
PR111191001	(-5.49 +/- 12.)E-07	+(+4.79 +/- 1.9)E-06	+(+5.53 +/- .67)E-05	(+1.52 +/- 2.7)E-06	+(+4.83 +/- .35)E-05
PR111291001	+(+8.92 +/- 3.1)E-06	+(+5.97 +/- .33)E-05	+(+3.41 +/- .09)E-04	(+7.99 +/- 25.)E-07	+(+2.97 +/- .07)E-04
PR111391001	+(+1.66 +/- .39)E-05	+(+7.40 +/- .41)E-05	+(+3.38 +/- .09)E-04	(-7.03 +/- 25.)E-07	+(+2.66 +/- .08)E-04
PR111491001	+(+1.63 +/- .34)E-05	+(+7.72 +/- .35)E-05	+(+3.50 +/- .09)E-04	(+4.28 +/- 27.)E-07	+(+2.77 +/- .07)E-04
PR111591001	+(+1.02 +/- .35)E-05	+(+7.67 +/- .34)E-05	+(+3.32 +/- .09)E-04	(+2.46 +/- 2.7)E-06	+(+2.84 +/- .08)E-04
PR111691001	+(+1.34 +/- .29)E-05	+(+6.72 +/- .31)E-05	+(+3.44 +/- .09)E-04	(+3.91 +/- 29.)E-07	+(+2.53 +/- .07)E-04
PR111791001	+(+1.02 +/- .34)E-05	+(+7.35 +/- .32)E-05	+(+3.40 +/- .10)E-04	(+3.65 +/- 27.)E-07	+(+2.66 +/- .08)E-04
PR111991001	(-3.23 +/- 11.)E-07	(-3.73 +/- 17.)E-07	(-1.22 +/- .65)E-05	(-1.67 +/- 24.)E-07	(+2.75 +/- 3.1)E-06

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	XE 138
PR112091001	(-1.24 +/- 1.0)E-06	(-8.57 +/- 18.)E-07	(-1.69 +/- .58)E-05	(-1.10 +/- 2.2)E-06	(+2.94 +/- 3.2)E-06
PR112191001	(-9.62 +/- 12.)E-07	(-1.43 +/- 1.7)E-06	(-1.35 +/- .46)E-05	(+1.04 +/- 2.2)E-06	(+1.96 +/- 3.1)E-06
PR112291001	(-5.20 +/- 11.)E-07	(-2.91 +/- 1.6)E-06	(-1.04 +/- .60)E-05	(+3.61 +/- 22.)E-07	(+1.93 +/- 3.0)E-06
PR112291002	(+1.11 +/- 1.7)E-06	(-1.12 +/- 3.1)E-06	(-3.92 +/- 9.0)E-06	(+1.09 +/- 3.2)E-06	(+3.93 +/- 4.7)E-06
PR112391001	(+4.37 +/- ***)E-08	(-1.14 +/- 17.)E-07	(-1.35 +/- .67)E-05	(+1.26 +/- 2.2)E-06	(+2.66 +/- 2.9)E-06
PR112491001	(-2.94 +/- 11.)E-07	(-1.76 +/- 17.)E-07	(-1.13 +/- .44)E-05	(+1.19 +/- 2.3)E-06	(+3.07 +/- 3.1)E-06
PR112591001	(-6.66 +/- 11.)E-07	(-2.68 +/- 1.8)E-06	(-1.21 +/- .61)E-05	(+1.95 +/- 2.3)E-06	(+5.29 +/- 3.2)E-06
PR112691001	(-2.60 +/- 8.5)E-07	(+2.02 +/- 1.8)E-06	+(+1.93 +/- .44)E-05	(-2.40 +/- 2.3)E-06	+(+2.22 +/- .34)E-05
PR112791001	(+3.59 +/- 1.9)E-06	+(+2.74 +/- .27)E-05	+(+2.21 +/- .08)E-04	(-3.59 +/- 3.1)E-06	+(+1.56 +/- .05)E-04
PR112791002	+(+8.96 +/- 1.9)E-06	+(+3.49 +/- .51)E-05	+(+2.36 +/- .16)E-04	(+2.26 +/- 4.5)E-06	+(+1.61 +/- .07)E-04
PR112891001	+(+7.02 +/- 2.7)E-06	+(+6.31 +/- .44)E-05	+(+3.24 +/- .09)E-04	(+4.59 +/- 3.9)E-06	+(+2.44 +/- .07)E-04
PR112991001	+(+1.08 +/- .29)E-05	+(+6.45 +/- .32)E-05	+(+3.02 +/- .09)E-04	(+6.54 +/- 24.)E-07	+(+2.37 +/- .08)E-04

ID	CS 138	XE 139
PR110691001	(-1.36 +/- 2.0)E-06	(+5.56 +/- 18.)E-07
PR110791001	(-1.98 +/- 1.8)E-06	(-8.62 +/- 17.)E-07
PR110891001	(-1.96 +/- 1.9)E-06	(-5.87 +/- 16.)E-07
PR110991001	(-3.21 +/- 1.9)E-06	(+1.03 +/- 1.7)E-06
PR111091001	(-3.24 +/- 1.9)E-06	(-3.06 +/- 1.7)E-06
PR111191001	+(+3.28 +/- .25)E-05	(+2.20 +/- 2.0)E-06
PR111291001	+(+2.68 +/- .06)E-04	+(+1.15 +/- .35)E-05
PR111391001	+(+2.52 +/- .06)E-04	(+2.64 +/- 34.)E-07
PR111491001	+(+2.52 +/- .05)E-04	(+7.72 +/- 4.1)E-06

NPR-1A Fuel Test On-line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	CS 138	XE 139
PR111591001	+(+2.46 +/- .05)E-04	(+8.67 +/- 5.4)E-06
PR111691001	+(+2.43 +/- .05)E-04	+(+1.11 +/- .38)E-05
PR111791001	+(+2.41 +/- .05)E-04	(+2.83 +/- 46.)E-07
PR111991001	(-1.47 +/- 19.)E-07	(-4.12 +/- 1.6)E-06
PR112091001	(+1.34 +/- 1.9)E-06	(-2.14 +/- 1.6)E-06
PR112191001	(+8.15 +/- 19.)E-07	(-1.29 +/- 1.9)E-06
PR112291001	(-1.21 +/- 1.9)E-06	(+6.61 +/- 17.)E-07
PR112291002	(-1.19 +/- 28.)E-07	(-2.01 +/- 2.6)E-06
PR112391001	(+8.63 +/- 20.)E-07	(-3.04 +/- 17.)E-07
PR112491001	(-1.67 +/- 1.9)E-06	(-1.03 +/- 1.7)E-06
PR112591001	(-2.89 +/- 2.0)E-06	(-2.24 +/- 1.8)E-06
PR112691001	+(+1.52 +/- .21)E-05	(-1.70 +/- 1.4)E-06
PR112791001	+(+1.39 +/- .04)E-04	(+4.01 +/- 2.9)E-06
PR112791002	+(+1.56 +/- .06)E-04	(+1.44 +/- 3.8)E-06
PR112891001	+(+2.16 +/- .06)E-04	(+2.32 +/- 4.0)E-06
PR112991001	+(+2.20 +/- .05)E-04	(+2.97 +/- 3.6)E-06

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.

GAMMA-RAY ANALYSIS SUMMARY 3

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

COLLECTION PERIOD:
113091 TO 121691

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

26-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY Chas McDonald

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
113091 TO 121691

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR120191001	113091	PR120191001	1.00	PR100191001
PR120391001	120291	PR120391001	1.00	PR100191001
PR120491001	120391	PR120491001	1.00	PR100191001
PR120491002	120491	PR120491002	1.00	PR100191001
PR120591001	120491	PR120591001	1.00	PR100191001
PR120591002	120591	PR120591002	1.00	PR100191001
PR120591003	120591	PR120591003	1.00	PR100191001
PR120891001	120691	PR120891001	1.00	PR100191001
PR120991001	120891	PR120991001	1.00	PR100191001
PR121091001	120991	PR121091001	1.00	PR100191001
PR121191001	121091	PR121191001	1.00	PR100191001
PR121291001	121191	PR121291001	1.00	PR100191001
PR121291003	121291	PR121291003	1.00	PR100191001
PR121391001	121291	PR121391001	1.00	PR100191001
PR121391002	121391	PR121391002	1.00	PR100191001
PR121391003	121391	PR121391003	1.00	PR100191001
PR121391004	121391	PR121391004	1.00	PR100191001
PR121391005	121391	PR121391005	1.00	PR100191001
PR121491001	121391	PR121491001	1.00	PR100191001
PR121491002	121491	PR121491002	1.00	PR100191001
PR121491003	121491	PR121491003	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR121491004	121491	PR121491004	1.00	PR100191001
PR121491005	121491	PR121491005	1.00	PR100191001
PR121491006	121491	PR121491006	1.00	PR100191001
PR121591001	121491	PR121591001	1.00	PR100191001
PR121591002	121591	PR121591002	1.00	PR100191001
PR121591003	121591	PR121591003	1.00	PR100191001
PR121591004	121591	PR121591004	1.00	PR100191001
PR121591005	121591	PR121591005	1.00	PR100191001
PR121591006	121591	PR121591006	1.00	PR100191001
PR121691001	121591	PR121691001	1.00	PR100191001
PR121691002	121691	PR121691002	1.00	PR100191001
PR121691003	121691	PR121691003	1.00	PR100191001
PR121691004	121691	PR121691004	1.00	PR100191001
PR121691005	121691	PR121691005	1.00	PR100191001
PR121691006	121691	PR121691006	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
113091 TO 121691

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR120191001	+(+1.24 +/- .01)E-03	+(+4.28 +/- .32)E-05	+(+2.06 +/- .06)E-04	+(+1.43 +/- .10)E-04	+(+1.37 +/- .12)E-04
PR120391001	+(+1.29 +/- .01)E-03	+(+4.36 +/- .27)E-05	+(+2.03 +/- .08)E-04	+(+1.54 +/- .07)E-04	+(+1.58 +/- .14)E-04
PR120491001	+(+1.41 +/- .01)E-03	+(+4.15 +/- .24)E-05	+(+2.19 +/- .06)E-04	+(+1.70 +/- .09)E-04	+(+1.49 +/- .13)E-04
PR120491002	+(+1.39 +/- .02)E-03	+(+2.62 +/- .59)E-05	+(+2.40 +/- .15)E-04	+(+1.64 +/- .19)E-04	+(+1.36 +/- .19)E-04
PR120591001	+(+1.47 +/- .01)E-03	+(+4.50 +/- .30)E-05	+(+2.00 +/- .06)E-04	+(+1.40 +/- .10)E-04	+(+1.73 +/- .15)E-04
PR120591002	+(+1.39 +/- .03)E-03	+(+2.30 +/- .73)E-05	+(+2.33 +/- .15)E-04	+(+1.19 +/- .21)E-04	+(+8.92 +/- 2.8)E-05
PR120591003	+(+1.18 +/- .05)E-03	+(+4.86 +/- .94)E-05	+(+1.99 +/- .23)E-04	(+8.02 +/- 4.2)E-05	+(+1.55 +/- .63)E-04
PR120891001	+(+1.39 +/- .01)E-03	+(+3.83 +/- .24)E-05	+(+2.10 +/- .08)E-04	+(+1.73 +/- .08)E-04	+(+1.56 +/- .12)E-04
PR120991001	+(+1.42 +/- .01)E-03	+(+3.67 +/- .25)E-05	+(+2.12 +/- .09)E-04	+(+1.44 +/- .08)E-04	+(+1.53 +/- .15)E-04
PR121091001	+(+1.50 +/- .02)E-03	+(+3.88 +/- .25)E-05	+(+2.08 +/- .08)E-04	+(+1.38 +/- .08)E-04	+(+1.34 +/- .14)E-04
PR121191001	+(+1.34 +/- .01)E-03	+(+1.44 +/- .15)E-05	+(+8.70 +/- .46)E-05	+(+4.98 +/- .55)E-05	+(+4.96 +/- .94)E-05
PR121291001	+(+7.94 +/- .09)E-04	+(+1.48 +/- .14)E-05	+(+7.48 +/- .47)E-05	+(+5.14 +/- .56)E-05	+(+4.91 +/- 1.2)E-05
PR121291003	+(+7.53 +/- .06)E-03	+(+2.86 +/- .02)E-03	+(+7.72 +/- .12)E-03	+(+8.23 +/- .10)E-03	+(+8.67 +/- .14)E-03
PR121391001	+(+2.17 +/- .04)E-03	+(+3.36 +/- .02)E-03	+(+1.02 +/- .01)E-02	+(+1.06 +/- .01)E-02	+(+1.03 +/- .01)E-02
PR121391002	+(+1.72 +/- .03)E-03	+(+5.28 +/- .03)E-03	+(+1.33 +/- .01)E-02	+(+1.53 +/- .01)E-02	+(+1.48 +/- .02)E-02
PR121391003	+(+1.55 +/- .04)E-03	+(+5.65 +/- .03)E-03	+(+1.45 +/- .02)E-02	+(+1.65 +/- .02)E-02	+(+1.80 +/- .02)E-02
PR121391004	+(+1.72 +/- .04)E-03	+(+7.96 +/- .05)E-03	+(+2.06 +/- .02)E-02	+(+2.29 +/- .02)E-02	+(+2.07 +/- .02)E-02
PR121391005	+(+1.68 +/- .06)E-03	+(+2.45 +/- .01)E-02	+(+5.66 +/- .07)E-02	+(+6.56 +/- .03)E-02	+(+5.93 +/- .04)E-02
PR121491001	+(+1.43 +/- .08)E-03	+(+2.80 +/- .01)E-02	+(+9.48 +/- .17)E-02	+(+8.45 +/- .04)E-02	+(+8.75 +/- .07)E-02
PR121491002	+(+1.87 +/- .09)E-03	+(+2.27 +/- .01)E-02	+(+9.75 +/- .21)E-02	+(+7.34 +/- .04)E-02	+(+7.38 +/- .06)E-02
PR121491003	+(+1.53 +/- .15)E-03	+(+2.19 +/- .01)E-02	+(+9.61 +/- .14)E-02	+(+6.92 +/- .05)E-02	+(+7.12 +/- .06)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR121491004	+(+1.56 +/- .11)E-03	+(+1.75 +/- .01)E-02	+(+8.92 +/- .26)E-02	+(+5.75 +/- .04)E-02	+(+5.78 +/- .05)E-02
PR121491005	+(+1.58 +/- .08)E-03	+(+1.36 +/- .01)E-02	+(+7.24 +/- .22)E-02	+(+4.54 +/- .04)E-02	+(+4.60 +/- .05)E-02
PR121491006	+(+1.83 +/- .09)E-03	+(+1.95 +/- .01)E-02	+(+7.10 +/- .13)E-02	+(+5.72 +/- .05)E-02	+(+4.54 +/- .05)E-02
PR121591001	+(+1.57 +/- .11)E-03	+(+4.25 +/- .02)E-02	+(+1.45 +/- .02)E-01	+(+1.31 +/- .01)E-01	+(+1.44 +/- .01)E-01
PR121591002	+(+1.43 +/- .15)E-03	+(+2.10 +/- .01)E-02	+(+1.15 +/- .03)E-01	+(+7.91 +/- .06)E-02	+(+8.17 +/- .07)E-02
PR121591003	+(+2.60 +/- .10)E-03	+(+1.77 +/- .01)E-02	+(+9.59 +/- .24)E-02	+(+6.64 +/- .05)E-02	+(+6.91 +/- .07)E-02
PR121591004	+(+1.76 +/- .10)E-03	+(+1.59 +/- .01)E-02	+(+8.24 +/- .18)E-02	+(+5.89 +/- .04)E-02	+(+5.98 +/- .06)E-02
PR121591005	+(+1.52 +/- .07)E-03	+(+1.64 +/- .01)E-02	+(+7.36 +/- .10)E-02	+(+5.62 +/- .04)E-02	+(+5.80 +/- .05)E-02
PR121591006	+(+1.87 +/- .12)E-03	+(+1.60 +/- .01)E-02	+(+6.80 +/- .08)E-02	+(+5.35 +/- .04)E-02	+(+5.50 +/- .05)E-02
PR121691001	+(+1.69 +/- .08)E-03	+(+1.16 +/- .00)E-02	+(+5.79 +/- .12)E-02	+(+4.26 +/- .03)E-02	+(+4.44 +/- .04)E-02
PR121691002	+(+1.61 +/- .08)E-03	+(+1.60 +/- .01)E-02	+(+6.36 +/- .12)E-02	+(+5.15 +/- .04)E-02	+(+5.03 +/- .05)E-02
PR121691003	+(+1.58 +/- .09)E-03	+(+1.25 +/- .01)E-02	+(+5.31 +/- .06)E-02	+(+4.13 +/- .04)E-02	+(+4.44 +/- .04)E-02
PR121691004	+(+1.52 +/- .06)E-03	+(+1.14 +/- .00)E-02	+(+4.98 +/- .09)E-02	+(+3.77 +/- .03)E-02	+(+3.96 +/- .04)E-02
PR121691005	+(+1.62 +/- .06)E-03	+(+9.20 +/- .06)E-03	+(+4.48 +/- .11)E-02	+(+3.30 +/- .03)E-02	+(+3.56 +/- .04)E-02
PR121691006	+(+1.65 +/- .06)E-03	+(+7.62 +/- .06)E-03	+(+3.94 +/- .06)E-02	+(+2.85 +/- .02)E-02	+(+2.92 +/- .03)E-02

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR120191001	+(+6.88 +/- .10)E-04	+(+6.06 +/- .10)E-04	(-8.01 +/- 56.)E-07	(+1.75 +/- .98)E-04	(-4.18 +/- ***)E-07
PR120391001	+(+6.81 +/- .10)E-04	+(+6.07 +/- .08)E-04	(+1.49 +/- 6.7)E-06	(+7.22 +/- 10.)E-05	(-6.16 +/- 13.)E-06
PR120491001	+(+6.58 +/- .12)E-04	+(+5.90 +/- .08)E-04	(+1.02 +/- .58)E-05	(+1.60 +/- 1.2)E-04	(-1.08 +/- .95)E-05
PR120491002	+(+6.93 +/- .16)E-04	+(+5.82 +/- .13)E-04	(+1.19 +/- .97)E-05	(+3.31 +/- 1.7)E-04	(+5.79 +/- 17.)E-06
PR120591001	+(+6.57 +/- .10)E-04	+(+6.03 +/- .08)E-04	(+9.75 +/- 56.)E-07	(-4.49 +/- 12.)E-05	(+6.84 +/- ***)E-08
PR120591002	+(+6.65 +/- .20)E-04	+(+5.66 +/- .16)E-04	(-1.11 +/- 1.4)E-05	(-1.19 +/- 2.1)E-04	(-6.89 +/- ***)E-07

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR120591003	+(+5.99 +/- .38)E-04	+(+5.70 +/- .37)E-04	(+1.16 +/- 2.7)E-05	(+5.11 +/- 4.0)E-04	(+3.67 +/- 3.3)E-05
PR120891001	+(+6.62 +/- .10)E-04	+(+5.98 +/- .08)E-04	(-5.14 +/- 5.7)E-06	(-1.08 +/- 1.0)E-04	(-1.17 +/- .86)E-05
PR120991001	+(+6.29 +/- .11)E-04	+(+5.50 +/- .09)E-04	(-1.97 +/- 5.5)E-06	(+5.27 +/- 12.)E-05	(-5.22 +/- 8.4)E-06
PR121091001	+(+6.29 +/- .10)E-04	+(+5.60 +/- .07)E-04	(+6.82 +/- 5.7)E-06	(+1.33 +/- 1.0)E-04	(+3.16 +/- 9.2)E-06
PR121191001	+(+3.47 +/- .08)E-04	+(+3.12 +/- .06)E-04	(+4.26 +/- 3.8)E-06	(+2.07 +/- 59.)E-06	(-1.14 +/- .55)E-05
PR121291001	+(+3.41 +/- .08)E-04	+(+3.04 +/- .06)E-04	(-5.16 +/- 32.)E-07	(-7.62 +/- 5.1)E-05	(-2.42 +/- 6.1)E-06
PR121291003	+(+1.59 +/- .01)E-02	+(+1.26 +/- .01)E-02	(+4.27 +/- 2.8)E-05	+(+1.09 +/- .39)E-03	+(+8.58 +/- .14)E-02
PR121391001	+(+2.56 +/- .01)E-02	+(+2.28 +/- .01)E-02	(+2.74 +/- 2.6)E-05	+(+9.98 +/- 3.8)E-04	+(+1.42 +/- .01)E-02
PR121391002	+(+2.73 +/- .01)E-02	+(+2.43 +/- .01)E-02	(+3.64 +/- 2.9)E-05	+(+1.08 +/- .41)E-03	+(+2.51 +/- .01)E-02
PR121391003	+(+2.89 +/- .02)E-02	+(+2.60 +/- .01)E-02	(+4.90 +/- 4.1)E-05	(-7.77 +/- 5.5)E-04	+(+2.64 +/- .01)E-02
PR121391004	+(+3.39 +/- .02)E-02	+(+2.96 +/- .01)E-02	(+3.20 +/- 4.8)E-05	(-6.53 +/- 7.2)E-04	+(+3.61 +/- .03)E-02
PR121391005	+(+6.69 +/- .02)E-02	+(+5.29 +/- .03)E-02	(+7.12 +/- 7.3)E-05	(+1.73 +/- 1.0)E-03	+(+1.48 +/- .01)E-01
PR121491001	+(+1.97 +/- .01)E-01	+(+1.67 +/- .01)E-01	(+1.93 +/- 1.6)E-04	(+2.31 +/- 15.)E-04	+(+9.17 +/- .07)E-02
PR121491002	+(+2.60 +/- .01)E-01	+(+2.24 +/- .01)E-01	(+1.38 +/- 1.6)E-04	(-7.27 +/- 17.)E-04	+(+3.00 +/- .02)E-02
PR121491003	+(+3.16 +/- .01)E-01	+(+2.82 +/- .01)E-01	(+9.61 +/- 19.)E-05	+(+8.19 +/- 2.4)E-03	+(+1.91 +/- .02)E-02
PR121491004	+(+3.18 +/- .01)E-01	+(+2.82 +/- .01)E-01	+(+4.56 +/- 1.3)E-04	(+3.55 +/- 1.8)E-03	+(+1.22 +/- .03)E-02
PR121491005	+(+2.61 +/- .01)E-01	+(+2.37 +/- .01)E-01	+(+4.19 +/- 1.2)E-04	(+1.91 +/- 1.6)E-03	+(+1.93 +/- .03)E-02
PR121491006	+(+2.23 +/- .01)E-01	+(+2.00 +/- .01)E-01	+(+3.17 +/- 1.0)E-04	(+3.04 +/- 1.7)E-03	+(+1.29 +/- .01)E-01
PR121591001	+(+2.74 +/- .01)E-01	+(+2.38 +/- .01)E-01	+(+7.01 +/- 1.5)E-04	+(+4.67 +/- 2.1)E-03	+(+2.96 +/- .03)E-01
PR121591002	+(+2.96 +/- .00)E-01	+(+2.61 +/- .01)E-01	(+1.02 +/- 1.3)E-04	(-1.36 +/- 18.)E-04	+(+2.51 +/- .03)E-02
PR121591003	+(+2.72 +/- .01)E-01	+(+2.42 +/- .01)E-01	+(+4.70 +/- 1.3)E-04	(-1.06 +/- 1.7)E-03	+(+2.23 +/- .02)E-02
PR121591004	+(+2.38 +/- .01)E-01	+(+2.14 +/- .01)E-01	(+1.12 +/- 1.3)E-04	+(+4.75 +/- 1.6)E-03	+(+1.94 +/- .03)E-02
PR121591005	+(+2.14 +/- .01)E-01	+(+1.92 +/- .01)E-01	(+1.25 +/- 1.1)E-04	(-1.21 +/- 15.)E-04	+(+2.69 +/- .02)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR121591006	+(+2.06 +/- .00)E-01	+(+1.82 +/- .00)E-01	+(+3.05 +/- 1.2)E-04	(+2.38 +/- 1.4)E-03	+(+1.93 +/- .02)E-02
PR121691001	+(+1.85 +/- .01)E-01	+(+1.73 +/- .01)E-01	(+9.96 +/- 13.)E-05	+(+4.12 +/- 1.4)E-03	+(+1.27 +/- .02)E-02
PR121691002	+(+1.77 +/- .00)E-01	+(+1.57 +/- .00)E-01	(+2.14 +/- 1.2)E-04	+(+4.16 +/- 1.7)E-03	+(+1.94 +/- .02)E-02
PR121691003	+(+1.71 +/- .00)E-01	+(+1.54 +/- .01)E-01	+(+1.93 +/- .93)E-04	(+2.55 +/- 1.3)E-03	+(+1.48 +/- .01)E-02
PR121691004	+(+1.63 +/- .00)E-01	+(+1.45 +/- .00)E-01	(+2.02 +/- 1.4)E-04	(+1.73 +/- 1.3)E-03	+(+1.63 +/- .02)E-02
PR121691005	+(+1.54 +/- .00)E-01	+(+1.36 +/- .00)E-01	(+7.37 +/- 11.)E-05	(+7.74 +/- 12.)E-04	+(+1.09 +/- .01)E-02
PR121691006	+(+1.47 +/- .00)E-01	+(+1.30 +/- .00)E-01	+(+3.51 +/- .73)E-04	(+1.47 +/- 12.)E-04	+(+8.78 +/- .13)E-03

ID	XE 135	XEM 135	XE 137	CS 137	XE 138
PR120191001	+(+1.61 +/- .41)E-05	+(+6.40 +/- .31)E-05	+(+3.16 +/- .09)E-04	(+2.74 +/- 2.4)E-06	+(+2.61 +/- .09)E-04
PR120391001	(+5.00 +/- 3.3)E-06	+(+6.37 +/- .36)E-05	+(+3.03 +/- .10)E-04	(+1.31 +/- 2.4)E-06	+(+2.41 +/- .07)E-04
PR120491001	+(+8.12 +/- 3.5)E-06	+(+6.02 +/- .31)E-05	+(+3.06 +/- .11)E-04	(+1.78 +/- 3.0)E-06	+(+2.43 +/- .07)E-04
PR120491002	+(+1.62 +/- .49)E-05	+(+5.56 +/- .59)E-05	+(+3.18 +/- .15)E-04	(+8.02 +/- 5.6)E-06	+(+2.61 +/- .13)E-04
PR120591001	(+6.17 +/- 3.5)E-06	+(+6.24 +/- .32)E-05	+(+3.08 +/- .12)E-04	(-2.24 +/- 2.6)E-06	+(+2.23 +/- .09)E-04
PR120591002	+(+1.41 +/- .62)E-05	+(+6.69 +/- .68)E-05	+(+2.97 +/- .19)E-04	(+2.55 +/- 6.4)E-06	+(+2.42 +/- .16)E-04
PR120591003	(+6.59 +/- 11.)E-06	+(+7.03 +/- 1.1)E-05	+(+2.81 +/- .31)E-04	+(+1.74 +/- .80)E-05	+(+2.25 +/- .25)E-04
PR120891001	+(+1.21 +/- .30)E-05	+(+6.37 +/- .32)E-05	+(+2.87 +/- .09)E-04	(+4.21 +/- 2.5)E-06	+(+2.63 +/- .09)E-04
PR120991001	+(+1.25 +/- .28)E-05	+(+5.77 +/- .30)E-05	+(+2.88 +/- .13)E-04	(+2.01 +/- 2.4)E-06	+(+2.36 +/- .07)E-04
PR121091001	+(+1.05 +/- .32)E-05	+(+6.55 +/- .32)E-05	+(+2.95 +/- .10)E-04	(+1.53 +/- ***)E-08	+(+2.38 +/- .07)E-04
PR121191001	+(+6.61 +/- 1.8)E-06	+(+4.01 +/- .28)E-05	+(+2.33 +/- .08)E-04	(-2.55 +/- 2.2)E-06	+(+1.67 +/- .05)E-04
PR121291001	+(+6.95 +/- 2.0)E-06	+(+3.82 +/- .30)E-05	+(+2.41 +/- .08)E-04	(+4.92 +/- ***)E-08	+(+1.68 +/- .05)E-04
PR121291003	+(+1.05 +/- .03)E-03	+(+5.19 +/- .04)E-03	+(+8.60 +/- .08)E-03	(-1.86 +/- 1.5)E-05	+(+1.00 +/- .01)E-02
PR121391001	+(+3.01 +/- .02)E-03	+(+1.43 +/- .01)E-02	+(+1.43 +/- .01)E-02	(-1.99 +/- 1.4)E-05	+(+1.71 +/- .01)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	XE 138
PR121391002	+(+4.57 +/- .02)E-03	+(+2.17 +/- .01)E-02	+(+1.64 +/- .01)E-02	(+1.04 +/- 18.)E-06	+(+2.13 +/- .01)E-02
PR121391003	+(+6.27 +/- .03)E-03	+(+2.92 +/- .01)E-02	+(+1.81 +/- .01)E-02	(+1.85 +/- 2.1)E-05	+(+2.35 +/- .01)E-02
PR121391004	+(+9.47 +/- .06)E-03	+(+4.40 +/- .01)E-02	+(+2.18 +/- .01)E-02	(-6.63 +/- ***)E-07	+(+3.14 +/- .01)E-02
PR121391005	+(+2.49 +/- .01)E-02	+(+1.16 +/- .00)E-01	+(+5.46 +/- .02)E-02	(-7.69 +/- 45.)E-06	+(+9.03 +/- .03)E-02
PR121491001	+(+4.60 +/- .01)E-02	+(+2.17 +/- .00)E-01	+(+1.80 +/- .01)E-01	(-8.57 +/- 7.1)E-05	+(+2.41 +/- .00)E-01
PR121491002	+(+5.28 +/- .01)E-02	+(+2.49 +/- .00)E-01	+(+2.51 +/- .01)E-01	(+2.98 +/- 8.5)E-05	+(+3.01 +/- .01)E-01
PR121491003	+(+5.64 +/- .01)E-02	+(+2.66 +/- .01)E-01	+(+3.27 +/- .01)E-01	(+1.31 +/- 1.0)E-04	+(+3.55 +/- .00)E-01
PR121491004	+(+5.26 +/- .01)E-02	+(+2.50 +/- .01)E-01	+(+3.29 +/- .01)E-01	(+9.13 +/- 7.2)E-05	+(+3.39 +/- .01)E-01
PR121491005	+(+4.46 +/- .01)E-02	+(+2.12 +/- .00)E-01	+(+2.65 +/- .01)E-01	(-1.19 +/- 6.6)E-05	+(+2.69 +/- .01)E-01
PR121491006	+(+4.15 +/- .01)E-02	+(+1.96 +/- .00)E-01	+(+2.23 +/- .01)E-01	(-2.10 +/- 5.9)E-05	+(+2.30 +/- .00)E-01
PR121591001	+(+6.70 +/- .02)E-02	+(+3.18 +/- .01)E-01	+(+2.51 +/- .01)E-01	(-1.28 +/- .81)E-04	+(+3.36 +/- .01)E-01
PR121591002	+(+6.88 +/- .02)E-02	+(+3.24 +/- .01)E-01	+(+2.54 +/- .01)E-01	(-1.32 +/- .83)E-04	+(+3.25 +/- .00)E-01
PR121591003	+(+6.23 +/- .01)E-02	+(+2.93 +/- .00)E-01	+(+2.27 +/- .00)E-01	(+3.61 +/- 6.6)E-05	+(+2.73 +/- .00)E-01
PR121591004	+(+5.48 +/- .02)E-02	+(+2.58 +/- .00)E-01	+(+1.95 +/- .00)E-01	(-5.87 +/- 7.5)E-05	+(+2.30 +/- .00)E-01
PR121591005	+(+4.87 +/- .01)E-02	+(+2.29 +/- .00)E-01	+(+1.71 +/- .01)E-01	(+2.56 +/- 5.8)E-05	+(+2.03 +/- .01)E-01
PR121591006	+(+4.40 +/- .01)E-02	+(+2.06 +/- .00)E-01	+(+1.63 +/- .00)E-01	(+2.93 +/- 6.2)E-05	+(+1.88 +/- .00)E-01
PR121691001	+(+3.83 +/- .01)E-02	+(+1.79 +/- .00)E-01	+(+1.48 +/- .00)E-01	(+3.22 +/- 5.3)E-05	+(+1.64 +/- .01)E-01
PR121691002	+(+3.43 +/- .01)E-02	+(+1.61 +/- .00)E-01	+(+1.37 +/- .00)E-01	(+2.50 +/- 5.2)E-05	+(+1.61 +/- .00)E-01
PR121691003	+(+3.19 +/- .01)E-02	+(+1.50 +/- .01)E-01	+(+1.33 +/- .01)E-01	(+6.05 +/- 5.5)E-05	+(+1.55 +/- .00)E-01
PR121691004	+(+2.79 +/- .01)E-02	+(+1.32 +/- .00)E-01	+(+1.27 +/- .00)E-01	(-5.26 +/- 4.9)E-05	+(+1.42 +/- .00)E-01
PR121691005	+(+2.37 +/- .01)E-02	+(+1.12 +/- .00)E-01	+(+1.14 +/- .00)E-01	(+3.55 +/- 5.5)E-05	+(+1.25 +/- .00)E-01
PR121691006	+(+2.02 +/- .01)E-02	+(+9.60 +/- .02)E-02	+(+1.07 +/- .00)E-01	(+1.12 +/- 4.8)E-05	+(+1.18 +/- .00)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	CS 138	XE 139
PR120191001	+(+2.11 +/- .05)E-04	+(+7.77 +/- 3.7)E-06
PR120391001	+(+2.17 +/- .05)E-04	(-2.72 +/- 3.6)E-06
PR120491001	+(+2.19 +/- .05)E-04	(+7.60 +/- 4.2)E-06
PR120491002	+(+2.22 +/- .08)E-04	(+1.22 +/- .77)E-05
PR120591001	+(+2.15 +/- .05)E-04	(+6.04 +/- 4.0)E-06
PR120591002	+(+2.30 +/- .10)E-04	(+1.35 +/- 7.2)E-06
PR120591003	+(+2.18 +/- .20)E-04	+(+3.73 +/- 1.6)E-05
PR120891001	+(+2.15 +/- .05)E-04	(+1.08 +/- 3.6)E-06
PR120991001	+(+2.19 +/- .05)E-04	(+6.00 +/- 3.9)E-06
PR121091001	+(+2.12 +/- .05)E-04	(+2.84 +/- 3.6)E-06
PR121191001	+(+1.47 +/- .04)E-04	(+9.16 +/- 24.)E-07
PR121291001	+(+1.44 +/- .04)E-04	+(+5.05 +/- 2.2)E-06
PR121291003	+(+6.90 +/- .05)E-03	+(+9.41 +/- 1.9)E-05
PR121391001	+(+1.47 +/- .01)E-02	+(+1.01 +/- .18)E-04
PR121391002	+(+1.79 +/- .01)E-02	+(+1.28 +/- .28)E-04
PR121391003	+(+2.13 +/- .01)E-02	+(+1.01 +/- .41)E-04
PR121391004	+(+2.49 +/- .01)E-02	+(+1.97 +/- .45)E-04
PR121391005	+(+6.11 +/- .02)E-02	+(+3.51 +/- .47)E-04
PR121491001	+(+1.96 +/- .00)E-01	+(+1.27 +/- .14)E-03
PR121491002	+(+2.52 +/- .01)E-01	+(+1.74 +/- .24)E-03
PR121491003	+(+3.09 +/- .01)E-01	+(+2.30 +/- .31)E-03
PR121491004	+(+3.05 +/- .01)E-01	+(+2.70 +/- .30)E-03
PR121491005	+(+2.48 +/- .00)E-01	+(+2.35 +/- .18)E-03

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	CS 138	XE 139
PR121491006	+(+2.03 +/- .00)E-01	+(+1.90 +/- .14)E-03
PR121591001	+(+2.81 +/- .01)E-01	+(+2.05 +/- .25)E-03
PR121591002	+(+2.90 +/- .00)E-01	+(+1.73 +/- .27)E-03
PR121591003	+(+2.50 +/- .00)E-01	+(+1.69 +/- .24)E-03
PR121591004	+(+2.10 +/- .01)E-01	+(+1.52 +/- .18)E-03
PR121591005	+(+1.82 +/- .00)E-01	+(+1.18 +/- .09)E-03
PR121591006	+(+1.69 +/- .00)E-01	+(+1.18 +/- .07)E-03
PR121691001	+(+1.50 +/- .00)E-01	+(+1.14 +/- .13)E-03
PR121691002	+(+1.39 +/- .00)E-01	+(+1.12 +/- .14)E-03
PR121691003	+(+1.40 +/- .00)E-01	+(+9.95 +/- 1.0)E-04
PR121691004	+(+1.28 +/- .00)E-01	+(+9.76 +/- .95)E-04
PR121691005	+(+1.12 +/- .00)E-01	+(+8.86 +/- .59)E-04
PR121691006	+(+1.05 +/- .00)E-01	+(+7.53 +/- .74)E-04

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.

GAMMA-RAY ANALYSIS SUMMARY 4

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

COLLECTION PERIOD:
121691 TO 122491

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

26-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
121691 TO 122491

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR121791001	121691	PR121791001	1.00	PR100191001
PR121791002	121791	PR121791002	1.00	PR100191001
PR121791003	121791	PR121791003	1.00	PR100191001
PR121791004	121791	PR121791004	1.00	PR100191001
PR121791005	121791	PR121791005	1.00	PR100191001
PR121791006	121791	PR121791006	1.00	PR100191001
PR121891001	121791	PR121891001	1.00	PR100191001
PR121891002	121891	PR121891002	1.00	PR100191001
PR121891003	121891	PR121891003	1.00	PR100191001
PR121891004	121891	PR121891004	1.00	PR100191001
PR121891005	121891	PR121891005	1.00	PR100191001
PR121891006	121891	PR121891006	1.00	PR100191001
PR121991001	121891	PR121991001	1.00	PR100191001
PR121991002	121991	PR121991002	1.00	PR100191001
PR121991003	121991	PR121991003	1.00	PR100191001
PR121991004	121991	PR121991004	1.00	PR100191001
PR121991005	121991	PR121991005	1.00	PR100191001
PR121991006	121991	PR121991006	1.00	PR100191001
PR122091001	121991	PR122091001	1.00	PR100191001
PR122091002	122091	PR122091002	1.00	PR100191001
PR122091003	122091	PR122091003	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR122091004	122091	PR122091004	1.00	PR100191001
PR122091005	122091	PR122091005	1.00	PR100191001
PR122091006	122091	PR122091006	1.00	PR100191001
PR122191001	122091	PR122191001	1.00	PR100191001
PR122191002	122191	PR122191002	1.00	PR100191001
PR122191003	122191	PR122191003	1.00	PR100191001
PR122191004	122191	PR122191004	1.00	PR100191001
PR122191005	122191	PR122191005	1.00	PR100191001
PR122191006	122191	PR122191006	1.00	PR100191001
PR122291001	122191	PR122291001	1.00	PR100191001
PR122291002	122291	PR122291002	1.00	PR100191001
PR122291003	122291	PR122291003	1.00	PR100191001
PR122291004	122291	PR122291004	1.00	PR100191001
PR122291005	122291	PR122291005	1.00	PR100191001
PR122291006	122291	PR122291006	1.00	PR100191001
PR122391001	122291	PR122391001	1.00	PR100191001
PR122391002	122391	PR122391002	1.00	PR100191001
PR122391003	122391	PR122391003	1.00	PR100191001
PR122391004	122391	PR122391004	1.00	PR100191001
PR122391005	122391	PR122391005	1.00	PR100191001
PR122391006	122391	PR122391006	1.00	PR100191001
PR122491001	122391	PR122491001	1.00	PR100191001
PR122491002	122491	PR122491002	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR122491003	122491	PR122491003	1.00	PR100191001
PR122491004	122491	PR122491004	1.00	PR100191001
PR122491005	122491	PR122491005	1.00	PR100191001
PR122491006	122491	PR122491006	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
121691 TO 122491

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR121791001	+(+1.74 +/- .06)E-03	+(+1.47 +/- .01)E-02	+(+5.18 +/- .10)E-02	+(+4.19 +/- .03)E-02	+(+4.10 +/- .04)E-02
PR121791002	+(+1.37 +/- .07)E-03	+(+8.11 +/- .05)E-03	+(+4.40 +/- .13)E-02	+(+3.08 +/- .03)E-02	+(+3.27 +/- .04)E-02
PR121791003	+(+1.67 +/- .06)E-03	+(+9.63 +/- .05)E-03	+(+4.14 +/- .05)E-02	+(+3.45 +/- .03)E-02	+(+3.31 +/- .03)E-02
PR121791004	+(+1.98 +/- .06)E-03	+(+7.04 +/- .04)E-03	+(+3.69 +/- .06)E-02	+(+2.69 +/- .03)E-02	+(+2.90 +/- .03)E-02
PR121791005	+(+1.63 +/- .08)E-03	+(+6.49 +/- .04)E-03	+(+3.49 +/- .07)E-02	+(+2.52 +/- .02)E-02	+(+2.62 +/- .03)E-02
PR121791006	+(+1.73 +/- .06)E-03	+(+6.16 +/- .04)E-03	+(+3.41 +/- .08)E-02	+(+2.37 +/- .02)E-02	+(+2.30 +/- .04)E-02
PR121891001	+(+1.74 +/- .07)E-03	+(+1.27 +/- .01)E-02	+(+4.30 +/- .08)E-02	+(+3.71 +/- .03)E-02	+(+3.28 +/- .04)E-02
PR121891002	+(+1.66 +/- .09)E-03	+(+7.32 +/- .05)E-03	+(+3.67 +/- .07)E-02	+(+2.66 +/- .03)E-02	+(+3.42 +/- .05)E-02
PR121891003	+(+1.82 +/- .09)E-03	+(+6.20 +/- .04)E-03	+(+3.22 +/- .05)E-02	+(+2.42 +/- .03)E-02	+(+2.34 +/- .03)E-02
PR121891004	+(+1.63 +/- .06)E-03	+(+1.27 +/- .00)E-02	+(+4.56 +/- .08)E-02	+(+3.95 +/- .03)E-02	+(+3.98 +/- .03)E-02
PR121891005	+(+1.63 +/- .06)E-03	+(+1.01 +/- .01)E-02	+(+4.75 +/- .11)E-02	+(+3.48 +/- .03)E-02	+(+3.75 +/- .04)E-02
PR121891006	+(+1.60 +/- .06)E-03	+(+6.47 +/- .04)E-03	+(+3.44 +/- .06)E-02	+(+2.44 +/- .02)E-02	+(+2.63 +/- .03)E-02
PR121991001	+(+2.75 +/- .07)E-03	+(+9.08 +/- .04)E-03	+(+4.34 +/- .08)E-02	+(+3.23 +/- .03)E-02	+(+3.22 +/- .04)E-02
PR121991002	+(+1.74 +/- .10)E-03	+(+6.77 +/- .05)E-03	+(+3.60 +/- .07)E-02	+(+2.57 +/- .02)E-02	+(+2.61 +/- .03)E-02
PR121991003	+(+1.78 +/- .07)E-03	+(+1.19 +/- .01)E-02	+(+4.31 +/- .06)E-02	+(+3.88 +/- .03)E-02	+(+3.80 +/- .04)E-02
PR121991004	+(+1.94 +/- .07)E-03	+(+1.10 +/- .01)E-02	+(+5.01 +/- .09)E-02	+(+3.95 +/- .03)E-02	+(+4.21 +/- .04)E-02
PR121991005	+(+1.63 +/- .06)E-03	+(+1.02 +/- .00)E-02	+(+4.59 +/- .07)E-02	+(+3.63 +/- .03)E-02	+(+3.72 +/- .03)E-02
PR121991006	+(+1.86 +/- .07)E-03	+(+1.08 +/- .00)E-02	+(+4.84 +/- .09)E-02	+(+3.92 +/- .03)E-02	+(+3.92 +/- .04)E-02
PR122091001	+(+2.08 +/- .07)E-03	+(+1.06 +/- .00)E-02	+(+4.73 +/- .07)E-02	+(+3.76 +/- .03)E-02	+(+3.77 +/- .04)E-02
PR122091002	+(+2.27 +/- .12)E-03	+(+1.18 +/- .01)E-02	+(+4.93 +/- .07)E-02	+(+4.07 +/- .04)E-02	+(+4.04 +/- .04)E-02
PR122091003	+(+2.02 +/- .12)E-03	+(+1.46 +/- .01)E-02	+(+5.49 +/- .07)E-02	+(+4.74 +/- .04)E-02	+(+4.90 +/- .04)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR122091004	+(+2.04 +/- .07)E-03	+(+1.37 +/- .01)E-02	+(+5.68 +/- .13)E-02	+(+4.68 +/- .04)E-02	+(+4.67 +/- .04)E-02
PR122091005	+(+1.70 +/- .07)E-03	+(+2.14 +/- .02)E-02	+(+7.25 +/- .13)E-02	+(+6.53 +/- .05)E-02	+(+6.65 +/- .08)E-02
PR122091006	+(+2.36 +/- .09)E-03	+(+1.99 +/- .01)E-02	+(+7.87 +/- .13)E-02	+(+6.69 +/- .04)E-02	+(+6.84 +/- .05)E-02
PR122191001	+(+1.59 +/- .07)E-03	+(+1.63 +/- .01)E-02	+(+7.28 +/- .13)E-02	+(+5.84 +/- .03)E-02	+(+6.03 +/- .05)E-02
PR122191002	+(+1.71 +/- .07)E-03	+(+1.25 +/- .01)E-02	+(+6.42 +/- .15)E-02	+(+4.68 +/- .04)E-02	+(+4.83 +/- .04)E-02
PR122191003	+(+2.17 +/- .14)E-03	+(+1.54 +/- .01)E-02	+(+6.78 +/- .09)E-02	+(+5.47 +/- .04)E-02	+(+5.69 +/- .05)E-02
PR122191004	+(+2.02 +/- .09)E-03	+(+1.30 +/- .01)E-02	+(+6.68 +/- .15)E-02	+(+4.89 +/- .05)E-02	+(+4.88 +/- .05)E-02
PR122191005	+(+1.99 +/- .08)E-03	+(+1.17 +/- .01)E-02	+(+6.35 +/- .10)E-02	+(+4.52 +/- .03)E-02	+(+4.62 +/- .04)E-02
PR122191006	+(+2.11 +/- .08)E-03	+(+1.72 +/- .01)E-02	+(+7.02 +/- .14)E-02	+(+5.80 +/- .04)E-02	+(+6.10 +/- .05)E-02
PR122291001	+(+1.79 +/- .09)E-03	+(+1.98 +/- .04)E-02	+(+8.11 +/- .20)E-02	+(+6.72 +/- .05)E-02	+(+8.98 +/- .07)E-02
PR122291002	+(+1.87 +/- .11)E-03	+(+3.99 +/- .02)E-02	+(+1.46 +/- .02)E-01	+(+1.30 +/- .01)E-01	+(+1.40 +/- .01)E-01
PR122291003	+(+1.58 +/- .12)E-03	+(+2.95 +/- .02)E-02	+(+1.54 +/- .04)E-01	+(+1.12 +/- .01)E-01	+(+1.12 +/- .01)E-01
PR122291004	+(+1.30 +/- .09)E-03	+(+2.40 +/- .01)E-02	+(+1.34 +/- .03)E-01	+(+9.15 +/- .08)E-02	+(+9.31 +/- .08)E-02
PR122291005	+(+2.02 +/- .12)E-03	+(+2.51 +/- .02)E-02	+(+1.31 +/- .03)E-01	+(+9.29 +/- .06)E-02	+(+9.31 +/- .07)E-02
PR122291006	+(+1.92 +/- .16)E-03	+(+2.05 +/- .01)E-02	+(+1.14 +/- .02)E-01	+(+7.89 +/- .08)E-02	+(+8.14 +/- .06)E-02
PR122391001	+(+3.08 +/- .10)E-03	+(+2.07 +/- .01)E-02	+(+1.13 +/- .02)E-01	+(+7.99 +/- .06)E-02	+(+8.00 +/- .06)E-02
PR122391002	+(+2.75 +/- .10)E-03	+(+2.33 +/- .01)E-02	+(+1.15 +/- .03)E-01	+(+8.62 +/- .06)E-02	+(+8.71 +/- .07)E-02
PR122391003	+(+1.90 +/- .12)E-03	+(+3.73 +/- .02)E-02	+(+1.44 +/- .03)E-01	+(+1.23 +/- .01)E-01	+(+1.22 +/- .01)E-01
PR122391004	+(+1.83 +/- .10)E-03	+(+2.79 +/- .02)E-02	+(+1.38 +/- .03)E-01	+(+1.05 +/- .01)E-01	+(+1.06 +/- .01)E-01
PR122391005	+(+1.38 +/- .12)E-03	+(+2.65 +/- .03)E-02	+(+1.19 +/- .03)E-01	+(+9.34 +/- .05)E-02	+(+1.02 +/- .01)E-01
PR122391006	+(+1.53 +/- .15)E-03	+(+3.08 +/- .01)E-02	+(+1.21 +/- .02)E-01	+(+1.02 +/- .01)E-01	+(+1.03 +/- .01)E-01
PR122491001	+(+2.74 +/- .11)E-03	+(+3.44 +/- .02)E-02	+(+1.41 +/- .02)E-01	+(+1.17 +/- .01)E-01	+(+1.26 +/- .01)E-01
PR122491002	+(+1.97 +/- .10)E-03	+(+4.09 +/- .02)E-02	+(+1.64 +/- .03)E-01	+(+1.42 +/- .01)E-01	+(+1.35 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR122491003	+(+1.84 +/- .16)E-03	+(+5.60 +/- .02)E-02	+(+1.96 +/- .04)E-01	+(+1.75 +/- .01)E-01	+(+1.65 +/- .01)E-01
PR122491004	+(+1.82 +/- .15)E-03	+(+6.80 +/- .03)E-02	+(+2.58 +/- .04)E-01	+(+2.23 +/- .01)E-01	+(+2.54 +/- .02)E-01
PR122491005	+(+1.93 +/- .13)E-03	+(+5.70 +/- .03)E-02	+(+2.49 +/- .05)E-01	+(+1.97 +/- .01)E-01	+(+2.01 +/- .01)E-01
PR122491006	+(+1.73 +/- .15)E-03	+(+5.39 +/- .02)E-02	+(+2.40 +/- .05)E-01	+(+1.89 +/- .01)E-01	+(+1.88 +/- .01)E-01

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR121791001	+(+1.57 +/- .00)E-01	+(+1.36 +/- .01)E-01	(+1.27 +/- .87)E-04	(+1.21 +/- 1.5)E-03	+(+2.07 +/- .03)E-02
PR121791002	+(+1.68 +/- .00)E-01	+(+1.53 +/- .01)E-01	+(+3.29 +/- 1.0)E-04	+(+2.85 +/- 1.2)E-03	+(+8.59 +/- .23)E-03
PR121791003	+(+1.42 +/- .00)E-01	+(+1.24 +/- .00)E-01	(+8.95 +/- 11.)E-05	(+1.50 +/- 1.1)E-03	+(+1.10 +/- .02)E-02
PR121791004	+(+1.36 +/- .00)E-01	+(+1.23 +/- .00)E-01	(+6.56 +/- 8.2)E-05	(+1.09 +/- 1.1)E-03	+(+7.83 +/- .15)E-03
PR121791005	+(+1.34 +/- .00)E-01	+(+1.19 +/- .00)E-01	+(+1.80 +/- .77)E-04	+(+2.28 +/- 1.1)E-03	+(+7.03 +/- .12)E-03
PR121791006	+(+1.32 +/- .00)E-01	+(+1.16 +/- .00)E-01	+(+1.88 +/- .91)E-04	(+1.04 +/- 1.2)E-03	+(+6.48 +/- .12)E-03
PR121891001	+(+1.34 +/- .00)E-01	+(+1.17 +/- .00)E-01	+(+2.84 +/- .78)E-04	(+1.64 +/- 1.1)E-03	+(+2.04 +/- .03)E-02
PR121891002	+(+1.32 +/- .00)E-01	+(+1.19 +/- .00)E-01	+(+1.87 +/- .77)E-04	(+1.93 +/- 1.1)E-03	+(+8.24 +/- .13)E-03
PR121891003	+(+1.26 +/- .00)E-01	+(+1.11 +/- .00)E-01	(+1.61 +/- .83)E-04	+(+2.51 +/- 1.0)E-03	+(+6.63 +/- .18)E-03
PR121891004	+(+1.29 +/- .00)E-01	+(+1.14 +/- .00)E-01	+(+1.79 +/- .78)E-04	(+5.68 +/- 11.)E-04	+(+1.54 +/- .02)E-02
PR121891005	+(+1.57 +/- .00)E-01	+(+1.37 +/- .00)E-01	+(+2.67 +/- 1.0)E-04	(+5.83 +/- 12.)E-04	+(+1.06 +/- .01)E-02
PR121891006	+(+1.33 +/- .00)E-01	+(+1.21 +/- .00)E-01	+(+2.38 +/- .68)E-04	(+2.14 +/- 1.1)E-03	+(+6.61 +/- .12)E-03
PR121991001	+(+1.46 +/- .00)E-01	+(+1.25 +/- .00)E-01	+(+2.29 +/- .81)E-04	(+1.52 +/- 1.2)E-03	+(+8.57 +/- .21)E-03
PR121991002	+(+1.42 +/- .00)E-01	+(+1.29 +/- .00)E-01	(+1.20 +/- .79)E-04	(+6.99 +/- 12.)E-04	+(+6.32 +/- .13)E-03
PR121991003	+(+1.38 +/- .00)E-01	+(+1.19 +/- .01)E-01	+(+2.66 +/- .95)E-04	(-7.08 +/- 13.)E-04	+(+1.13 +/- .02)E-01
PR121991004	+(+1.77 +/- .00)E-01	+(+1.57 +/- .00)E-01	(+1.67 +/- .89)E-04	(+2.20 +/- 1.4)E-03	+(+1.82 +/- .03)E-02
PR121991005	+(+1.65 +/- .00)E-01	+(+1.46 +/- .00)E-01	(+1.43 +/- .86)E-04	+(+3.37 +/- 1.3)E-03	+(+2.05 +/- .03)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR121991006	+(+1.66 +/- .00)E-01	+(+1.48 +/- .01)E-01	+(+2.85 +/- 1.1)E-04	+(+2.55 +/- 1.3)E-03	+(+2.19 +/- .01)E-02
PR122091001	+(+1.67 +/- .00)E-01	+(+1.47 +/- .00)E-01	+(+1.72 +/- .86)E-04	(+2.28 +/- 1.2)E-03	+(+1.86 +/- .01)E-02
PR122091002	+(+1.69 +/- .00)E-01	+(+1.49 +/- .00)E-01	+(+2.95 +/- 1.0)E-04	+(+3.43 +/- 1.2)E-03	+(+3.27 +/- .03)E-02
PR122091003	+(+1.76 +/- .00)E-01	+(+1.55 +/- .00)E-01	(+1.86 +/- 1.2)E-04	+(+3.19 +/- 1.5)E-03	+(+9.10 +/- .06)E-02
PR122091004	+(+1.80 +/- .00)E-01	+(+1.58 +/- .00)E-01	(+1.68 +/- .92)E-04	(+7.06 +/- 13.)E-04	+(+3.29 +/- .03)E-02
PR122091005	+(+1.97 +/- .00)E-01	+(+1.71 +/- .01)E-01	+(+2.74 +/- 1.1)E-04	(-1.94 +/- 1.4)E-03	+(+1.12 +/- .01)E-01
PR122091006	+(+2.20 +/- .00)E-01	+(+1.95 +/- .01)E-01	(+1.89 +/- 1.3)E-04	+(+5.09 +/- 1.5)E-03	+(+5.58 +/- .06)E-02
PR122191001	+(+2.24 +/- .00)E-01	+(+1.99 +/- .01)E-01	(+1.48 +/- 1.1)E-04	(+1.18 +/- 1.5)E-03	+(+2.77 +/- .03)E-02
PR122191002	+(+2.22 +/- .00)E-01	+(+1.96 +/- .01)E-01	(+1.67 +/- 1.5)E-04	(+1.52 +/- 14.)E-04	+(+1.53 +/- .02)E-02
PR122191003	+(+2.36 +/- .00)E-01	+(+2.07 +/- .01)E-01	(+2.46 +/- 1.5)E-04	(+2.21 +/- 1.5)E-03	+(+2.46 +/- .02)E-02
PR122191004	+(+2.38 +/- .01)E-01	+(+2.12 +/- .01)E-01	+(+3.73 +/- 1.4)E-04	(+1.88 +/- 1.4)E-03	+(+1.59 +/- .02)E-02
PR122191005	+(+2.38 +/- .00)E-01	+(+2.10 +/- .00)E-01	+(+2.31 +/- 1.0)E-04	(+1.90 +/- 1.5)E-03	+(+1.28 +/- .02)E-02
PR122191006	+(+2.42 +/- .00)E-01	+(+2.11 +/- .01)E-01	+(+6.85 +/- 1.1)E-04	+(+5.29 +/- 2.0)E-03	+(+1.49 +/- .03)E-01
PR122291001	+(+2.64 +/- .01)E-01	+(+2.33 +/- .01)E-01	(+2.12 +/- 1.4)E-04	(-1.12 +/- ***)E-05	+(+1.56 +/- .04)E-01
PR122291002	+(+4.74 +/- .01)E-01	+(+4.01 +/- .01)E-01	+(+5.03 +/- 1.9)E-04	(+2.37 +/- 2.2)E-03	+(+1.47 +/- .01)E-01
PR122291003	+(+5.70 +/- .01)E-01	+(+5.01 +/- .01)E-01	+(+6.69 +/- 1.7)E-04	(+3.10 +/- 24.)E-04	+(+5.17 +/- .05)E-02
PR122291004	+(+5.28 +/- .01)E-01	+(+4.74 +/- .01)E-01	+(+1.33 +/- .26)E-03	+(+6.22 +/- 2.5)E-03	+(+3.43 +/- .04)E-02
PR122291005	+(+4.72 +/- .01)E-01	+(+4.23 +/- .01)E-01	+(+5.95 +/- 1.5)E-04	(+5.29 +/- 3.4)E-03	+(+3.71 +/- .03)E-02
PR122291006	+(+4.31 +/- .01)E-01	+(+3.85 +/- .01)E-01	+(+8.22 +/- 1.5)E-04	(+3.33 +/- 2.1)E-03	+(+2.52 +/- .02)E-02
PR122391001	+(+4.25 +/- .01)E-01	+(+3.78 +/- .01)E-01	+(+1.26 +/- .18)E-03	(+2.26 +/- 2.2)E-03	+(+2.59 +/- .02)E-02
PR122391002	+(+4.14 +/- .01)E-01	+(+3.71 +/- .01)E-01	+(+1.25 +/- .14)E-03	(+4.84 +/- 2.6)E-03	+(+8.11 +/- .10)E-02
PR122391003	+(+4.07 +/- .01)E-01	+(+3.62 +/- .01)E-01	(+3.28 +/- 2.1)E-04	+(+6.71 +/- 2.0)E-03	+(+3.11 +/- .02)E-01
PR122391004	+(+4.01 +/- .01)E-01	+(+3.58 +/- .02)E-01	+(+8.68 +/- 1.4)E-04	(+2.27 +/- 2.0)E-03	+(+4.11 +/- .05)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR122391005	+(+3.88 +/- .01)E-01	+(+3.47 +/- .01)E-01	+(+9.98 +/- 2.0)E-04	+(+6.21 +/- 2.0)E-03	+(+1.99 +/- .04)E-01
PR122391006	+(+4.04 +/- .00)E-01	+(+3.57 +/- .01)E-01	+(+4.22 +/- 1.5)E-04	(+5.00 +/- 3.0)E-03	+(+2.59 +/- .01)E-01
PR122491001	+(+4.19 +/- .01)E-01	+(+3.70 +/- .01)E-01	+(+1.30 +/- .15)E-03	+(+6.87 +/- 2.2)E-03	+(+2.84 +/- .04)E-01
PR122491002	+(+4.43 +/- .01)E-01	+(+3.91 +/- .01)E-01	+(+1.03 +/- .14)E-03	(+2.96 +/- 2.1)E-03	+(+8.29 +/- .09)E-02
PR122491003	+(+4.69 +/- .01)E-01	+(+4.16 +/- .01)E-01	+(+1.49 +/- .24)E-03	+(+1.36 +/- .22)E-02	+(+2.98 +/- .04)E-01
PR122491004	+(+5.68 +/- .01)E-01	+(+4.96 +/- .02)E-01	(+1.49 +/- 2.5)E-04	(+4.46 +/- 3.6)E-03	+(+3.97 +/- .06)E-01
PR122491005	+(+6.64 +/- .02)E-01	+(+5.82 +/- .02)E-01	+(+1.77 +/- .20)E-03	+(+1.72 +/- .29)E-02	+(+1.22 +/- .01)E-01
PR122491006	+(+6.93 +/- .01)E-01	+(+6.16 +/- .02)E-01	+(+1.93 +/- .23)E-03	+(+1.02 +/- .38)E-02	+(+8.99 +/- .11)E-02

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR121791001	+(+2.06 +/- .01)E-02	+(+9.48 +/- .37)E-02	+(+1.21 +/- .01)E-01	(-1.48 +/- 4.7)E-05	+(+1.13 +/- .00)E-01
PR121791002	+(+2.29 +/- .01)E-02	+(+1.08 +/- .00)E-01	+(+1.35 +/- .01)E-01	(+5.49 +/- 4.9)E-05	+(+1.33 +/- .01)E-01
PR121791003	+(+1.93 +/- .01)E-02	+(+9.11 +/- .07)E-02	+(+1.01 +/- .00)E-01	(-4.13 +/- 4.4)E-05	+(+1.01 +/- .00)E-01
PR121791004	+(+1.63 +/- .01)E-02	+(+7.78 +/- .02)E-02	+(+9.63 +/- .03)E-02	(-9.85 +/- 4.3)E-05	+(+9.54 +/- .03)E-02
PR121791005	+(+1.47 +/- .01)E-02	+(+6.91 +/- .02)E-02	+(+9.36 +/- .04)E-02	(+4.30 +/- 4.3)E-05	+(+9.07 +/- .03)E-02
PR121791006	+(+1.27 +/- .01)E-02	+(+6.07 +/- .01)E-02	+(+8.94 +/- .03)E-02	(+4.58 +/- 4.7)E-05	+(+8.58 +/- .02)E-02
PR121891001	+(+1.27 +/- .01)E-02	+(+6.07 +/- .01)E-02	+(+9.35 +/- .03)E-02	(+5.74 +/- 43.)E-06	+(+8.91 +/- .02)E-02
PR121891002	+(+1.54 +/- .01)E-02	+(+7.31 +/- .02)E-02	+(+9.23 +/- .03)E-02	(+6.36 +/- 5.4)E-05	+(+1.01 +/- .00)E-01
PR121891003	+(+1.30 +/- .01)E-02	+(+6.18 +/- .01)E-02	+(+8.59 +/- .04)E-02	(+6.42 +/- 4.1)E-05	+(+8.20 +/- .02)E-02
PR121891004	+(+1.37 +/- .01)E-02	+(+6.56 +/- .02)E-02	+(+9.05 +/- .03)E-02	(+3.54 +/- 43.)E-06	+(+9.13 +/- .03)E-02
PR121891005	+(+1.49 +/- .01)E-02	+(+7.23 +/- .02)E-02	+(+1.29 +/- .01)E-01	(-8.39 +/- 48.)E-06	+(+1.21 +/- .00)E-01
PR121891006	+(+1.34 +/- .01)E-02	+(+6.40 +/- .01)E-02	+(+9.89 +/- .04)E-02	(+3.35 +/- 5.4)E-05	+(+1.03 +/- .00)E-01
PR121991001	+(+1.33 +/- .01)E-02	+(+6.40 +/- .02)E-02	+(+1.13 +/- .00)E-01	(+5.92 +/- 4.5)E-05	+(+1.06 +/- .00)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR121991002	+(+1.27 +/- .01)E-02	+(+6.15 +/- .02)E-02	+(+1.08 +/- .00)E-01	(-5.84 +/- 4.5)E-05	+(+1.07 +/- .00)E-01
PR121991003	+(+1.32 +/- .01)E-02	+(+6.38 +/- .02)E-02	+(+9.73 +/- .03)E-02	(-2.74 +/- 4.4)E-05	+(+9.19 +/- .03)E-02
PR121991004	+(+1.76 +/- .01)E-02	+(+8.48 +/- .02)E-02	+(+1.27 +/- .01)E-01	(+8.71 +/- 5.0)E-05	+(+1.23 +/- .00)E-01
PR121991005	+(+1.73 +/- .01)E-02	+(+8.20 +/- .02)E-02	+(+1.15 +/- .00)E-01	(+3.23 +/- 6.7)E-05	+(+1.13 +/- .00)E-01
PR121991006	+(+1.65 +/- .01)E-02	+(+7.87 +/- .02)E-02	+(+1.15 +/- .00)E-01	(+7.75 +/- 6.1)E-05	+(+1.14 +/- .00)E-01
PR122091001	+(+1.59 +/- .01)E-02	+(+7.58 +/- .02)E-02	+(+1.17 +/- .00)E-01	(+6.67 +/- 49.)E-06	+(+1.16 +/- .00)E-01
PR122091002	+(+1.87 +/- .01)E-02	+(+8.89 +/- .02)E-02	+(+1.18 +/- .00)E-01	(-8.71 +/- 4.9)E-05	+(+1.18 +/- .00)E-01
PR122091003	+(+2.48 +/- .01)E-02	+(+1.17 +/- .00)E-01	+(+1.26 +/- .00)E-01	(-1.24 +/- .50)E-04	+(+1.31 +/- .00)E-01
PR122091004	+(+2.32 +/- .01)E-02	+(+1.10 +/- .00)E-01	+(+1.28 +/- .00)E-01	(+3.12 +/- 5.1)E-05	+(+1.28 +/- .00)E-01
PR122091005	+(+2.77 +/- .01)E-02	+(+1.29 +/- .00)E-01	+(+1.48 +/- .00)E-01	(+5.46 +/- 7.1)E-05	+(+1.50 +/- .00)E-01
PR122091006	+(+3.09 +/- .01)E-02	+(+1.46 +/- .00)E-01	+(+1.69 +/- .00)E-01	(+1.58 +/- .91)E-04	+(+1.80 +/- .00)E-01
PR122191001	+(+3.03 +/- .01)E-02	+(+1.43 +/- .00)E-01	+(+1.73 +/- .01)E-01	(+1.23 +/- .81)E-04	+(+1.79 +/- .01)E-01
PR122191002	+(+2.75 +/- .01)E-02	+(+1.29 +/- .00)E-01	+(+1.65 +/- .01)E-01	(+4.93 +/- 5.7)E-05	+(+1.66 +/- .00)E-01
PR122191003	+(+2.61 +/- .01)E-02	+(+1.23 +/- .00)E-01	+(+1.78 +/- .01)E-01	(+1.53 +/- ***)E-07	+(+1.78 +/- .00)E-01
PR122191004	+(+2.45 +/- .01)E-02	+(+1.16 +/- .00)E-01	+(+1.78 +/- .01)E-01	(+6.76 +/- 5.9)E-05	+(+1.77 +/- .00)E-01
PR122191005	+(+2.31 +/- .01)E-02	+(+1.10 +/- .00)E-01	+(+1.77 +/- .00)E-01	(-9.91 +/- 7.7)E-05	+(+1.74 +/- .00)E-01
PR122191006	+(+2.36 +/- .01)E-02	+(+1.13 +/- .00)E-01	+(+1.76 +/- .00)E-01	(+8.23 +/- 5.9)E-05	+(+1.72 +/- .00)E-01
PR122291001	+(+3.25 +/- .01)E-02	+(+1.55 +/- .00)E-01	+(+1.89 +/- .00)E-01	(+4.81 +/- 6.3)E-05	+(+1.86 +/- .01)E-01
PR122291002	+(+5.90 +/- .02)E-02	+(+2.79 +/- .00)E-01	+(+3.85 +/- .01)E-01	(+8.45 +/- 10.)E-05	+(+3.47 +/- .01)E-01
PR122291003	+(+5.82 +/- .02)E-02	+(+2.77 +/- .00)E-01	+(+4.80 +/- .01)E-01	(-1.39 +/- 1.5)E-04	+(+4.42 +/- .01)E-01
PR122291004	+(+5.24 +/- .02)E-02	+(+2.51 +/- .01)E-01	+(+4.36 +/- .01)E-01	(+1.51 +/- 1.6)E-04	+(+4.21 +/- .01)E-01
PR122291005	+(+4.75 +/- .02)E-02	+(+2.27 +/- .00)E-01	+(+3.78 +/- .01)E-01	(+1.28 +/- 1.2)E-04	+(+3.70 +/- .01)E-01
PR122291006	+(+4.21 +/- .01)E-02	+(+2.02 +/- .00)E-01	+(+3.32 +/- .01)E-01	(+6.29 +/- 99.)E-06	+(+3.31 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR122391001	+(+3.96 +/- .01)E-02	+(+1.89 +/- .00)E-01	+(+3.23 +/- .01)E-01	(-1.19 +/- .97)E-04	+(+3.12 +/- .01)E-01
PR122391002	+(+3.89 +/- .01)E-02	+(+1.85 +/- .00)E-01	+(+3.10 +/- .01)E-01	(+1.21 +/- 1.0)E-04	+(+3.08 +/- .01)E-01
PR122391003	+(+4.40 +/- .02)E-02	+(+2.11 +/- .01)E-01	+(+3.02 +/- .01)E-01	(+1.21 +/- 1.2)E-04	+(+3.10 +/- .02)E-01
PR122391004	+(+4.61 +/- .01)E-02	+(+2.19 +/- .00)E-01	+(+2.95 +/- .01)E-01	(+3.35 +/- ***)E-06	+(+3.09 +/- .01)E-01
PR122391005	+(+4.40 +/- .02)E-02	+(+2.08 +/- .00)E-01	+(+2.87 +/- .01)E-01	(+1.90 +/- 1.1)E-04	+(+2.89 +/- .00)E-01
PR122391006	+(+4.93 +/- .02)E-02	+(+2.32 +/- .00)E-01	+(+2.92 +/- .01)E-01	(+3.42 +/- 13.)E-05	+(+2.91 +/- .01)E-01
PR122491001	+(+5.53 +/- .03)E-02	+(+2.59 +/- .01)E-01	+(+2.98 +/- .01)E-01	(-3.12 +/- 89.)E-06	+(+3.11 +/- .01)E-01
PR122491002	+(+6.12 +/- .02)E-02	+(+2.87 +/- .01)E-01	+(+3.11 +/- .01)E-01	(+8.34 +/- 11.)E-05	+(+3.32 +/- .01)E-01
PR122491003	+(+6.98 +/- .01)E-02	+(+3.29 +/- .01)E-01	+(+3.35 +/- .01)E-01	(+5.85 +/- 13.)E-05	+(+3.79 +/- .01)E-01
PR122491004	+(+1.02 +/- .00)E-01	+(+4.78 +/- .01)E-01	+(+4.21 +/- .01)E-01	(+1.59 +/- 1.5)E-04	+(+4.92 +/- .01)E-01
PR122491005	+(+1.08 +/- .01)E-01	+(+5.09 +/- .01)E-01	+(+5.06 +/- .01)E-01	(+1.09 +/- 1.9)E-04	+(+5.64 +/- .01)E-01
PR122491006	+(+1.03 +/- .00)E-01	+(+4.89 +/- .01)E-01	+(+5.28 +/- .02)E-01	(+1.50 +/- 1.7)E-04	+(+5.74 +/- .02)E-01

ID	XE 138	XE 139
PR121791001	+(+1.37 +/- .00)E-01	+(+9.38 +/- 1.1)E-04
PR121791002	+(+1.41 +/- .00)E-01	+(+1.03 +/- .14)E-03
PR121791003	+(+1.13 +/- .00)E-01	+(+8.13 +/- 1.2)E-04
PR121791004	+(+1.06 +/- .00)E-01	+(+7.49 +/- .71)E-04
PR121791005	+(+1.01 +/- .00)E-01	+(+7.08 +/- .56)E-04
PR121791006	+(+9.80 +/- .03)E-02	+(+7.50 +/- .52)E-04
PR121891001	+(+1.07 +/- .00)E-01	+(+7.24 +/- .77)E-04
PR121891002	+(+1.06 +/- .00)E-01	+(+7.25 +/- 1.1)E-04
PR121891003	+(+9.30 +/- .03)E-02	+(+7.15 +/- .77)E-04

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 138	XE 139
PR121891004	+(+1.06 +/- .00)E-01	+(+7.16 +/- .56)E-04
PR121891005	+(+1.42 +/- .00)E-01	+(+1.01 +/- .08)E-03
PR121891006	+(+1.06 +/- .00)E-01	+(+9.37 +/- 1.2)E-04
PR121991001	+(+1.27 +/- .00)E-01	+(+9.56 +/- .82)E-04
PR121991002	+(+1.12 +/- .00)E-01	+(+9.83 +/- 1.0)E-04
PR121991003	+(+1.10 +/- .00)E-01	+(+7.80 +/- .78)E-04
PR121991004	+(+1.38 +/- .00)E-01	+(+1.13 +/- .12)E-03
PR121991005	+(+1.27 +/- .00)E-01	+(+9.42 +/- 1.1)E-04
PR121991006	+(+1.29 +/- .00)E-01	+(+9.49 +/- .92)E-04
PR122091001	+(+1.32 +/- .00)E-01	+(+8.04 +/- .99)E-04
PR122091002	+(+1.34 +/- .00)E-01	+(+9.85 +/- 1.2)E-04
PR122091003	+(+1.48 +/- .00)E-01	+(+8.67 +/- 1.4)E-04
PR122091004	+(+1.47 +/- .00)E-01	+(+1.03 +/- .10)E-03
PR122091005	+(+1.78 +/- .00)E-01	+(+1.11 +/- .08)E-03
PR122091006	+(+2.03 +/- .00)E-01	+(+1.16 +/- .18)E-03
PR122191001	+(+2.01 +/- .01)E-01	+(+1.36 +/- .15)E-03
PR122191002	+(+1.86 +/- .00)E-01	+(+1.29 +/- .15)E-03
PR122191003	+(+2.02 +/- .00)E-01	+(+1.23 +/- .18)E-03
PR122191004	+(+1.99 +/- .00)E-01	+(+1.41 +/- .17)E-03
PR122191005	+(+1.97 +/- .01)E-01	+(+1.42 +/- .12)E-03
PR122191006	+(+1.96 +/- .01)E-01	+(+1.57 +/- .11)E-03
PR122291001	+(+2.12 +/- .01)E-01	+(+1.75 +/- .24)E-03
PR122291002	+(+4.30 +/- .01)E-01	+(+3.42 +/- .48)E-03

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 138	XE 139
PR122291003	+(+5.08 +/- .01)E-01	+(+4.37 +/- .37)E-03
PR122291004	+(+4.59 +/- .01)E-01	+(+3.08 +/- .26)E-03
PR122291005	+(+4.13 +/- .01)E-01	+(+3.29 +/- .21)E-03
PR122291006	+(+3.61 +/- .01)E-01	+(+3.11 +/- .31)E-03
PR122391001	+(+3.53 +/- .01)E-01	+(+2.83 +/- .34)E-03
PR122391002	+(+3.43 +/- .01)E-01	+(+2.60 +/- .33)E-03
PR122391003	+(+3.53 +/- .01)E-01	+(+2.56 +/- .39)E-03
PR122391004	+(+3.48 +/- .01)E-01	+(+2.51 +/- .27)E-03
PR122391005	+(+3.23 +/- .01)E-01	+(+2.70 +/- .18)E-03
PR122391006	+(+3.32 +/- .00)E-01	+(+2.59 +/- .22)E-03
PR122491001	+(+3.51 +/- .01)E-01	+(+2.87 +/- .31)E-03
PR122491002	+(+3.85 +/- .01)E-01	+(+2.83 +/- .32)E-03
PR122491003	+(+4.33 +/- .01)E-01	+(+2.80 +/- .43)E-03
PR122491004	+(+5.74 +/- .01)E-01	+(+4.04 +/- .46)E-03
PR122491005	+(+6.47 +/- .02)E-01	+(+5.61 +/- .47)E-03
PR122491006	+(+6.40 +/- .01)E-01	+(+5.70 +/- .43)E-03

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.

GAMMA-RAY ANALYSIS SUMMARY 5

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

COLLECTION PERIOD:
122491 TO 123091

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

26-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY Chr V McInnes

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
122491 TO 123091

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR122591001	122491	PR122591001	1.00	PR100191001
PR122591002	122591	PR122591002	1.00	PR100191001
PR122591003	122591	PR122591003	1.00	PR100191001
PR122591004	122591	PR122591004	1.00	PR100191001
PR122591005	122591	PR122591005	1.00	PR100191001
PR122591006	122591	PR122591006	1.00	PR100191001
PR122691001	122591	PR122691001	1.00	PR100191001
PR122691002	122691	PR122691002	1.00	PR100191001
PR122691003	122691	PR122691003	1.00	PR100191001
PR122691004	122691	PR122691004	1.00	PR100191001
PR122691005	122691	PR122691005	1.00	PR100191001
PR122691006	122691	PR122691006	1.00	PR100191001
PR122791001	122691	PR122791001	1.00	PR100191001
PR122791002	122791	PR122791002	1.00	PR100191001
PR122791003	122791	PR122791003	1.00	PR100191001
PR122791004	122791	PR122791004	1.00	PR100191001
PR122791005	122791	PR122791005	1.00	PR100191001
PR122791006	122791	PR122791006	1.00	PR100191001
PR122891001	122791	PR122891001	1.00	PR100191001
PR122891002	122891	PR122891002	1.00	PR100191001
PR122891003	122891	PR122891003	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR122891004	122891	PR122891004	1.00	PR100191001
PR122891005	122891	PR122891005	1.00	PR100191001
PR122891006	122891	PR122891006	1.00	PR100191001
PR122991001	122891	PR122991001	1.00	PR100191001
PR122991002	122991	PR122991002	1.00	PR100191001
PR122991003	122991	PR122991003	1.00	PR100191001
PR122991004	122991	PR122991004	1.00	PR100191001
PR122991005	122991	PR122991005	1.00	PR100191001
PR122991006	122991	PR122991006	1.00	PR100191001
PR123091001	122991	PR123091001	1.00	PR100191001
PR123091002	123091	PR123091002	1.00	PR100191001
PR123091003	123091	PR123091003	1.00	PR100191001
PR123091004	123091	PR123091004	1.00	PR100191001
PR123091005	123091	PR123091005	1.00	PR100191001
PR123091006	123091	PR123091006	1.00	PR100191001
PR123091007	123091	PR123091007	1.00	PR100191001
PR123091008	123091	PR123091008	1.00	PR100191001
PR123091009	123091	PR123091009	1.00	PR100191001
PR123091010	123091	PR123091010	1.00	PR100191001
PR123091011	123091	PR123091011	1.00	PR100191001
PR123091012	123091	PR123091012	1.00	PR100191001
PR123091013	123091	PR123091013	1.00	PR100191001
PR123091014	123091	PR123091014	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR123091015	123091	PR123091015	1.00	PR100191001
PR123091016	123091	PR123091016	1.00	PR100191001
PR123091017	123091	PR123091017	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
122491 TO 123091

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR122591001	+(+1.83 +/- .14)E-03	+(+4.10 +/- .02)E-02	+(+2.07 +/- .03)E-01	+(+1.50 +/- .01)E-01	+(+1.60 +/- .01)E-01
PR122591002	+(+2.04 +/- .14)E-03	+(+5.37 +/- .04)E-02	+(+2.27 +/- .04)E-01	+(+1.84 +/- .01)E-01	+(+1.94 +/- .01)E-01
PR122591003	+(+1.76 +/- .13)E-03	+(+5.80 +/- .05)E-02	+(+2.48 +/- .05)E-01	+(+2.02 +/- .01)E-01	+(+2.05 +/- .01)E-01
PR122591004	+(+1.78 +/- .13)E-03	+(+5.06 +/- .02)E-02	+(+2.38 +/- .04)E-01	+(+1.84 +/- .01)E-01	+(+2.01 +/- .01)E-01
PR122591005	+(+2.13 +/- .17)E-03	+(+6.70 +/- .05)E-02	+(+2.67 +/- .03)E-01	+(+2.29 +/- .01)E-01	+(+2.47 +/- .01)E-01
PR122591006	+(+1.66 +/- .13)E-03	+(+5.87 +/- .03)E-02	+(+2.74 +/- .06)E-01	+(+2.12 +/- .01)E-01	+(+2.14 +/- .01)E-01
PR122691001	+(+2.77 +/- .15)E-03	+(+5.72 +/- .03)E-02	+(+2.67 +/- .04)E-01	+(+2.08 +/- .01)E-01	+(+2.12 +/- .01)E-01
PR122691002	+(+1.02 +/- .12)E-03	+(+5.70 +/- .03)E-02	+(+2.64 +/- .05)E-01	+(+2.05 +/- .01)E-01	+(+2.16 +/- .01)E-01
PR122691003	+(+1.26 +/- .12)E-03	+(+4.67 +/- .02)E-02	+(+2.40 +/- .05)E-01	+(+1.75 +/- .01)E-01	+(+1.80 +/- .01)E-01
PR122691004	+(+1.96 +/- .15)E-03	+(+5.21 +/- .03)E-02	+(+2.36 +/- .03)E-01	+(+1.86 +/- .01)E-01	+(+1.96 +/- .01)E-01
PR122691005	+(+1.57 +/- .12)E-03	+(+4.23 +/- .02)E-02	+(+2.06 +/- .04)E-01	+(+1.55 +/- .01)E-01	+(+1.60 +/- .01)E-01
PR122691006	+(+2.01 +/- .13)E-03	+(+5.93 +/- .03)E-02	+(+2.38 +/- .04)E-01	+(+2.00 +/- .01)E-01	+(+2.04 +/- .01)E-01
PR122791001	+(+1.65 +/- .13)E-03	+(+5.54 +/- .03)E-02	+(+2.50 +/- .03)E-01	+(+2.03 +/- .01)E-01	+(+2.10 +/- .01)E-01
PR122791002	+(+1.17 +/- .16)E-03	+(+4.72 +/- .02)E-02	+(+2.31 +/- .03)E-01	+(+1.79 +/- .01)E-01	+(+1.84 +/- .01)E-01
PR122791003	+(+1.90 +/- .20)E-03	+(+5.55 +/- .03)E-02	+(+2.42 +/- .04)E-01	+(+1.95 +/- .01)E-01	+(+1.88 +/- .01)E-01
PR122791004	+(+1.78 +/- .15)E-03	+(+5.21 +/- .02)E-02	+(+2.25 +/- .03)E-01	+(+1.82 +/- .01)E-01	+(+2.00 +/- .01)E-01
PR122791005	+(+1.85 +/- .13)E-03	+(+5.47 +/- .03)E-02	+(+2.47 +/- .04)E-01	+(+2.00 +/- .01)E-01	+(+2.04 +/- .01)E-01
PR122791006	+(+2.33 +/- .16)E-03	+(+4.22 +/- .02)E-02	+(+1.98 +/- .04)E-01	+(+1.55 +/- .01)E-01	+(+1.59 +/- .01)E-01
PR122891001	+(+2.72 +/- .13)E-03	+(+6.28 +/- .02)E-02	+(+2.24 +/- .02)E-01	+(+2.08 +/- .01)E-01	+(+2.12 +/- .01)E-01
PR122891002	+(+1.82 +/- .13)E-03	+(+4.40 +/- .02)E-02	+(+2.12 +/- .04)E-01	+(+1.63 +/- .01)E-01	+(+1.69 +/- .01)E-01
PR122891003	+(+1.77 +/- .14)E-03	+(+4.30 +/- .02)E-02	+(+2.12 +/- .04)E-01	+(+1.62 +/- .01)E-01	+(+1.66 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR122891004	+(+1.90 +/- .17)E-03	+(+3.83 +/- .02)E-02	+(+1.94 +/- .03)E-01	+(+1.45 +/- .01)E-01	+(+1.48 +/- .01)E-01
PR122891005	+(+1.82 +/- .15)E-03	+(+5.97 +/- .03)E-02	+(+2.39 +/- .04)E-01	+(+2.03 +/- .01)E-01	+(+2.06 +/- .01)E-01
PR122891006	+(+2.03 +/- .15)E-03	+(+6.83 +/- .05)E-02	+(+2.79 +/- .04)E-01	+(+2.32 +/- .01)E-01	+(+2.57 +/- .01)E-01
PR122991001	+(+2.30 +/- .17)E-03	+(+6.78 +/- .03)E-02	+(+2.93 +/- .04)E-01	+(+2.40 +/- .01)E-01	+(+2.42 +/- .01)E-01
PR122991002	+(+1.62 +/- .17)E-03	+(+7.65 +/- .04)E-02	+(+3.07 +/- .04)E-01	+(+2.68 +/- .02)E-01	+(+2.79 +/- .01)E-01
PR122991003	+(+1.69 +/- .24)E-03	+(+5.40 +/- .03)E-02	+(+2.55 +/- .05)E-01	+(+1.99 +/- .01)E-01	+(+2.13 +/- .01)E-01
PR122991004	+(+1.40 +/- .12)E-03	+(+5.85 +/- .03)E-02	+(+2.47 +/- .05)E-01	+(+2.04 +/- .01)E-01	+(+2.03 +/- .01)E-01
PR122991005	+(+1.72 +/- .16)E-03	+(+4.03 +/- .02)E-02	+(+2.08 +/- .03)E-01	+(+1.54 +/- .01)E-01	+(+1.61 +/- .01)E-01
PR122991006	+(+1.51 +/- .15)E-03	+(+4.17 +/- .02)E-02	+(+2.10 +/- .04)E-01	+(+1.58 +/- .01)E-01	+(+1.58 +/- .01)E-01
PR123091001	+(+1.61 +/- .17)E-03	+(+3.66 +/- .02)E-02	+(+1.97 +/- .04)E-01	+(+1.45 +/- .01)E-01	+(+1.45 +/- .01)E-01
PR123091002	+(+2.14 +/- .15)E-03	+(+3.95 +/- .02)E-02	+(+1.96 +/- .03)E-01	+(+1.48 +/- .01)E-01	+(+1.51 +/- .01)E-01
PR123091003	+(+1.95 +/- .13)E-03	+(+4.10 +/- .02)E-02	+(+1.96 +/- .04)E-01	+(+1.51 +/- .01)E-01	+(+1.53 +/- .01)E-01
PR123091004	+(+1.78 +/- .26)E-03	+(+5.09 +/- .05)E-02	+(+2.01 +/- .04)E-01	+(+1.62 +/- .02)E-01	+(+1.44 +/- .02)E-01
PR123091005	+(+1.79 +/- .25)E-03	+(+4.09 +/- .02)E-02	+(+2.00 +/- .04)E-01	+(+1.47 +/- .01)E-01	+(+1.68 +/- .02)E-01
PR123091006	+(+2.98 +/- .34)E-03	+(+5.47 +/- .02)E-02	+(+2.20 +/- .04)E-01	+(+1.85 +/- .02)E-01	+(+1.83 +/- .02)E-01
PR123091007	+(+1.99 +/- .29)E-03	+(+3.71 +/- .03)E-02	+(+1.86 +/- .03)E-01	+(+1.40 +/- .01)E-01	+(+1.60 +/- .02)E-01
PR123091008	+(+1.44 +/- .29)E-03	+(+5.77 +/- .03)E-02	+(+2.31 +/- .03)E-01	+(+2.04 +/- .01)E-01	+(+2.00 +/- .02)E-01
PR123091009	+(+2.66 +/- .28)E-03	+(+3.74 +/- .02)E-02	+(+1.96 +/- .03)E-01	+(+1.44 +/- .01)E-01	+(+1.53 +/- .02)E-01
PR123091010	+(+1.71 +/- .23)E-03	+(+3.67 +/- .02)E-02	+(+1.94 +/- .02)E-01	+(+1.41 +/- .01)E-01	+(+1.41 +/- .02)E-01
PR123091011	+(+2.68 +/- .32)E-03	+(+7.03 +/- .06)E-02	+(+2.56 +/- .03)E-01	+(+2.37 +/- .01)E-01	+(+2.49 +/- .02)E-01
PR123091012	+(+1.80 +/- .23)E-03	+(+4.43 +/- .02)E-02	+(+2.19 +/- .03)E-01	+(+1.72 +/- .01)E-01	+(+1.87 +/- .02)E-01
PR123091013	+(+1.62 +/- .26)E-03	+(+4.10 +/- .03)E-02	+(+2.10 +/- .04)E-01	+(+1.58 +/- .01)E-01	+(+1.60 +/- .02)E-01
PR123091014	+(+1.84 +/- .36)E-03	+(+7.45 +/- .07)E-02	+(+2.60 +/- .04)E-01	+(+2.36 +/- .01)E-01	+(+2.28 +/- .02)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR123091015	+(+1.86 +/- .33)E-03	+(+6.11 +/- .04)E-02	+(+2.52 +/- .05)E-01	+(+2.07 +/- .02)E-01	+(+2.34 +/- .02)E-01
PR123091016	+(+2.77 +/- .29)E-03	+(+9.55 +/- .05)E-02	+(+3.06 +/- .06)E-01	+(+2.91 +/- .02)E-01	+(+2.74 +/- .02)E-01
PR123091017	+(+1.86 +/- .24)E-03	+(+4.52 +/- .03)E-02	+(+2.17 +/- .02)E-01	+(+1.67 +/- .01)E-01	+(+2.24 +/- .02)E-01

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR122591001	+(+6.65 +/- .02)E-01	+(+5.98 +/- .02)E-01	+(+2.92 +/- .41)E-03	+(+8.65 +/- 3.1)E-03	+(+5.19 +/- .05)E-02
PR122591002	+(+6.79 +/- .01)E-01	+(+6.05 +/- .02)E-01	+(+1.61 +/- .24)E-03	(+5.17 +/- 2.7)E-03	+(+2.08 +/- .04)E-01
PR122591003	+(+6.86 +/- .01)E-01	+(+6.08 +/- .02)E-01	+(+2.06 +/- .29)E-03	(+4.04 +/- 2.7)E-03	+(+1.94 +/- .04)E-01
PR122591004	+(+7.05 +/- .01)E-01	+(+6.28 +/- .02)E-01	+(+1.97 +/- .27)E-03	+(+1.35 +/- .28)E-02	+(+6.46 +/- .09)E-02
PR122591005	+(+7.35 +/- .01)E-01	+(+6.53 +/- .02)E-01	+(+1.42 +/- .24)E-03	(+4.86 +/- 3.1)E-03	+(+2.48 +/- .05)E-01
PR122591006	+(+7.51 +/- .01)E-01	+(+6.74 +/- .03)E-01	+(+2.32 +/- .25)E-03	(+4.60 +/- 3.5)E-03	+(+7.16 +/- .06)E-02
PR122691001	+(+7.53 +/- .01)E-01	+(+6.68 +/- .02)E-01	+(+2.53 +/- .28)E-03	+(+1.09 +/- .29)E-02	+(+7.00 +/- .10)E-02
PR122691002	+(+7.41 +/- .02)E-01	+(+6.69 +/- .03)E-01	+(+2.37 +/- .20)E-03	+(+8.96 +/- 2.7)E-03	+(+1.23 +/- .02)E-01
PR122691003	+(+7.26 +/- .01)E-01	+(+6.47 +/- .02)E-01	+(+2.34 +/- .26)E-03	+(+7.97 +/- 3.0)E-03	+(+3.95 +/- .08)E-02
PR122691004	+(+7.03 +/- .01)E-01	+(+6.27 +/- .02)E-01	(+4.06 +/- 2.4)E-04	(+4.39 +/- 2.9)E-03	+(+1.86 +/- .04)E-01
PR122691005	+(+6.61 +/- .01)E-01	+(+5.94 +/- .02)E-01	+(+1.05 +/- .18)E-03	+(+1.08 +/- .27)E-02	+(+1.17 +/- .01)E-01
PR122691006	+(+6.62 +/- .01)E-01	+(+5.86 +/- .02)E-01	+(+6.73 +/- 1.5)E-04	+(+6.44 +/- 2.8)E-03	+(+2.52 +/- .03)E-01
PR122791001	+(+6.65 +/- .01)E-01	+(+5.89 +/- .02)E-01	+(+1.85 +/- .18)E-03	+(+1.06 +/- .27)E-02	+(+6.79 +/- .04)E-02
PR122791002	+(+6.29 +/- .01)E-01	+(+5.63 +/- .02)E-01	+(+1.43 +/- .17)E-03	+(+8.49 +/- 3.4)E-03	+(+3.83 +/- .03)E-02
PR122791003	+(+6.38 +/- .01)E-01	+(+5.66 +/- .03)E-01	+(+8.28 +/- 1.8)E-04	+(+8.95 +/- 2.6)E-03	+(+2.42 +/- .03)E-01
PR122791004	+(+6.41 +/- .01)E-01	+(+5.75 +/- .01)E-01	+(+6.79 +/- 2.0)E-04	+(+9.20 +/- 3.2)E-03	+(+2.90 +/- .02)E-01
PR122791005	+(+6.37 +/- .01)E-01	+(+5.66 +/- .02)E-01	+(+1.77 +/- .20)E-03	+(+1.01 +/- .39)E-02	+(+2.09 +/- .03)E-01
PR122791006	+(+5.99 +/- .01)E-01	+(+5.37 +/- .02)E-01	+(+1.85 +/- .21)E-03	+(+9.63 +/- 3.4)E-03	+(+9.61 +/- .12)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR122891001	+(+6.21 +/- .01)E-01	+(+5.46 +/- .01)E-01	+(+6.42 +/- 2.7)E-04	+(+7.93 +/- 2.8)E-03	+(+4.43 +/- .04)E-01
PR122891002	+(+6.74 +/- .01)E-01	+(+5.92 +/- .02)E-01	+(+6.73 +/- 2.4)E-04	+(+9.96 +/- 2.5)E-03	+(+5.78 +/- .06)E-02
PR122891003	+(+7.05 +/- .01)E-01	+(+6.31 +/- .02)E-01	+(+1.62 +/- .18)E-03	+(+8.38 +/- 2.6)E-03	+(+8.17 +/- .08)E-02
PR122891004	+(+6.71 +/- .01)E-01	+(+5.96 +/- .02)E-01	+(+2.22 +/- .20)E-03	(+2.07 +/- 2.6)E-03	+(+4.00 +/- .05)E-02
PR122891005	+(+7.51 +/- .01)E-01	+(+6.52 +/- .02)E-01	+(+2.45 +/- .22)E-03	+(+8.51 +/- 3.0)E-03	+(+2.71 +/- .05)E-01
PR122891006	+(+8.05 +/- .02)E-01	+(+7.16 +/- .03)E-01	+(+2.00 +/- .27)E-03	+(+8.77 +/- 3.3)E-03	+(+4.41 +/- .07)E-01
PR122991001	+(+8.55 +/- .02)E-01	+(+7.62 +/- .02)E-01	+(+9.60 +/- 3.1)E-04	+(+1.43 +/- .35)E-02	+(+2.22 +/- .02)E-01
PR122991002	+(+8.52 +/- .02)E-01	+(+7.60 +/- .02)E-01	+(+3.00 +/- .34)E-03	+(+1.29 +/- .38)E-02	+(+5.17 +/- .07)E-01
PR122991003	+(+8.23 +/- .01)E-01	+(+7.38 +/- .05)E-01	+(+2.20 +/- .33)E-03	+(+8.27 +/- 3.1)E-03	+(+1.85 +/- .02)E-01
PR122991004	+(+7.83 +/- .01)E-01	+(+6.99 +/- .02)E-01	+(+1.23 +/- .24)E-03	+(+1.13 +/- .31)E-02	+(+2.26 +/- .02)E-01
PR122991005	+(+7.42 +/- .01)E-01	+(+6.61 +/- .02)E-01	+(+1.71 +/- .25)E-03	(+8.96 +/- 30.)E-04	+(+4.58 +/- .03)E-02
PR122991006	+(+7.32 +/- .01)E-01	+(+6.53 +/- .02)E-01	+(+1.94 +/- .21)E-03	+(+9.36 +/- 2.9)E-03	+(+4.22 +/- .03)E-02
PR123091001	+(+6.99 +/- .01)E-01	+(+6.22 +/- .02)E-01	+(+6.04 +/- 2.1)E-04	+(+9.73 +/- 3.3)E-03	+(+3.65 +/- .04)E-02
PR123091002	+(+6.76 +/- .01)E-01	+(+6.03 +/- .02)E-01	+(+2.11 +/- .23)E-03	+(+1.03 +/- .26)E-02	+(+6.26 +/- .05)E-02
PR123091003	+(+6.64 +/- .01)E-01	+(+6.07 +/- .02)E-01	+(+2.16 +/- .25)E-03	+(+7.46 +/- 2.6)E-03	+(+5.26 +/- .07)E-02
PR123091004	+(+6.44 +/- .02)E-01	+(+5.76 +/- .02)E-01	(+6.78 +/- 3.9)E-04	(+9.71 +/- 55.)E-04	+(+9.42 +/- .13)E-02
PR123091005	+(+6.76 +/- .02)E-01	+(+6.03 +/- .02)E-01	(+5.52 +/- 4.1)E-04	+(+1.78 +/- .58)E-02	+(+9.41 +/- .10)E-02
PR123091006	+(+6.64 +/- .02)E-01	+(+5.99 +/- .02)E-01	+(+9.77 +/- 3.6)E-04	+(+1.38 +/- .56)E-02	+(+3.51 +/- .04)E-01
PR123091007	+(+6.31 +/- .02)E-01	+(+5.67 +/- .02)E-01	(+6.93 +/- 3.6)E-04	(+7.06 +/- 48.)E-04	+(+5.02 +/- .08)E-02
PR123091008	+(+6.83 +/- .02)E-01	+(+5.89 +/- .02)E-01	(+4.48 +/- 3.6)E-04	+(+1.20 +/- .58)E-02	+(+5.41 +/- .06)E-02
PR123091009	+(+6.73 +/- .02)E-01	+(+5.99 +/- .02)E-01	(+6.34 +/- 4.8)E-04	(+9.32 +/- 5.5)E-03	+(+3.51 +/- .08)E-02
PR123091010	+(+6.64 +/- .02)E-01	+(+5.92 +/- .02)E-01	+(+1.34 +/- .35)E-03	(+2.17 +/- 4.9)E-03	+(+3.13 +/- .08)E-02
PR123091011	+(+7.11 +/- .02)E-01	+(+6.22 +/- .02)E-01	+(+1.22 +/- .40)E-03	+(+1.91 +/- .76)E-02	+(+4.65 +/- .12)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR123091012	+(+7.05 +/- .02)E-01	+(+6.30 +/- .02)E-01	(+8.29 +/- 4.2)E-04	(+2.86 +/- 7.7)E-03	+(+4.05 +/- .07)E-02
PR123091013	+(+6.87 +/- .02)E-01	+(+6.17 +/- .02)E-01	+(+1.20 +/- .46)E-03	(+4.25 +/- 5.2)E-03	+(+4.07 +/- .06)E-02
PR123091014	+(+7.06 +/- .02)E-01	+(+6.22 +/- .02)E-01	(+2.85 +/- 3.8)E-04	(+2.53 +/- 53.)E-04	+(+6.50 +/- .12)E-01
PR123091015	+(+7.22 +/- .02)E-01	+(+6.44 +/- .03)E-01	(+2.95 +/- 4.6)E-04	+(+1.91 +/- .56)E-02	+(+9.48 +/- .10)E-02
PR123091016	+(+7.22 +/- .02)E-01	+(+6.46 +/- .03)E-01	(+2.35 +/- 4.0)E-04	+(+1.84 +/- .70)E-02	+(+7.87 +/- .10)E-01
PR123091017	+(+7.07 +/- .02)E-01	+(+6.46 +/- .03)E-01	(+5.12 +/- 3.9)E-04	(+2.08 +/- 5.6)E-03	+(+9.48 +/- .10)E-02

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR122591001	+(+9.37 +/- .04)E-02	+(+4.41 +/- .01)E-01	+(+5.03 +/- .01)E-01	(+2.72 +/- 1.8)E-04	+(+5.38 +/- .01)E-01
PR122591002	+(+9.43 +/- .05)E-02	+(+4.44 +/- .01)E-01	+(+4.97 +/- .02)E-01	(+3.24 +/- 2.0)E-04	+(+5.33 +/- .02)E-01
PR122591003	+(+9.91 +/- .04)E-02	+(+4.70 +/- .01)E-01	+(+4.99 +/- .01)E-01	(+3.96 +/- 2.2)E-04	+(+5.38 +/- .01)E-01
PR122591004	+(+1.02 +/- .00)E-01	+(+4.81 +/- .01)E-01	+(+5.09 +/- .02)E-01	(+8.66 +/- 17.)E-05	+(+5.50 +/- .01)E-01
PR122591005	+(+1.10 +/- .00)E-01	+(+5.19 +/- .01)E-01	+(+5.28 +/- .01)E-01	(+2.79 +/- 1.9)E-04	+(+5.81 +/- .02)E-01
PR122591006	+(+1.07 +/- .00)E-01	+(+5.09 +/- .01)E-01	+(+5.45 +/- .02)E-01	(+3.64 +/- 2.2)E-04	+(+5.86 +/- .01)E-01
PR122691001	+(+1.03 +/- .01)E-01	+(+4.87 +/- .01)E-01	+(+5.38 +/- .02)E-01	(+9.64 +/- 21.)E-05	+(+5.96 +/- .01)E-01
PR122691002	+(+1.00 +/- .01)E-01	+(+4.75 +/- .01)E-01	+(+5.35 +/- .01)E-01	(+7.24 +/- 19.)E-05	+(+5.88 +/- .02)E-01
PR122691003	+(+9.22 +/- .03)E-02	+(+4.37 +/- .01)E-01	+(+5.21 +/- .01)E-01	(-1.66 +/- ***)E-07	+(+5.57 +/- .02)E-01
PR122691004	+(+8.90 +/- .04)E-02	+(+4.21 +/- .01)E-01	+(+4.94 +/- .02)E-01	(+8.14 +/- ***)E-06	+(+5.33 +/- .01)E-01
PR122691005	+(+7.82 +/- .02)E-02	+(+3.70 +/- .01)E-01	+(+4.44 +/- .01)E-01	(+2.72 +/- 1.7)E-04	+(+4.85 +/- .01)E-01
PR122691006	+(+7.90 +/- .02)E-02	+(+3.68 +/- .01)E-01	+(+4.41 +/- .02)E-01	(+9.85 +/- 15.)E-05	+(+4.76 +/- .01)E-01
PR122791001	+(+8.39 +/- .02)E-02	+(+3.92 +/- .01)E-01	+(+4.39 +/- .01)E-01	(+2.37 +/- 1.8)E-04	+(+4.99 +/- .02)E-01
PR122791002	+(+8.00 +/- .03)E-02	+(+3.74 +/- .01)E-01	+(+4.24 +/- .02)E-01	(+2.90 +/- 1.5)E-04	+(+4.81 +/- .01)E-01
PR122791003	+(+7.75 +/- .05)E-02	+(+3.64 +/- .01)E-01	+(+4.37 +/- .01)E-01	(+1.73 +/- 2.0)E-04	+(+4.83 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR122791004	+(+7.19 +/- .04)E-02	+(+3.44 +/- .01)E-01	+(+4.45 +/- .01)E-01	(+5.37 +/- 17.)E-05	+(+5.07 +/- .01)E-01
PR122791005	+(+7.69 +/- .04)E-02	+(+3.67 +/- .01)E-01	+(+4.24 +/- .01)E-01	(+6.43 +/- 17.)E-05	+(+4.90 +/- .03)E-01
PR122791006	+(+6.63 +/- .02)E-02	+(+3.14 +/- .01)E-01	+(+3.96 +/- .01)E-01	(+3.45 +/- 1.8)E-04	+(+4.41 +/- .01)E-01
PR122891001	+(+6.87 +/- .02)E-02	+(+3.27 +/- .01)E-01	+(+4.12 +/- .01)E-01	(+3.10 +/- 1.7)E-04	+(+4.41 +/- .01)E-01
PR122891002	+(+6.90 +/- .04)E-02	+(+3.30 +/- .01)E-01	+(+4.44 +/- .02)E-01	(+2.15 +/- 1.1)E-04	+(+4.61 +/- .01)E-01
PR122891003	+(+7.08 +/- .04)E-02	+(+3.38 +/- .01)E-01	+(+4.87 +/- .01)E-01	(+2.48 +/- 1.8)E-04	+(+5.06 +/- .01)E-01
PR122891004	+(+6.60 +/- .03)E-02	+(+3.14 +/- .01)E-01	+(+4.47 +/- .02)E-01	(+2.32 +/- 1.5)E-04	+(+4.70 +/- .01)E-01
PR122891005	+(+8.13 +/- .04)E-02	+(+3.85 +/- .01)E-01	+(+5.22 +/- .02)E-01	(+1.29 +/- 1.8)E-04	+(+5.18 +/- .01)E-01
PR122891006	+(+9.15 +/- .05)E-02	+(+4.34 +/- .01)E-01	+(+5.65 +/- .03)E-01	(+3.24 +/- 1.8)E-04	+(+6.09 +/- .01)E-01
PR122991001	+(+9.89 +/- .04)E-02	+(+4.70 +/- .01)E-01	+(+6.15 +/- .02)E-01	(+4.32 +/- 2.4)E-04	+(+6.50 +/- .01)E-01
PR122991002	+(+1.06 +/- .01)E-01	+(+5.01 +/- .01)E-01	+(+6.04 +/- .01)E-01	(+9.62 +/- 23.)E-05	+(+6.58 +/- .02)E-01
PR122991003	+(+9.83 +/- .03)E-02	+(+4.67 +/- .01)E-01	+(+5.83 +/- .01)E-01	(+4.74 +/- 2.6)E-04	+(+6.06 +/- .01)E-01
PR122991004	+(+8.87 +/- .02)E-02	+(+4.22 +/- .01)E-01	+(+5.44 +/- .01)E-01	(+3.49 +/- 2.2)E-04	+(+5.69 +/- .01)E-01
PR122991005	+(+7.78 +/- .04)E-02	+(+3.70 +/- .01)E-01	+(+5.00 +/- .02)E-01	(+1.36 +/- 1.8)E-04	+(+5.21 +/- .01)E-01
PR122991006	+(+7.03 +/- .03)E-02	+(+3.36 +/- .01)E-01	+(+4.88 +/- .02)E-01	(+1.97 +/- 2.0)E-04	+(+5.08 +/- .01)E-01
PR123091001	+(+6.36 +/- .02)E-02	+(+3.03 +/- .00)E-01	+(+4.62 +/- .02)E-01	(+1.81 +/- 1.5)E-04	+(+4.78 +/- .01)E-01
PR123091002	+(+5.96 +/- .02)E-02	+(+2.83 +/- .01)E-01	+(+4.51 +/- .02)E-01	(+4.14 +/- 15.)E-05	+(+4.66 +/- .01)E-01
PR123091003	+(+5.77 +/- .01)E-02	+(+2.73 +/- .01)E-01	+(+4.50 +/- .02)E-01	(+1.85 +/- 1.6)E-04	+(+4.60 +/- .01)E-01
PR123091004	+(+5.78 +/- .03)E-02	+(+2.74 +/- .01)E-01	+(+4.34 +/- .01)E-01	(+2.29 +/- 2.0)E-04	+(+4.50 +/- .02)E-01
PR123091005	+(+6.20 +/- .03)E-02	+(+2.95 +/- .01)E-01	+(+4.86 +/- .01)E-01	(-1.26 +/- 23.)E-05	+(+4.76 +/- .02)E-01
PR123091006	+(+6.32 +/- .03)E-02	+(+3.00 +/- .01)E-01	+(+4.72 +/- .02)E-01	(+3.27 +/- 2.5)E-04	+(+4.90 +/- .01)E-01
PR123091007	+(+5.96 +/- .03)E-02	+(+2.84 +/- .01)E-01	+(+4.13 +/- .02)E-01	+(+5.54 +/- 2.6)E-04	+(+4.48 +/- .01)E-01
PR123091008	+(+6.28 +/- .04)E-02	+(+3.01 +/- .01)E-01	+(+4.45 +/- .01)E-01	(+1.62 +/- 2.1)E-04	+(+4.56 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR123091009	+(+6.13 +/- .04)E-02	+(+2.90 +/- .01)E-01	+(+4.38 +/- .02)E-01	(+3.19 +/- 2.1)E-04	+(+4.60 +/- .01)E-01
PR123091010	+(+5.92 +/- .04)E-02	+(+2.82 +/- .01)E-01	+(+4.30 +/- .01)E-01	(+3.23 +/- 2.9)E-04	+(+4.44 +/- .01)E-01
PR123091011	+(+7.06 +/- .03)E-02	+(+3.36 +/- .01)E-01	+(+4.64 +/- .03)E-01	(+5.19 +/- 3.2)E-04	+(+4.76 +/- .01)E-01
PR123091012	+(+6.87 +/- .04)E-02	+(+3.28 +/- .01)E-01	+(+4.49 +/- .01)E-01	(+8.95 +/- 23.)E-05	+(+4.81 +/- .02)E-01
PR123091013	+(+6.79 +/- .03)E-02	+(+3.22 +/- .01)E-01	+(+4.44 +/- .01)E-01	(+3.13 +/- 2.6)E-04	+(+4.73 +/- .02)E-01
PR123091014	+(+7.45 +/- .03)E-02	+(+3.54 +/- .01)E-01	+(+4.61 +/- .01)E-01	(+2.27 +/- 2.7)E-04	+(+4.79 +/- .02)E-01
PR123091015	+(+7.66 +/- .03)E-02	+(+3.65 +/- .01)E-01	+(+4.70 +/- .02)E-01	(+1.07 +/- 2.2)E-04	+(+5.01 +/- .02)E-01
PR123091016	+(+8.09 +/- .03)E-02	+(+3.82 +/- .01)E-01	+(+4.76 +/- .03)E-01	(+2.38 +/- 2.7)E-04	+(+5.20 +/- .02)E-01
PR123091017	+(+7.60 +/- .04)E-02	+(+3.62 +/- .01)E-01	+(+4.59 +/- .02)E-01	(+1.85 +/- 2.4)E-04	+(+5.10 +/- .02)E-01

ID	XE 138	XE 139
PR122591001	+(+5.99 +/- .01)E-01	+(+4.97 +/- .51)E-03
PR122591002	+(+5.98 +/- .02)E-01	+(+4.55 +/- .63)E-03
PR122591003	+(+6.12 +/- .02)E-01	+(+4.42 +/- .37)E-03
PR122591004	+(+6.12 +/- .02)E-01	+(+5.19 +/- .61)E-03
PR122591005	+(+6.48 +/- .02)E-01	+(+5.71 +/- .33)E-03
PR122591006	+(+6.66 +/- .01)E-01	+(+6.16 +/- .65)E-03
PR122691001	+(+6.66 +/- .02)E-01	+(+5.88 +/- .77)E-03
PR122691002	+(+6.56 +/- .02)E-01	+(+5.30 +/- .89)E-03
PR122691003	+(+6.13 +/- .02)E-01	+(+4.89 +/- .90)E-03
PR122691004	+(+5.88 +/- .01)E-01	+(+5.01 +/- .66)E-03
PR122691005	+(+5.27 +/- .01)E-01	+(+4.96 +/- .41)E-03
PR122691006	+(+5.34 +/- .01)E-01	+(+4.70 +/- .38)E-03

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 138	XE 139
PR122791001	+(+5.63 +/- .01)E-01	+(+4.55 +/- .51)E-03
PR122791002	+(+5.39 +/- .01)E-01	+(+4.14 +/- .47)E-03
PR122791003	+(+5.55 +/- .02)E-01	+(+4.50 +/- .68)E-03
PR122791004	+(+5.52 +/- .01)E-01	+(+4.79 +/- .61)E-03
PR122791005	+(+5.54 +/- .01)E-01	+(+4.46 +/- .33)E-03
PR122791006	+(+4.83 +/- .02)E-01	+(+4.02 +/- .35)E-03
PR122891001	+(+5.09 +/- .01)E-01	+(+4.45 +/- .50)E-03
PR122891002	+(+5.28 +/- .01)E-01	+(+4.63 +/- .62)E-03
PR122891003	+(+5.70 +/- .02)E-01	+(+4.95 +/- .63)E-03
PR122891004	+(+5.24 +/- .01)E-01	+(+4.89 +/- .41)E-03
PR122891005	+(+6.10 +/- .02)E-01	+(+6.00 +/- .44)E-03
PR122891006	+(+6.82 +/- .02)E-01	+(+6.91 +/- .48)E-03
PR122991001	+(+7.43 +/- .02)E-01	+(+7.59 +/- .48)E-03
PR122991002	+(+7.30 +/- .03)E-01	+(+7.62 +/- .57)E-03
PR122991003	+(+6.66 +/- .02)E-01	+(+7.19 +/- .55)E-03
PR122991004	+(+6.34 +/- .02)E-01	+(+6.71 +/- .52)E-03
PR122991005	+(+5.72 +/- .01)E-01	+(+6.24 +/- .48)E-03
PR122991006	+(+5.67 +/- .01)E-01	+(+5.50 +/- .45)E-03
PR123091001	+(+5.35 +/- .01)E-01	+(+5.28 +/- .42)E-03
PR123091002	+(+5.20 +/- .01)E-01	+(+4.96 +/- .37)E-03
PR123091003	+(+5.17 +/- .01)E-01	+(+5.69 +/- .33)E-03
PR123091004	+(+5.11 +/- .01)E-01	+(+5.14 +/- .44)E-03
PR123091005	+(+5.44 +/- .02)E-01	+(+5.17 +/- .38)E-03

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 138	XE 139
PR123091006	+(+5.51 +/- .02)E-01	+(+4.71 +/- .40)E-03
PR123091007	+(+4.78 +/- .02)E-01	+(+4.24 +/- .34)E-03
PR123091008	+(+5.32 +/- .02)E-01	+(+4.86 +/- .42)E-03
PR123091009	+(+5.05 +/- .01)E-01	+(+4.86 +/- .44)E-03
PR123091010	+(+4.97 +/- .02)E-01	+(+4.99 +/- .49)E-03
PR123091011	+(+5.56 +/- .02)E-01	+(+6.07 +/- .45)E-03
PR123091012	+(+5.34 +/- .02)E-01	+(+5.38 +/- .40)E-03
PR123091013	+(+5.27 +/- .02)E-01	+(+4.66 +/- .45)E-03
PR123091014	+(+5.59 +/- .02)E-01	+(+5.29 +/- .35)E-03
PR123091015	+(+5.64 +/- .02)E-01	+(+5.47 +/- .50)E-03
PR123091016	+(+6.01 +/- .03)E-01	+(+6.41 +/- .47)E-03
PR123091017	+(+5.44 +/- .02)E-01	+(+5.27 +/- .34)E-03

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.

GAMMA-RAY ANALYSIS SUMMARY 6

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

COLLECTION PERIOD:
123091 TO 010192

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

26-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
123091 TO 010192

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR010192001	123191	PR010192001	1.00	PR100191001
PR010192002	010192	PR010192002	1.00	PR100191001
PR010192003	010192	PR010192003	1.00	PR100191001
PR010192004	010192	PR010192004	1.00	PR100191001
PR010192005	010192	PR010192005	1.00	PR100191001
PR010192006	010192	PR010192006	1.00	PR100191001
PR010192007	010192	PR010192007	1.00	PR100191001
PR010192008	010192	PR010192008	1.00	PR100191001
PR010192009	010192	PR010192009	1.00	PR100191001
PR010192010	010192	PR010192010	1.00	PR100191001
PR010192011	010192	PR010192011	1.00	PR100191001
PR010192012	010192	PR010192012	1.00	PR100191001
PR010192013	010192	PR010192013	1.00	PR100191001
PR010192014	010192	PR010192014	1.00	PR100191001
PR010192015	010192	PR010192015	1.00	PR100191001
PR010192016	010192	PR010192016	1.00	PR100191001
PR010192017	010192	PR010192017	1.00	PR100191001
PR010192018	010192	PR010192018	1.00	PR100191001
PR010192019	010192	PR010192019	1.00	PR100191001
PR010192020	010192	PR010192020	1.00	PR100191001
PR010192021	010192	PR010192021	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR010192022	010192	PR010192022	1.00	PR100191001
PR010192023	010192	PR010192023	1.00	PR100191001
PR010192024	010192	PR010192024	1.00	PR100191001
PR123191001	123091	PR123191001	1.00	PR100191001
PR123191002	123191	PR123191002	1.00	PR100191001
PR123191003	123191	PR123191003	1.00	PR100191001
PR123191004	123191	PR123191004	1.00	PR100191001
PR123191005	123191	PR123191005	1.00	PR100191001
PR123191006	123191	PR123191006	1.00	PR100191001
PR123191007	123191	PR123191007	1.00	PR100191001
PR123191008	123191	PR123191008	1.00	PR100191001
PR123191009	123191	PR123191009	1.00	PR100191001
PR123191010	123191	PR123191010	1.00	PR100191001
PR123191011	123191	PR123191011	1.00	PR100191001
PR123191012	123191	PR123191012	1.00	PR100191001
PR123191013	123191	PR123191013	1.00	PR100191001
PR123191014	123191	PR123191014	1.00	PR100191001
PR123191015	123191	PR123191015	1.00	PR100191001
PR123191016	123191	PR123191016	1.00	PR100191001
PR123191017	123191	PR123191017	1.00	PR100191001
PR123191018	123191	PR123191018	1.00	PR100191001
PR123191019	123191	PR123191019	1.00	PR100191001
PR123191020	123191	PR123191020	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR123191021	123191	PR123191021	1.00	PR100191001
PR123191022	123191	PR123191022	1.00	PR100191001
PR123191023	123191	PR123191023	1.00	PR100191001
PR123191024	123191	PR123191024	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
123091 TO 010192

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR010192001	+(+2.43 +/- .43)E-03	+(+6.72 +/- .07)E-02	+(+3.26 +/- .07)E-01	+(+2.41 +/- .02)E-01	+(+2.47 +/- .02)E-01
PR010192002	+(+1.90 +/- .39)E-03	+(+6.25 +/- .05)E-02	+(+3.22 +/- .08)E-01	+(+2.35 +/- .02)E-01	+(+2.37 +/- .02)E-01
PR010192003	+(+2.48 +/- .43)E-03	+(+7.49 +/- .06)E-02	+(+3.48 +/- .09)E-01	+(+2.70 +/- .02)E-01	+(+2.64 +/- .03)E-01
PR010192004	+(+1.90 +/- .40)E-03	+(+6.60 +/- .05)E-02	+(+3.31 +/- .08)E-01	+(+2.42 +/- .02)E-01	+(+2.58 +/- .02)E-01
PR010192005	+(+1.74 +/- .37)E-03	+(+1.09 +/- .02)E-01	+(+4.02 +/- .07)E-01	+(+3.50 +/- .03)E-01	+(+3.71 +/- .03)E-01
PR010192006	+(+2.04 +/- .35)E-03	+(+6.08 +/- .06)E-02	+(+3.23 +/- .07)E-01	+(+2.31 +/- .02)E-01	+(+3.02 +/- .02)E-01
PR010192007	+(+1.61 +/- .30)E-03	+(+5.97 +/- .05)E-02	+(+3.20 +/- .09)E-01	+(+2.25 +/- .02)E-01	+(+2.35 +/- .02)E-01
PR010192008	+(+1.97 +/- .34)E-03	+(+7.26 +/- .07)E-02	+(+3.46 +/- .08)E-01	+(+2.65 +/- .02)E-01	+(+2.59 +/- .02)E-01
PR010192009	+(+8.85 +/- 3.6)E-04	+(+7.07 +/- .06)E-02	+(+3.45 +/- .09)E-01	+(+2.63 +/- .02)E-01	+(+2.78 +/- .02)E-01
PR010192010	+(+1.71 +/- .35)E-03	+(+9.05 +/- .13)E-02	+(+3.75 +/- .08)E-01	+(+3.10 +/- .02)E-01	+(+3.18 +/- .02)E-01
PR010192011	+(+9.26 +/- 3.4)E-04	+(+5.95 +/- .06)E-02	+(+2.92 +/- .03)E-01	+(+2.22 +/- .02)E-01	+(+2.71 +/- .03)E-01
PR010192012	+(+1.88 +/- .34)E-03	+(+6.49 +/- .04)E-02	+(+3.22 +/- .08)E-01	+(+2.32 +/- .02)E-01	+(+2.34 +/- .02)E-01
PR010192013	+(+1.47 +/- .41)E-03	+(+7.48 +/- .08)E-02	+(+3.48 +/- .06)E-01	+(+2.72 +/- .02)E-01	+(+2.58 +/- .02)E-01
PR010192014	+(+1.25 +/- .32)E-03	+(+6.33 +/- .05)E-02	+(+3.16 +/- .07)E-01	+(+2.32 +/- .02)E-01	+(+2.66 +/- .02)E-01
PR010192015	+(+1.07 +/- .30)E-03	+(+4.58 +/- .05)E-02	+(+2.36 +/- .06)E-01	+(+1.67 +/- .01)E-01	+(+2.02 +/- .02)E-01
PR010192016	(+4.91 +/- 2.7)E-04	+(+3.70 +/- .03)E-02	+(+1.91 +/- .05)E-01	+(+1.29 +/- .01)E-01	+(+1.54 +/- .02)E-01
PR010192017	+(+5.96 +/- 2.4)E-04	+(+2.78 +/- .02)E-02	+(+1.49 +/- .03)E-01	+(+1.03 +/- .01)E-01	+(+1.17 +/- .02)E-01
PR010192018	+(+8.08 +/- 2.4)E-04	+(+1.99 +/- .01)E-02	+(+1.15 +/- .02)E-01	+(+7.65 +/- .09)E-02	+(+9.07 +/- .12)E-02
PR010192019	+(+8.19 +/- 2.1)E-04	+(+1.58 +/- .01)E-02	+(+9.94 +/- .17)E-02	+(+6.51 +/- .08)E-02	+(+7.11 +/- .11)E-02
PR010192020	+(+3.78 +/- 1.9)E-04	+(+1.63 +/- .02)E-02	+(+9.81 +/- .19)E-02	+(+6.69 +/- .09)E-02	+(+6.79 +/- .11)E-02
PR010192021	+(+5.79 +/- 1.9)E-04	+(+1.81 +/- .01)E-02	+(+1.07 +/- .03)E-01	+(+7.20 +/- .08)E-02	+(+7.13 +/- .14)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR010192022	+(+7.31 +/- 1.9)E-04	+(+1.55 +/- .01)E-02	+(+9.74 +/- .26)E-02	+(+6.31 +/- .08)E-02	+(+6.64 +/- .10)E-02
PR010192023	+(+6.27 +/- 1.8)E-04	+(+1.51 +/- .01)E-02	+(+9.23 +/- .18)E-02	+(+6.30 +/- .09)E-02	+(+6.35 +/- .10)E-02
PR010192024	+(+6.72 +/- 1.8)E-04	+(+1.41 +/- .02)E-02	+(+8.95 +/- .22)E-02	+(+5.80 +/- .10)E-02	+(+6.02 +/- .10)E-02
PR123191001	+(+1.36 +/- .31)E-03	+(+5.85 +/- .05)E-02	+(+2.54 +/- .04)E-01	+(+2.04 +/- .01)E-01	+(+1.98 +/- .02)E-01
PR123191002	+(+2.16 +/- .27)E-03	+(+5.11 +/- .04)E-02	+(+2.48 +/- .05)E-01	+(+1.87 +/- .02)E-01	+(+1.96 +/- .02)E-01
PR123191003	+(+1.68 +/- .34)E-03	+(+4.58 +/- .03)E-02	+(+2.38 +/- .04)E-01	+(+1.74 +/- .01)E-01	+(+1.88 +/- .02)E-01
PR123191004	+(+1.94 +/- .28)E-03	+(+5.05 +/- .03)E-02	+(+2.45 +/- .05)E-01	+(+1.89 +/- .02)E-01	+(+1.82 +/- .02)E-01
PR123191005	+(+2.00 +/- .27)E-03	+(+6.51 +/- .04)E-02	+(+2.67 +/- .03)E-01	+(+2.28 +/- .02)E-01	+(+2.27 +/- .02)E-01
PR123191006	+(+2.24 +/- .42)E-03	+(+8.57 +/- .08)E-02	+(+3.01 +/- .05)E-01	+(+2.77 +/- .02)E-01	+(+2.31 +/- .02)E-01
PR123191007	+(+2.53 +/- .29)E-03	+(+6.18 +/- .04)E-02	+(+2.67 +/- .04)E-01	+(+2.25 +/- .02)E-01	+(+2.85 +/- .02)E-01
PR123191008	+(+3.09 +/- .39)E-03	+(+7.01 +/- .04)E-02	+(+2.80 +/- .04)E-01	+(+2.42 +/- .02)E-01	+(+2.47 +/- .02)E-01
PR123191009	+(+1.34 +/- .27)E-03	+(+7.02 +/- .05)E-02	+(+2.99 +/- .06)E-01	+(+2.42 +/- .02)E-01	+(+2.52 +/- .02)E-01
PR123191010	+(+1.70 +/- .30)E-03	+(+6.15 +/- .04)E-02	+(+2.85 +/- .05)E-01	+(+2.21 +/- .02)E-01	+(+2.30 +/- .03)E-01
PR123191011	+(+1.74 +/- .29)E-03	+(+7.25 +/- .04)E-02	+(+3.07 +/- .07)E-01	+(+2.49 +/- .02)E-01	+(+2.48 +/- .02)E-01
PR123191012	+(+1.52 +/- .26)E-03	+(+6.16 +/- .04)E-02	+(+2.77 +/- .03)E-01	+(+2.23 +/- .02)E-01	+(+2.36 +/- .02)E-01
PR123191013	+(+2.10 +/- .28)E-03	+(+6.45 +/- .03)E-02	+(+2.95 +/- .05)E-01	+(+2.30 +/- .02)E-01	+(+2.32 +/- .02)E-01
PR123191014	+(+2.57 +/- .38)E-03	+(+9.72 +/- .09)E-02	+(+3.40 +/- .03)E-01	+(+3.22 +/- .02)E-01	+(+2.61 +/- .02)E-01
PR123191015	+(+2.47 +/- .42)E-03	+(+1.05 +/- .01)E-01	+(+3.73 +/- .05)E-01	+(+3.39 +/- .03)E-01	+(+4.20 +/- .03)E-01
PR123191016	+(+1.27 +/- .33)E-03	+(+7.46 +/- .05)E-02	+(+3.35 +/- .04)E-01	+(+2.76 +/- .02)E-01	+(+3.02 +/- .03)E-01
PR123191017	+(+1.34 +/- .27)E-03	+(+7.81 +/- .03)E-02	+(+3.50 +/- .08)E-01	+(+2.74 +/- .02)E-01	+(+2.89 +/- .03)E-01
PR123191018	(+9.38 +/- 4.8)E-04	+(+7.26 +/- .04)E-02	+(+3.36 +/- .04)E-01	+(+2.63 +/- .02)E-01	+(+2.79 +/- .03)E-01
PR123191019	+(+2.31 +/- .43)E-03	+(+6.99 +/- .05)E-02	+(+3.30 +/- .04)E-01	+(+2.55 +/- .02)E-01	+(+2.59 +/- .02)E-01
PR123191020	+(+5.00 +/- .70)E-03	+(+6.91 +/- .05)E-02	+(+3.42 +/- .06)E-01	+(+2.61 +/- .02)E-01	+(+2.77 +/- .03)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR123191021	+(+1.90 +/- .29)E-03	+(+7.30 +/- .05)E-02	+(+3.49 +/- .07)E-01	+(+2.69 +/- .02)E-01	+(+2.69 +/- .02)E-01
PR123191022	+(+1.35 +/- .34)E-03	+(+6.38 +/- .06)E-02	+(+3.28 +/- .08)E-01	+(+2.41 +/- .02)E-01	+(+2.44 +/- .02)E-01
PR123191023	+(+1.77 +/- .35)E-03	+(+7.11 +/- .06)E-02	+(+3.52 +/- .08)E-01	+(+2.65 +/- .02)E-01	+(+2.70 +/- .03)E-01
PR123191024	+(+1.73 +/- .33)E-03	+(+6.68 +/- .06)E-02	+(+3.37 +/- .07)E-01	+(+2.46 +/- .02)E-01	+(+2.47 +/- .02)E-01

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR010192001	+(+1.06 +/- .00)E+00	+(+9.41 +/- .03)E-01	+(+1.90 +/- .48)E-03	(+1.26 +/- .71)E-02	+(+9.09 +/- .12)E-02
PR010192002	+(+1.05 +/- .00)E+00	+(+9.30 +/- .03)E-01	(-4.38 +/- 47.)E-05	+(+3.01 +/- .86)E-02	+(+6.13 +/- .07)E-02
PR010192003	+(+1.06 +/- .00)E+00	+(+9.40 +/- .03)E-01	(+8.59 +/- 4.8)E-04	(+1.70 +/- .89)E-02	+(+8.13 +/- .13)E-02
PR010192004	+(+1.07 +/- .00)E+00	+(+9.51 +/- .03)E-01	+(+1.49 +/- .48)E-03	(+4.46 +/- 6.6)E-03	+(+6.93 +/- .14)E-02
PR010192005	+(+1.11 +/- .00)E+00	+(+9.83 +/- .03)E-01	+(+1.13 +/- .52)E-03	+(+4.34 +/- .79)E-02	+(+1.05 +/- .03)E+00
PR010192006	+(+1.09 +/- .00)E+00	+(+9.92 +/- .05)E-01	+(+1.49 +/- .49)E-03	(+9.35 +/- 7.2)E-03	+(+6.41 +/- .09)E-02
PR010192007	+(+1.06 +/- .00)E+00	+(+9.61 +/- .04)E-01	+(+2.14 +/- .49)E-03	(+1.16 +/- .70)E-02	+(+6.24 +/- .09)E-02
PR010192008	+(+1.04 +/- .00)E+00	+(+9.32 +/- .03)E-01	(+9.34 +/- 4.8)E-04	(+2.31 +/- 6.8)E-03	+(+9.30 +/- .11)E-02
PR010192009	+(+1.02 +/- .00)E+00	+(+9.17 +/- .03)E-01	(+5.77 +/- 4.7)E-04	+(+1.73 +/- .78)E-02	+(+7.79 +/- .10)E-02
PR010192010	+(+1.05 +/- .00)E+00	+(+9.21 +/- .04)E-01	(+1.18 +/- .65)E-03	(+9.66 +/- 11.)E-03	+(+5.77 +/- .15)E-01
PR010192011	+(+1.03 +/- .00)E+00	+(+9.36 +/- .03)E-01	+(+1.98 +/- .54)E-03	(+2.27 +/- 7.1)E-03	+(+7.27 +/- .09)E-02
PR010192012	+(+1.02 +/- .00)E+00	+(+9.16 +/- .04)E-01	+(+1.38 +/- .47)E-03	(+2.71 +/- 7.0)E-03	+(+8.16 +/- .16)E-02
PR010192013	+(+1.03 +/- .00)E+00	+(+9.15 +/- .02)E-01	+(+1.23 +/- .49)E-03	+(+1.90 +/- .74)E-02	+(+7.65 +/- .09)E-02
PR010192014	+(+1.01 +/- .00)E+00	+(+9.16 +/- .04)E-01	+(+1.06 +/- .50)E-03	(+7.60 +/- 81.)E-04	+(+7.45 +/- .09)E-02
PR010192015	+(+8.70 +/- .02)E-01	+(+8.27 +/- .03)E-01	+(+1.99 +/- .43)E-03	(+1.12 +/- .63)E-02	+(+5.63 +/- .13)E-02
PR010192016	+(+7.52 +/- .03)E-01	+(+7.13 +/- .03)E-01	+(+2.85 +/- .37)E-03	+(+1.47 +/- .59)E-02	+(+5.29 +/- .07)E-02
PR010192017	+(+6.10 +/- .02)E-01	+(+5.94 +/- .02)E-01	+(+2.48 +/- .32)E-03	+(+1.13 +/- .54)E-02	+(+4.03 +/- .09)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR010192018	+(+5.20 +/- .01)E-01	+(+4.89 +/- .01)E-01	+(+2.30 +/- .31)E-03	(-4.93 +/- 44.)E-04	+(+3.73 +/- .05)E-02
PR010192019	+(+4.49 +/- .01)E-01	+(+4.16 +/- .01)E-01	+(+1.53 +/- .29)E-03	(+6.53 +/- 5.4)E-03	+(+2.35 +/- .05)E-02
PR010192020	+(+4.30 +/- .02)E-01	+(+3.88 +/- .01)E-01	+(+2.17 +/- .28)E-03	(-6.20 +/- 3.8)E-03	+(+2.29 +/- .04)E-02
PR010192021	+(+4.22 +/- .01)E-01	+(+3.80 +/- .01)E-01	+(+3.09 +/- .29)E-03	(+6.70 +/- 4.9)E-03	+(+2.40 +/- .04)E-02
PR010192022	+(+4.08 +/- .01)E-01	+(+3.70 +/- .02)E-01	+(+2.22 +/- .37)E-03	+(+1.14 +/- .39)E-02	+(+1.99 +/- .04)E-02
PR010192023	+(+3.99 +/- .01)E-01	+(+3.54 +/- .01)E-01	+(+2.65 +/- .27)E-03	+(+1.09 +/- .38)E-02	+(+2.12 +/- .04)E-02
PR010192024	+(+3.75 +/- .01)E-01	+(+3.39 +/- .01)E-01	+(+2.45 +/- .30)E-03	+(+1.27 +/- .37)E-02	+(+1.86 +/- .04)E-02
PR123191001	+(+7.26 +/- .02)E-01	+(+6.43 +/- .02)E-01	(+2.72 +/- 3.8)E-04	(-3.71 +/- 5.2)E-03	+(+9.02 +/- .10)E-02
PR123191002	+(+7.68 +/- .02)E-01	+(+6.70 +/- .02)E-01	+(+1.27 +/- .39)E-03	+(+1.70 +/- .64)E-02	+(+5.45 +/- .06)E-02
PR123191003	+(+7.78 +/- .02)E-01	+(+6.88 +/- .02)E-01	+(+1.19 +/- .39)E-03	(+9.76 +/- 6.0)E-03	+(+3.98 +/- .06)E-02
PR123191004	+(+7.70 +/- .02)E-01	+(+6.89 +/- .02)E-01	+(+1.28 +/- .39)E-03	+(+1.52 +/- .60)E-02	+(+5.42 +/- .06)E-02
PR123191005	+(+7.81 +/- .02)E-01	+(+7.06 +/- .03)E-01	+(+1.34 +/- .40)E-03	(+5.23 +/- 5.8)E-03	+(+9.00 +/- .10)E-02
PR123191006	+(+7.77 +/- .02)E-01	+(+6.85 +/- .02)E-01	(+7.20 +/- 5.0)E-04	(+9.78 +/- 8.8)E-03	+(+9.35 +/- .17)E-01
PR123191007	+(+7.70 +/- .02)E-01	+(+6.94 +/- .03)E-01	(+7.15 +/- 4.1)E-04	(+4.26 +/- 6.4)E-03	+(+1.18 +/- .01)E-01
PR123191008	+(+7.98 +/- .02)E-01	+(+6.99 +/- .02)E-01	+(+1.25 +/- .40)E-03	(-4.92 +/- 56.)E-04	+(+1.83 +/- .02)E-01
PR123191009	+(+8.39 +/- .02)E-01	+(+7.37 +/- .03)E-01	+(+2.44 +/- .64)E-03	(+6.74 +/- 8.4)E-03	+(+1.66 +/- .03)E-01
PR123191010	+(+8.62 +/- .03)E-01	+(+7.66 +/- .03)E-01	+(+1.87 +/- .43)E-03	+(+2.26 +/- .69)E-02	+(+1.06 +/- .02)E-01
PR123191011	+(+8.50 +/- .03)E-01	+(+7.76 +/- .03)E-01	(+4.80 +/- 5.2)E-04	(-1.33 +/- 5.9)E-03	+(+1.47 +/- .02)E-01
PR123191012	+(+8.17 +/- .02)E-01	+(+7.39 +/- .03)E-01	(+9.47 +/- 5.9)E-04	(+1.25 +/- .99)E-02	+(+1.00 +/- .01)E-01
PR123191013	+(+8.36 +/- .02)E-01	+(+7.36 +/- .03)E-01	+(+1.21 +/- .40)E-03	+(+1.80 +/- .67)E-02	+(+9.71 +/- .16)E-02
PR123191014	+(+8.48 +/- .02)E-01	+(+7.39 +/- .03)E-01	(+1.42 +/- 4.7)E-04	+(+1.70 +/- .74)E-02	+(+6.53 +/- .19)E-01
PR123191015	+(+9.48 +/- .02)E-01	+(+8.26 +/- .03)E-01	(+7.36 +/- 5.2)E-04	(+5.34 +/- 8.6)E-03	+(+4.70 +/- .05)E-01
PR123191016	+(+9.62 +/- .03)E-01	+(+8.54 +/- .03)E-01	+(+1.01 +/- .46)E-03	(-3.60 +/- 6.5)E-03	+(+1.27 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR123191017	+(+1.01 +/- .00)E+00	+(+8.82 +/- .03)E-01	(+8.20 +/- 6.4)E-04	(+6.68 +/- 8.0)E-03	+(+1.15 +/- .01)E-01
PR123191018	+(+1.04 +/- .00)E+00	+(+9.11 +/- .04)E-01	(+8.98 +/- 5.0)E-04	(+9.03 +/- 9.1)E-03	+(+1.01 +/- .01)E-01
PR123191019	+(+1.05 +/- .00)E+00	+(+9.29 +/- .03)E-01	(+1.04 +/- .53)E-03	+(+1.72 +/- .77)E-02	+(+8.03 +/- .08)E-02
PR123191020	+(+1.08 +/- .00)E+00	+(+9.54 +/- .04)E-01	(+8.10 +/- 5.0)E-04	+(+2.97 +/- .76)E-02	+(+7.12 +/- .08)E-02
PR123191021	+(+1.08 +/- .00)E+00	+(+9.64 +/- .04)E-01	+(+1.38 +/- .49)E-03	(+1.51 +/- .84)E-02	+(+9.31 +/- .16)E-02
PR123191022	+(+1.06 +/- .00)E+00	+(+9.58 +/- .04)E-01	+(+1.97 +/- .60)E-03	+(+1.78 +/- .73)E-02	+(+6.45 +/- .11)E-02
PR123191023	+(+1.08 +/- .00)E+00	+(+9.77 +/- .03)E-01	(+9.98 +/- 5.2)E-04	(+1.35 +/- .74)E-02	+(+8.61 +/- .15)E-02
PR123191024	+(+1.07 +/- .00)E+00	+(+9.64 +/- .03)E-01	+(+1.54 +/- .48)E-03	(+1.49 +/- .78)E-02	+(+7.07 +/- .08)E-02

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR010192001	+(+1.14 +/- .01)E-01	+(+5.37 +/- .02)E-01	+(+8.23 +/- .02)E-01	(+9.24 +/- 28.)E-05	+(+8.53 +/- .03)E-01
PR010192002	+(+1.11 +/- .00)E-01	+(+5.30 +/- .01)E-01	+(+8.08 +/- .02)E-01	(-1.19 +/- 3.3)E-04	+(+8.33 +/- .03)E-01
PR010192003	+(+1.14 +/- .01)E-01	+(+5.35 +/- .02)E-01	+(+8.16 +/- .03)E-01	(+5.03 +/- 3.7)E-04	+(+8.26 +/- .02)E-01
PR010192004	+(+1.13 +/- .01)E-01	+(+5.35 +/- .03)E-01	+(+8.35 +/- .02)E-01	(+7.55 +/- 4.4)E-04	+(+8.45 +/- .02)E-01
PR010192005	+(+1.28 +/- .01)E-01	+(+6.08 +/- .03)E-01	+(+8.75 +/- .04)E-01	(+6.64 +/- 4.1)E-04	+(+8.75 +/- .02)E-01
PR010192006	+(+1.33 +/- .00)E-01	+(+6.26 +/- .04)E-01	+(+8.32 +/- .04)E-01	(+4.00 +/- 4.8)E-04	+(+8.89 +/- .02)E-01
PR010192007	+(+1.30 +/- .01)E-01	+(+6.10 +/- .02)E-01	+(+8.16 +/- .04)E-01	(+1.90 +/- 3.5)E-04	+(+8.54 +/- .03)E-01
PR010192008	+(+1.28 +/- .01)E-01	+(+6.03 +/- .02)E-01	+(+7.90 +/- .03)E-01	(+3.21 +/- 2.9)E-04	+(+8.22 +/- .02)E-01
PR010192009	+(+1.26 +/- .01)E-01	+(+5.91 +/- .02)E-01	+(+7.69 +/- .03)E-01	(+4.21 +/- 4.4)E-04	+(+8.18 +/- .02)E-01
PR010192010	+(+1.30 +/- .01)E-01	+(+6.12 +/- .02)E-01	+(+7.99 +/- .04)E-01	(+5.78 +/- 3.9)E-04	+(+8.22 +/- .02)E-01
PR010192011	+(+1.28 +/- .00)E-01	+(+6.05 +/- .02)E-01	+(+7.95 +/- .03)E-01	(+4.67 +/- 3.6)E-04	+(+8.42 +/- .03)E-01
PR010192012	+(+1.27 +/- .01)E-01	+(+5.96 +/- .04)E-01	+(+7.91 +/- .03)E-01	(+6.17 +/- 3.4)E-04	+(+8.12 +/- .02)E-01
PR010192013	+(+1.26 +/- .00)E-01	+(+5.93 +/- .02)E-01	+(+7.85 +/- .03)E-01	(+3.74 +/- 3.9)E-04	+(+8.11 +/- .02)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR010192014	+(+1.21 +/- .01)E-01	+(+5.69 +/- .02)E-01	+(+7.80 +/- .02)E-01	(+5.64 +/- 3.9)E-04	+(+8.20 +/- .03)E-01
PR010192015	+(+1.07 +/- .01)E-01	+(+5.11 +/- .02)E-01	+(+6.86 +/- .03)E-01	(+5.71 +/- 3.6)E-04	+(+7.48 +/- .02)E-01
PR010192016	+(+9.34 +/- .05)E-02	+(+4.54 +/- .02)E-01	+(+6.04 +/- .02)E-01	(+1.57 +/- 2.5)E-04	+(+6.37 +/- .01)E-01
PR010192017	+(+8.11 +/- .03)E-02	+(+3.97 +/- .01)E-01	+(+4.72 +/- .02)E-01	(+2.10 +/- 2.3)E-04	+(+5.19 +/- .01)E-01
PR010192018	+(+7.01 +/- .03)E-02	+(+3.47 +/- .01)E-01	+(+3.88 +/- .02)E-01	(+3.24 +/- 1.8)E-04	+(+4.29 +/- .02)E-01
PR010192019	+(+6.18 +/- .04)E-02	+(+3.06 +/- .01)E-01	+(+3.28 +/- .01)E-01	+(+4.85 +/- 2.0)E-04	+(+3.44 +/- .01)E-01
PR010192020	+(+5.70 +/- .04)E-02	+(+2.83 +/- .01)E-01	+(+3.13 +/- .01)E-01	(+2.65 +/- 1.6)E-04	+(+2.99 +/- .01)E-01
PR010192021	+(+5.35 +/- .02)E-02	+(+2.65 +/- .01)E-01	+(+3.09 +/- .02)E-01	(+1.79 +/- 1.6)E-04	+(+2.89 +/- .01)E-01
PR010192022	+(+4.84 +/- .03)E-02	+(+2.42 +/- .01)E-01	+(+2.96 +/- .01)E-01	(+1.04 +/- 1.5)E-04	+(+2.77 +/- .01)E-01
PR010192023	+(+4.49 +/- .02)E-02	+(+2.24 +/- .01)E-01	+(+2.86 +/- .01)E-01	(+2.70 +/- 1.7)E-04	+(+2.70 +/- .01)E-01
PR010192024	+(+4.12 +/- .02)E-02	+(+2.04 +/- .01)E-01	+(+2.71 +/- .01)E-01	(+1.83 +/- 1.5)E-04	+(+2.57 +/- .01)E-01
PR123191001	+(+7.90 +/- .05)E-02	+(+3.70 +/- .01)E-01	+(+4.79 +/- .02)E-01	(+4.47 +/- 2.8)E-04	+(+5.13 +/- .02)E-01
PR123191002	+(+7.89 +/- .03)E-02	+(+3.76 +/- .01)E-01	+(+5.45 +/- .02)E-01	(-1.11 +/- 2.2)E-04	+(+5.50 +/- .02)E-01
PR123191003	+(+7.73 +/- .05)E-02	+(+3.68 +/- .01)E-01	+(+5.47 +/- .02)E-01	(+1.98 +/- 2.3)E-04	+(+5.58 +/- .02)E-01
PR123191004	+(+7.76 +/- .03)E-02	+(+3.66 +/- .01)E-01	+(+5.40 +/- .03)E-01	(+3.27 +/- 2.7)E-04	+(+5.53 +/- .02)E-01
PR123191005	+(+7.83 +/- .03)E-02	+(+3.71 +/- .01)E-01	+(+5.44 +/- .02)E-01	(+4.03 +/- 2.3)E-04	+(+5.67 +/- .02)E-01
PR123191006	+(+7.85 +/- .03)E-02	+(+3.77 +/- .01)E-01	+(+5.48 +/- .02)E-01	(-6.73 +/- 32.)E-05	+(+5.65 +/- .02)E-01
PR123191007	+(+8.15 +/- .04)E-02	+(+3.88 +/- .01)E-01	+(+5.08 +/- .02)E-01	(+7.87 +/- 23.)E-05	+(+5.77 +/- .02)E-01
PR123191008	+(+8.55 +/- .05)E-02	+(+4.02 +/- .01)E-01	+(+5.33 +/- .01)E-01	(+4.92 +/- 2.5)E-04	+(+5.71 +/- .02)E-01
PR123191009	+(+8.93 +/- .03)E-02	+(+4.19 +/- .01)E-01	+(+5.86 +/- .02)E-01	(+3.69 +/- 24.)E-05	+(+6.02 +/- .02)E-01
PR123191010	+(+8.88 +/- .04)E-02	+(+4.21 +/- .01)E-01	+(+6.16 +/- .02)E-01	(+3.57 +/- 3.6)E-04	+(+6.33 +/- .02)E-01
PR123191011	+(+9.18 +/- .04)E-02	+(+4.33 +/- .02)E-01	+(+6.11 +/- .02)E-01	(+5.75 +/- 3.5)E-04	+(+6.54 +/- .02)E-01
PR123191012	+(+9.11 +/- .03)E-02	+(+4.26 +/- .01)E-01	+(+5.66 +/- .03)E-01	(+5.89 +/- 3.5)E-04	+(+6.40 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR123191013	+(+9.31 +/- .07)E-02	+(+4.36 +/- .01)E-01	+(+5.78 +/- .04)E-01	(+1.15 +/- 2.7)E-04	+(+6.32 +/- .02)E-01
PR123191014	+(+9.75 +/- .06)E-02	+(+4.57 +/- .01)E-01	+(+5.90 +/- .03)E-01	(+2.16 +/- 2.9)E-04	+(+6.31 +/- .01)E-01
PR123191015	+(+1.11 +/- .01)E-01	+(+5.24 +/- .02)E-01	+(+6.98 +/- .02)E-01	(+2.43 +/- 2.7)E-04	+(+7.22 +/- .02)E-01
PR123191016	+(+1.13 +/- .01)E-01	+(+5.32 +/- .01)E-01	+(+7.20 +/- .04)E-01	(+3.66 +/- 3.8)E-04	+(+7.60 +/- .02)E-01
PR123191017	+(+1.12 +/- .01)E-01	+(+5.32 +/- .02)E-01	+(+7.58 +/- .03)E-01	(+3.93 +/- 3.5)E-04	+(+7.83 +/- .02)E-01
PR123191018	+(+1.13 +/- .01)E-01	+(+5.35 +/- .01)E-01	+(+7.88 +/- .02)E-01	(+4.54 +/- 2.8)E-04	+(+7.97 +/- .02)E-01
PR123191019	+(+1.13 +/- .01)E-01	+(+5.36 +/- .02)E-01	+(+8.05 +/- .04)E-01	(+2.93 +/- 3.2)E-04	+(+8.09 +/- .02)E-01
PR123191020	+(+1.15 +/- .01)E-01	+(+5.44 +/- .03)E-01	+(+8.32 +/- .05)E-01	(+1.40 +/- 4.1)E-04	+(+8.38 +/- .02)E-01
PR123191021	+(+1.15 +/- .01)E-01	+(+5.47 +/- .02)E-01	+(+8.44 +/- .04)E-01	(+6.79 +/- 3.6)E-04	+(+8.58 +/- .03)E-01
PR123191022	+(+1.14 +/- .01)E-01	+(+5.42 +/- .02)E-01	+(+8.41 +/- .04)E-01	(+8.49 +/- 30.)E-05	+(+8.52 +/- .03)E-01
PR123191023	+(+1.15 +/- .01)E-01	+(+5.47 +/- .02)E-01	+(+8.44 +/- .02)E-01	(+3.44 +/- 4.2)E-04	+(+8.57 +/- .03)E-01
PR123191024	+(+1.15 +/- .01)E-01	+(+5.42 +/- .03)E-01	+(+8.34 +/- .03)E-01	(+5.47 +/- 30.)E-05	+(+8.60 +/- .03)E-01

ID	XE 138	XE 139
PR010192001	+(+9.33 +/- .03)E-01	+(+9.57 +/- 1.2)E-03
PR010192002	+(+9.14 +/- .03)E-01	+(+9.30 +/- 1.1)E-03
PR010192003	+(+9.43 +/- .03)E-01	+(+1.01 +/- .12)E-02
PR010192004	+(+9.43 +/- .03)E-01	+(+9.63 +/- .91)E-03
PR010192005	+(+1.02 +/- .00)E+00	+(+1.16 +/- .12)E-02
PR010192006	+(+9.36 +/- .03)E-01	+(+9.76 +/- 1.0)E-03
PR010192007	+(+9.19 +/- .03)E-01	+(+9.60 +/- 1.1)E-03
PR010192008	+(+9.19 +/- .03)E-01	+(+9.36 +/- 1.0)E-03
PR010192009	+(+9.08 +/- .03)E-01	+(+9.47 +/- 1.1)E-03

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 138	XE 139
PR010192010	+(+9.46 +/- .04)E-01	+(+8.83 +/- 1.2)E-03
PR010192011	+(+8.96 +/- .03)E-01	+(+8.76 +/- 1.0)E-03
PR010192012	+(+9.05 +/- .03)E-01	+(+9.05 +/- .99)E-03
PR010192013	+(+9.20 +/- .03)E-01	+(+9.84 +/- 1.1)E-03
PR010192014	+(+8.80 +/- .03)E-01	+(+8.87 +/- .87)E-03
PR010192015	+(+7.42 +/- .02)E-01	+(+1.01 +/- .05)E-02
PR010192016	+(+6.19 +/- .02)E-01	+(+8.05 +/- .52)E-03
PR010192017	+(+4.89 +/- .01)E-01	+(+7.27 +/- .49)E-03
PR010192018	+(+3.94 +/- .01)E-01	+(+6.11 +/- .38)E-03
PR010192019	+(+3.30 +/- .01)E-01	+(+5.31 +/- .26)E-03
PR010192020	+(+3.17 +/- .01)E-01	+(+5.55 +/- .32)E-03
PR010192021	+(+3.21 +/- .01)E-01	+(+5.29 +/- .31)E-03
PR010192022	+(+2.99 +/- .01)E-01	+(+4.45 +/- .24)E-03
PR010192023	+(+2.95 +/- .01)E-01	+(+4.55 +/- .22)E-03
PR010192024	+(+2.75 +/- .01)E-01	+(+4.60 +/- .30)E-03
PR123191001	+(+5.95 +/- .02)E-01	+(+6.08 +/- .48)E-03
PR123191002	+(+6.41 +/- .02)E-01	+(+6.54 +/- .52)E-03
PR123191003	+(+6.24 +/- .02)E-01	+(+5.93 +/- .56)E-03
PR123191004	+(+6.24 +/- .02)E-01	+(+6.23 +/- .46)E-03
PR123191005	+(+6.44 +/- .02)E-01	+(+6.62 +/- .38)E-03
PR123191006	+(+6.56 +/- .02)E-01	+(+6.89 +/- .55)E-03
PR123191007	+(+6.16 +/- .02)E-01	+(+6.09 +/- .53)E-03
PR123191008	+(+6.54 +/- .03)E-01	+(+6.15 +/- .62)E-03

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 138	XE 139
PR123191009	+(+7.15 +/- .04)E-01	+(+6.66 +/- .64)E-03
PR123191010	+(+7.21 +/- .03)E-01	+(+7.16 +/- .62)E-03
PR123191011	+(+7.50 +/- .03)E-01	+(+6.61 +/- .59)E-03
PR123191012	+(+6.95 +/- .03)E-01	+(+6.08 +/- .58)E-03
PR123191013	+(+7.17 +/- .03)E-01	+(+7.06 +/- .43)E-03
PR123191014	+(+7.49 +/- .03)E-01	+(+7.44 +/- .59)E-03
PR123191015	+(+8.61 +/- .03)E-01	+(+1.03 +/- .08)E-02
PR123191016	+(+8.75 +/- .03)E-01	+(+9.72 +/- .59)E-03
PR123191017	+(+8.85 +/- .03)E-01	+(+1.03 +/- .07)E-02
PR123191018	+(+9.16 +/- .03)E-01	+(+1.02 +/- .07)E-02
PR123191019	+(+9.21 +/- .03)E-01	+(+1.03 +/- .07)E-02
PR123191020	+(+9.58 +/- .03)E-01	+(+1.08 +/- .06)E-02
PR123191021	+(+9.72 +/- .05)E-01	+(+1.07 +/- .08)E-02
PR123191022	+(+9.30 +/- .04)E-01	+(+1.00 +/- .09)E-02
PR123191023	+(+9.67 +/- .03)E-01	+(+1.11 +/- .10)E-02
PR123191024	+(+9.47 +/- .03)E-01	+(+1.00 +/- .11)E-02

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.

GAMMA-RAY ANALYSIS SUMMARY 7

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

COLLECTION PERIOD:
010192 TO 010592

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

26-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY Curt Wilson

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
010192 TO 010592

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR010292001	010192	PR010292001	1.00	PR100191001
PR010292002	010292	PR010292002	1.00	PR100191001
PR010292003	010292	PR010292003	1.00	PR100191001
PR010292004	010292	PR010292004	1.00	PR100191001
PR010292005	010292	PR010292005	1.00	PR100191001
PR010292006	010292	PR010292006	1.00	PR100191001
PR010292007	010292	PR010292007	1.00	PR100191001
PR010292008	010292	PR010292008	1.00	PR100191001
PR010292009	010292	PR010292009	1.00	PR100191001
PR010292010	010292	PR010292010	1.00	PR100191001
PR010292011	010292	PR010292011	1.00	PR100191001
PR010292012	010292	PR010292012	1.00	PR100191001
PR010292013	010292	PR010292013	1.00	PR100191001
PR010292014	010292	PR010292014	1.00	PR100191001
PR010292015	010292	PR010292015	1.00	PR100191001
PR010292016	010292	PR010292016	1.00	PR100191001
PR010292017	010292	PR010292017	1.00	PR100191001
PR010392001	010292	PR010392001	1.00	PR100191001
PR010392002	010392	PR010392002	1.00	PR100191001
PR010392003	010392	PR010392003	1.00	PR100191001
PR010392004	010392	PR010392004	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...
PR010392005	010392	PR010392005	1.00	PR100191001
PR010392006	010392	PR010392006	1.00	PR100191001
PR010392007	010392	PR010392007	1.00	PR100191001
PR010392008	010392	PR010392008	1.00	PR100191001
PR010492001	010392	PR010492001	1.00	PR100191001
PR010492002	010492	PR010492002	1.00	PR100191001
PR010492003	010492	PR010492003	1.00	PR100191001
PR010592001	010492	PR010592001	1.00	PR100191001
PR010692001	010592	PR010692001	1.00	PR100191001

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
010192 TO 010592

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR010292001	+(+4.69 +/- 1.8)E-04	+(+1.48 +/- .01)E-02	+(+8.74 +/- .18)E-02	+(+6.07 +/- .07)E-02	+(+5.85 +/- .09)E-02
PR010292002	+(+4.29 +/- 1.9)E-04	+(+1.40 +/- .01)E-02	+(+8.61 +/- .19)E-02	+(+5.97 +/- .07)E-02	+(+5.97 +/- .10)E-02
PR010292003	+(+4.45 +/- 1.7)E-04	+(+1.44 +/- .01)E-02	+(+8.51 +/- .16)E-02	+(+5.65 +/- .08)E-02	+(+6.19 +/- .12)E-02
PR010292004	+(+5.73 +/- 1.7)E-04	+(+1.39 +/- .01)E-02	+(+8.44 +/- .16)E-02	+(+5.71 +/- .08)E-02	+(+6.20 +/- .10)E-02
PR010292005	+(+8.94 +/- 1.7)E-04	+(+1.37 +/- .01)E-02	+(+8.59 +/- .19)E-02	+(+5.67 +/- .08)E-02	+(+5.83 +/- .10)E-02
PR010292006	+(+6.21 +/- 1.6)E-04	+(+1.33 +/- .01)E-02	+(+8.16 +/- .17)E-02	+(+5.41 +/- .08)E-02	+(+5.59 +/- .10)E-02
PR010292007	+(+8.02 +/- 1.6)E-04	+(+1.32 +/- .01)E-02	+(+7.85 +/- .18)E-02	+(+5.56 +/- .08)E-02	+(+5.55 +/- .09)E-02
PR010292008	+(+8.82 +/- 2.0)E-04	+(+1.33 +/- .01)E-02	+(+8.20 +/- .20)E-02	+(+5.56 +/- .08)E-02	+(+5.36 +/- .10)E-02
PR010292009	+(+8.12 +/- 1.7)E-04	+(+1.30 +/- .01)E-02	+(+8.10 +/- .20)E-02	+(+5.51 +/- .08)E-02	+(+5.35 +/- .09)E-02
PR010292010	+(+7.46 +/- 1.6)E-04	+(+1.31 +/- .01)E-02	+(+7.81 +/- .09)E-02	+(+5.26 +/- .08)E-02	+(+5.45 +/- .09)E-02
PR010292011	+(+8.06 +/- 1.4)E-04	+(+1.31 +/- .01)E-02	+(+7.69 +/- .14)E-02	+(+5.35 +/- .06)E-02	+(+5.46 +/- .08)E-02
PR010292012	+(+7.57 +/- 1.3)E-04	+(+1.28 +/- .01)E-02	+(+7.71 +/- .16)E-02	+(+5.23 +/- .07)E-02	+(+5.34 +/- .06)E-02
PR010292013	+(+7.38 +/- 1.2)E-04	+(+1.26 +/- .01)E-02	+(+7.46 +/- .11)E-02	+(+5.14 +/- .06)E-02	+(+5.26 +/- .07)E-02
PR010292014	+(+5.34 +/- 1.3)E-04	+(+1.26 +/- .01)E-02	+(+7.20 +/- .12)E-02	+(+5.06 +/- .05)E-02	+(+5.32 +/- .07)E-02
PR010292015	+(+5.76 +/- 1.1)E-04	+(+1.19 +/- .01)E-02	+(+7.10 +/- .17)E-02	+(+4.81 +/- .05)E-02	+(+5.04 +/- .10)E-02
PR010292016	+(+9.93 +/- 2.0)E-04	+(+1.17 +/- .01)E-02	+(+6.81 +/- .11)E-02	+(+4.69 +/- .06)E-02	+(+4.95 +/- .06)E-02
PR010292017	+(+5.30 +/- 1.4)E-04	+(+1.34 +/- .01)E-02	+(+6.90 +/- .09)E-02	+(+5.14 +/- .05)E-02	+(+4.84 +/- .06)E-02
PR010392001	+(+5.53 +/- 1.0)E-04	+(+1.23 +/- .01)E-02	+(+6.65 +/- .10)E-02	+(+4.79 +/- .05)E-02	+(+5.36 +/- .06)E-02
PR010392002	+(+5.97 +/- 1.0)E-04	+(+1.09 +/- .01)E-02	+(+6.28 +/- .15)E-02	+(+4.32 +/- .06)E-02	+(+4.63 +/- .06)E-02
PR010392003	+(+4.90 +/- .98)E-04	+(+1.11 +/- .01)E-02	+(+6.39 +/- .13)E-02	+(+4.40 +/- .05)E-02	+(+4.57 +/- .07)E-02
PR010392004	+(+6.20 +/- .91)E-04	+(+1.07 +/- .01)E-02	+(+6.24 +/- .13)E-02	+(+4.34 +/- .05)E-02	+(+4.38 +/- .06)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
PR010392005	+(+6.32 +/- .98)E-04	+(+1.09 +/- .01)E-02	+(+6.27 +/- .16)E-02	+(+4.33 +/- .05)E-02	+(+4.47 +/- .07)E-02
PR010392006	+(+5.89 +/- .82)E-04	+(+1.16 +/- .01)E-02	+(+6.45 +/- .10)E-02	+(+4.56 +/- .04)E-02	+(+4.69 +/- .04)E-02
PR010392007	+(+5.76 +/- .90)E-04	+(+1.05 +/- .00)E-02	+(+6.17 +/- .12)E-02	+(+4.22 +/- .03)E-02	+(+4.40 +/- .05)E-02
PR010392008	+(+3.84 +/- .50)E-04	+(+1.75 +/- .03)E-02	+(+2.26 +/- .03)E-02	+(+4.28 +/- .03)E-02	+(+9.23 +/- .06)E-02
PR010492001	+(+2.32 +/- .27)E-04	+(+2.35 +/- .01)E-02	+(+5.56 +/- .05)E-03	+(+3.72 +/- .01)E-02	+(+4.23 +/- .03)E-02
PR010492002	+(+1.61 +/- .74)E-05	+(+2.45 +/- .02)E-03	+(+9.70 +/- 1.6)E-05	+(+2.51 +/- .04)E-03	+(+3.21 +/- .08)E-03
PR010492003	(+1.91 +/- 3.9)E-06	+(+8.22 +/- .12)E-04	(+2.84 +/- 2.0)E-05	+(+5.70 +/- .23)E-04	+(+6.11 +/- .47)E-04
PR010592001	(+3.10 +/- 15.)E-07	+(+4.37 +/- .19)E-05	(-3.79 +/- 24.)E-07	(+1.43 +/- 7.4)E-06	(-8.61 +/- 9.0)E-06
PR010692001	(+2.15 +/- 1.7)E-06	(+1.31 +/- 1.8)E-06	(-1.61 +/- 3.3)E-06	(-6.25 +/- 8.9)E-06	(-2.34 +/- .95)E-05

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR010292001	+(+3.60 +/- .01)E-01	+(+3.23 +/- .01)E-01	+(+1.55 +/- .25)E-03	(-1.62 +/- 3.4)E-03	+(+2.22 +/- .05)E-02
PR010292002	+(+3.64 +/- .01)E-01	+(+3.18 +/- .01)E-01	+(+1.92 +/- .25)E-03	(+2.86 +/- 3.6)E-03	+(+1.87 +/- .04)E-02
PR010292003	+(+3.60 +/- .01)E-01	+(+3.21 +/- .01)E-01	+(+1.68 +/- .22)E-03	+(+9.69 +/- 3.8)E-03	+(+1.82 +/- .04)E-02
PR010292004	+(+3.54 +/- .01)E-01	+(+3.17 +/- .01)E-01	+(+1.87 +/- .22)E-03	+(+7.74 +/- 3.5)E-03	+(+1.68 +/- .04)E-02
PR010292005	+(+3.47 +/- .01)E-01	+(+3.11 +/- .01)E-01	+(+1.30 +/- .23)E-03	(+7.91 +/- 4.3)E-03	+(+1.72 +/- .04)E-02
PR010292006	+(+3.41 +/- .01)E-01	+(+3.03 +/- .01)E-01	+(+1.37 +/- .24)E-03	+(+9.85 +/- 3.5)E-03	+(+1.60 +/- .04)E-02
PR010292007	+(+3.32 +/- .01)E-01	+(+2.97 +/- .01)E-01	+(+2.21 +/- .27)E-03	(-9.89 +/- 38.)E-04	+(+1.48 +/- .04)E-02
PR010292008	+(+3.29 +/- .01)E-01	+(+2.90 +/- .01)E-01	+(+1.54 +/- .24)E-03	(+2.61 +/- 35.)E-04	+(+1.51 +/- .04)E-02
PR010292009	+(+3.27 +/- .01)E-01	+(+2.90 +/- .01)E-01	+(+2.16 +/- .29)E-03	(-1.04 +/- 3.2)E-03	+(+1.59 +/- .04)E-02
PR010292010	+(+3.28 +/- .01)E-01	+(+2.89 +/- .01)E-01	+(+2.22 +/- .24)E-03	+(+8.34 +/- 4.1)E-03	+(+1.51 +/- .06)E-02
PR010292011	+(+3.23 +/- .01)E-01	+(+2.86 +/- .01)E-01	+(+2.45 +/- .22)E-03	(-3.03 +/- 22.)E-04	+(+1.33 +/- .02)E-02
PR010292012	+(+3.20 +/- .01)E-01	+(+2.82 +/- .01)E-01	+(+1.81 +/- .16)E-03	+(+4.98 +/- 2.3)E-03	+(+1.26 +/- .03)E-02

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	KR 89	RB 89	KR 90	XEM 131	XE 133
PR010292013	+(+3.09 +/- .01)E-01	+(+2.75 +/- .01)E-01	+(+1.29 +/- .17)E-03	(-2.21 +/- 2.2)E-03	+(+1.25 +/- .03)E-02
PR010292014	+(+2.96 +/- .01)E-01	+(+2.65 +/- .01)E-01	+(+1.30 +/- .15)E-03	(+3.41 +/- 2.3)E-03	+(+1.26 +/- .03)E-02
PR010292015	+(+2.84 +/- .01)E-01	+(+2.51 +/- .01)E-01	+(+1.42 +/- .16)E-03	(-2.29 +/- 24.)E-04	+(+1.16 +/- .03)E-02
PR010292016	+(+2.72 +/- .01)E-01	+(+2.43 +/- .01)E-01	+(+1.42 +/- .15)E-03	(-1.50 +/- 2.0)E-03	+(+1.14 +/- .02)E-02
PR010292017	+(+2.64 +/- .01)E-01	+(+2.36 +/- .01)E-01	+(+1.85 +/- .18)E-03	(+3.72 +/- 2.1)E-03	+(+4.87 +/- .03)E-02
PR010392001	+(+2.65 +/- .01)E-01	+(+2.36 +/- .01)E-01	+(+2.00 +/- .16)E-03	(+2.94 +/- 22.)E-04	+(+3.05 +/- .03)E-02
PR010392002	+(+2.46 +/- .01)E-01	+(+2.21 +/- .01)E-01	+(+1.72 +/- .15)E-03	(+2.12 +/- 2.2)E-03	+(+1.01 +/- .03)E-02
PR010392003	+(+2.44 +/- .01)E-01	+(+2.16 +/- .01)E-01	+(+1.58 +/- .13)E-03	+(+4.56 +/- 2.0)E-03	+(+1.11 +/- .02)E-02
PR010392004	+(+2.41 +/- .01)E-01	+(+2.11 +/- .01)E-01	+(+1.56 +/- .32)E-03	(+2.54 +/- 2.0)E-03	+(+9.49 +/- .23)E-03
PR010392005	+(+2.34 +/- .01)E-01	+(+2.09 +/- .01)E-01	+(+1.53 +/- .17)E-03	+(+5.74 +/- 2.1)E-03	+(+9.38 +/- .21)E-03
PR010392006	+(+2.37 +/- .01)E-01	+(+2.11 +/- .01)E-01	+(+1.37 +/- .11)E-03	+(+4.32 +/- 1.4)E-03	+(+9.85 +/- .27)E-03
PR010392007	+(+2.37 +/- .00)E-01	+(+2.11 +/- .01)E-01	+(+1.52 +/- .12)E-03	(+1.40 +/- 1.5)E-03	+(+7.92 +/- .15)E-03
PR010392008	+(+1.05 +/- .02)E-02	+(+3.39 +/- .01)E-02	(+1.56 +/- 54.)E-06	+(+4.32 +/- 1.0)E-03	+(+3.97 +/- .05)E-01
PR010492001	(-1.29 +/- 7.2)E-05	(+3.23 +/- 3.8)E-05	(+2.63 +/- 4.7)E-05	(+8.70 +/- 7.3)E-04	+(+7.74 +/- .07)E-01
PR010492002	(-1.63 +/- 3.6)E-05	(-7.94 +/- 7.7)E-06	(+5.18 +/- 2.7)E-05	(-2.09 +/- .88)E-03	+(+1.35 +/- .02)E-01
PR010492003	(+2.62 +/- 34.)E-06	(-6.82 +/- 4.7)E-06	(+6.94 +/- 24.)E-06	(+2.43 +/- 4.4)E-04	+(+7.14 +/- .05)E-02
PR010592001	(-2.64 +/- 8.9)E-06	(+8.00 +/- 24.)E-07	(-8.45 +/- 46.)E-07	+(+1.80 +/- .53)E-04	+(+4.57 +/- .02)E-02
PR010692001	(+9.19 +/- 8.2)E-06	(+1.11 +/- 2.6)E-06	(+1.42 +/- 4.8)E-06	(+1.16 +/- .90)E-04	+(+4.64 +/- .04)E-02

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR010292001	+(+3.82 +/- .02)E-02	+(+1.90 +/- .01)E-01	+(+2.59 +/- .01)E-01	(+1.39 +/- 1.6)E-04	+(+2.44 +/- .01)E-01
PR010292002	+(+3.56 +/- .02)E-02	+(+1.79 +/- .01)E-01	+(+2.59 +/- .01)E-01	+(+4.00 +/- 1.4)E-04	+(+2.40 +/- .02)E-01
PR010292003	+(+3.31 +/- .03)E-02	+(+1.67 +/- .00)E-01	+(+2.58 +/- .01)E-01	(+1.43 +/- 1.4)E-04	+(+2.35 +/- .01)E-01

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR010292004	+(+3.14 +/- .02)E-02	+(+1.57 +/- .01)E-01	+(+2.51 +/- .01)E-01	(+2.76 +/- 1.9)E-04	+(+2.30 +/- .01)E-01
PR010292005	+(+2.90 +/- .02)E-02	+(+1.47 +/- .01)E-01	+(+2.48 +/- .01)E-01	(+2.08 +/- 1.7)E-04	+(+2.28 +/- .01)E-01
PR010292006	+(+2.71 +/- .02)E-02	+(+1.38 +/- .00)E-01	+(+2.42 +/- .01)E-01	(+2.34 +/- 1.4)E-04	+(+2.22 +/- .01)E-01
PR010292007	+(+2.56 +/- .02)E-02	+(+1.30 +/- .01)E-01	+(+2.35 +/- .01)E-01	(+1.83 +/- 1.4)E-04	+(+2.17 +/- .01)E-01
PR010292008	+(+2.44 +/- .02)E-02	+(+1.24 +/- .02)E-01	+(+2.32 +/- .01)E-01	(+2.55 +/- 1.8)E-04	+(+2.13 +/- .01)E-01
PR010292009	+(+2.33 +/- .02)E-02	+(+1.17 +/- .00)E-01	+(+2.34 +/- .02)E-01	(+1.19 +/- 1.4)E-04	+(+2.12 +/- .01)E-01
PR010292010	+(+2.21 +/- .02)E-02	+(+1.12 +/- .00)E-01	+(+2.32 +/- .01)E-01	(+2.36 +/- 1.6)E-04	+(+2.11 +/- .01)E-01
PR010292011	+(+2.07 +/- .01)E-02	+(+1.05 +/- .00)E-01	+(+2.29 +/- .01)E-01	(+9.34 +/- 9.5)E-05	+(+2.07 +/- .01)E-01
PR010292012	+(+1.89 +/- .01)E-02	+(+9.69 +/- .03)E-02	+(+2.24 +/- .01)E-01	+(+4.04 +/- 1.3)E-04	+(+2.06 +/- .01)E-01
PR010292013	+(+1.78 +/- .01)E-02	+(+9.06 +/- .03)E-02	+(+2.18 +/- .01)E-01	+(+5.47 +/- 1.1)E-04	+(+2.00 +/- .01)E-01
PR010292014	+(+1.64 +/- .01)E-02	+(+8.46 +/- .03)E-02	+(+2.10 +/- .01)E-01	+(+2.48 +/- 1.2)E-04	+(+1.94 +/- .01)E-01
PR010292015	+(+1.51 +/- .01)E-02	+(+7.80 +/- .03)E-02	+(+2.02 +/- .01)E-01	+(+2.84 +/- .90)E-04	+(+1.86 +/- .00)E-01
PR010292016	+(+1.45 +/- .01)E-02	+(+7.36 +/- .02)E-02	+(+1.96 +/- .01)E-01	+(+2.61 +/- 1.2)E-04	+(+1.80 +/- .00)E-01
PR010292017	+(+1.37 +/- .01)E-02	+(+7.08 +/- .02)E-02	+(+1.92 +/- .01)E-01	(+8.15 +/- 9.2)E-05	+(+1.75 +/- .01)E-01
PR010392001	+(+1.37 +/- .01)E-02	+(+7.10 +/- .03)E-02	+(+1.95 +/- .01)E-01	+(+2.70 +/- .96)E-04	+(+1.83 +/- .01)E-01
PR010392002	+(+1.27 +/- .01)E-02	+(+6.49 +/- .02)E-02	+(+1.80 +/- .01)E-01	(+1.25 +/- .88)E-04	+(+1.66 +/- .01)E-01
PR010392003	+(+1.21 +/- .01)E-02	+(+6.32 +/- .02)E-02	+(+1.78 +/- .01)E-01	(+1.78 +/- 1.0)E-04	+(+1.62 +/- .00)E-01
PR010392004	+(+1.16 +/- .01)E-02	+(+6.09 +/- .02)E-02	+(+1.74 +/- .01)E-01	+(+4.09 +/- .83)E-04	+(+1.59 +/- .01)E-01
PR010392005	+(+1.14 +/- .01)E-02	+(+5.94 +/- .02)E-02	+(+1.73 +/- .01)E-01	+(+2.21 +/- .87)E-04	+(+1.56 +/- .01)E-01
PR010392006	+(+1.12 +/- .01)E-02	+(+5.83 +/- .02)E-02	+(+1.73 +/- .01)E-01	(-3.68 +/- 2.4)E-03	+(+1.56 +/- .00)E-01
PR010392007	+(+1.07 +/- .01)E-02	+(+5.66 +/- .02)E-02	+(+1.72 +/- .01)E-01	+(+1.96 +/- .63)E-04	+(+1.54 +/- .00)E-01
PR010392008	+(+7.02 +/- .04)E-03	+(+8.02 +/- .16)E-03	+(+9.38 +/- .17)E-03	+(+3.52 +/- .42)E-04	+(+7.96 +/- .02)E-02
PR010492001	+(+7.40 +/- .04)E-02	+(+5.90 +/- .02)E-02	(-3.38 +/- 6.3)E-05	+(+3.91 +/- .21)E-04	+(+5.59 +/- .27)E-04

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 135	XEM 135	XE 137	CS 137	CS 138
PR010492002	+(+2.48 +/- .01)E-02	+(+4.50 +/- .02)E-02	(+4.25 +/- 25.)E-06	+(+4.03 +/- .13)E-04	(-5.15 +/- 8.1)E-06
PR010492003	+(+1.88 +/- .01)E-02	+(+3.08 +/- .01)E-02	(-4.43 +/- 2.1)E-05	+(+3.99 +/- .13)E-04	(+4.16 +/- 5.7)E-06
PR010592001	+(+3.78 +/- .01)E-03	(-1.27 +/- 2.1)E-06	(-7.23 +/- 5.5)E-06	+(+3.92 +/- .05)E-04	(-2.64 +/- 1.8)E-06
PR010692001	+(+8.85 +/- .06)E-04	(+5.39 +/- 3.0)E-06	(+2.72 +/- 7.8)E-06	+(+4.01 +/- .10)E-04	(-2.30 +/- 2.0)E-06

ID	XE 138	XE 139
PR010292001	+(+2.70 +/- .01)E-01	+(+3.85 +/- .23)E-03
PR010292002	+(+2.67 +/- .01)E-01	+(+3.81 +/- .18)E-03
PR010292003	+(+2.63 +/- .01)E-01	+(+4.06 +/- .27)E-03
PR010292004	+(+2.60 +/- .01)E-01	+(+3.72 +/- .22)E-03
PR010292005	+(+2.54 +/- .01)E-01	+(+4.01 +/- .19)E-03
PR010292006	+(+2.49 +/- .01)E-01	+(+4.07 +/- .25)E-03
PR010292007	+(+2.44 +/- .01)E-01	+(+3.39 +/- .19)E-03
PR010292008	+(+2.41 +/- .01)E-01	+(+3.51 +/- .17)E-03
PR010292009	+(+2.39 +/- .01)E-01	+(+3.39 +/- .24)E-03
PR010292010	+(+2.37 +/- .01)E-01	+(+3.41 +/- .23)E-03
PR010292011	+(+2.34 +/- .01)E-01	+(+3.55 +/- .24)E-03
PR010292012	+(+2.28 +/- .01)E-01	+(+3.35 +/- .15)E-03
PR010292013	+(+2.24 +/- .00)E-01	+(+3.42 +/- .19)E-03
PR010292014	+(+2.17 +/- .00)E-01	+(+3.24 +/- .16)E-03
PR010292015	+(+2.08 +/- .01)E-01	+(+2.99 +/- .12)E-03
PR010292016	+(+2.02 +/- .01)E-01	+(+2.87 +/- .19)E-03
PR010292017	+(+1.99 +/- .00)E-01	+(+2.52 +/- .17)E-03

NPR-1A Fuel Test On-Line Spectrometer Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XE 138	XE 139
PR010392001	+(+2.01 +/- .01)E-01	+(+2.89 +/- .20)E-03
PR010392002	+(+1.83 +/- .00)E-01	+(+2.53 +/- .27)E-03
PR010392003	+(+1.82 +/- .00)E-01	+(+2.56 +/- .28)E-03
PR010392004	+(+1.79 +/- .00)E-01	+(+2.63 +/- .23)E-03
PR010392005	+(+1.76 +/- .01)E-01	+(+2.40 +/- .31)E-03
PR010392006	+(+1.78 +/- .00)E-01	+(+2.49 +/- .16)E-03
PR010392007	+(+1.74 +/- .00)E-01	+(+2.74 +/- .11)E-03
PR010392008	+(+1.83 +/- .02)E-02	+(+2.46 +/- .51)E-04
PR010492001	(-3.42 +/- 4.6)E-05	(-4.98 +/- 3.8)E-05
PR010492002	(+1.77 +/- 2.9)E-05	(-1.07 +/- 23.)E-06
PR010492003	(+3.44 +/- 3.0)E-05	(-4.14 +/- 16.)E-06
PR010592001	(+6.09 +/- 4.1)E-06	(-2.77 +/- 2.9)E-06
PR010692001	(+3.13 +/- 4.5)E-06	(+5.40 +/- 29.)E-07

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.

APPENDIX D

RADIONUCLIDE CONCENTRATIONS DETERMINED ANALYZING GAS GRAB SAMPLES

GAMMA-RAY ANALYSIS SUMMARY 1

NPR-1A Fuel Test Grab Sample Radionuclide Concentrations

COLLECTION PERIOD:
100291 TO 102591

PREPARED BY THE
RADIATION MEASUREMENTS LABORATORY

26-MAR-92

EG&G IDAHO INC.
IDAHO NATIONAL ENGINEERING LABORATORY
IDAHO FALLS, IDAHO

CHECKED BY Thom Sorensen

APPROVED BY Geo V McDonnell

NPR-1A Fuel Test Grab Sample Radionuclide Concentrations

SAMPLE INFORMATION

FOR THE PERIOD
100291 TO 102591

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...		
a1100291042	100291	A1100291042	150.00	a1090291030	a1100391029	a1110191024
a1100391024	100391	A1100391024	150.00	a1090291030	a1100391029	a1110191024
a1100491022	100491	A1100491022	150.00	a1090291030	a1100391029	a1110191024
a1100491025	100391	A1100491025	150.00	a1090291030	a1100391029	a1110191024
a1100791030	100791	A1100791030	150.00	a1090291030	a1100391029	a1110191024
a1100791033	100491	A1100791033	150.00	a1090291030	a1100391029	a1110191024
a1100891025	100891	A1100891025	150.00	a1090291030	a1100391029	a1110191024
a1100991021	100991	A1100991021	150.00	a1090291030	a1100391029	a1110191024
a1101091021	101091	A1101091021	150.00	a1090291030	a1100391029	a1110191024
a1101091023	100791	A1101091023	150.00	a1090291030	a1100391029	a1110191024
a1101191033	100891	A1101191033	150.00	a1090291030	a1100391029	a1110191024
a1101491031	100991	A1101491031	150.00	a1090291030	a1100391029	a1110191024
a1101591032	101091	A1101591032	150.00	a1090291030	a1100391029	a1110191024
a1101891024	101891	A1101891024	150.00	a1090291030	a1100391029	a1110191024
a1102191030	102191	A1102191030	150.00	a1090291030	a1100391029	a1110191024
a1102191038	101891	A1102191038	150.00	a1090291030	a1100391029	a1110191024
a1102291029	102291	A1102291029	150.00	a1090291030	a1100391029	a1110191024
a1102391031	102391	A1102391031	150.00	a1090291030	a1100391029	a1110191024
a1102491025	102491	A1102491025	150.00	a1090291030	a1100391029	a1110191024
a1102491034	102191	A1102491034	150.00	a1090291030	a1100391029	a1110191024
a1102591025	102291	A1102591025	150.00	a1090291030	a1100391029	a1110191024

NPR-1A Fuel Test Grab Sample Radionuclide Concentrations

SAMPLE INFORMATION CONTINUED

ID	COLLECTION DATE	LAB SAMPLE ID	SAMPLE SIZE (CC)	LAB BACKGROUND ID(S)...		
a1102891048	102391	A1102891048	150.00	a1090291030	a1100391029	a1110191024
a1102991031	102491	A1102991031	150.00	a1090291030	a1100391029	a1110191024
a1103091023	102591	A1103091023	150.00	a1090291030	a1100391029	a1110191024

NPR-1A Fuel Test Grab Sample Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC)

FOR THE PERIOD
100291 TO 102591

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
a1100291042	+(+5.26 +/- .03)E-02	+(+1.49 +/- .03)E-05	+(+7.06 +/- .41)E-05	+(+5.97 +/- .09)E-05	(-1.70 +/- .97)E-04
a1100391024	+(+1.51 +/- .01)E-02	+(+5.77 +/- .08)E-05	+(+2.31 +/- .03)E-04	+(+2.10 +/- .02)E-04	(-9.77 +/- 69.)E-06
a1100491022	+(+7.97 +/- .07)E-03	+(+5.15 +/- .06)E-05	+(+2.01 +/- .03)E-04	+(+1.84 +/- .02)E-04	+(+8.67 +/- 3.4)E-05
a1100491025	-	+(+5.85 +/- .20)E-05	-	-	-
a1100791030	+(+3.85 +/- .03)E-03	+(+4.87 +/- .09)E-05	+(+1.91 +/- .02)E-04	+(+1.74 +/- .02)E-04	+(+5.09 +/- 1.5)E-05
a1100791033	-	-	-	-	-
a1100891025	+(+3.03 +/- .04)E-03	+(+4.22 +/- .06)E-05	+(+1.70 +/- .02)E-04	+(+1.55 +/- .02)E-04	+(+3.56 +/- 1.8)E-05
a1100991021	+(+2.81 +/- .03)E-03	+(+4.44 +/- .06)E-05	+(+1.76 +/- .02)E-04	+(+1.54 +/- .01)E-04	+(+8.68 +/- 1.7)E-05
a1101091021	+(+2.40 +/- .02)E-03	+(+4.19 +/- .05)E-05	+(+1.60 +/- .02)E-04	+(+1.51 +/- .02)E-04	+(+8.42 +/- 1.2)E-05
a1101091023	-	-	-	-	-
a1101191033	-	-	-	-	-
a1101491031	-	-	-	-	-
a1101591032	-	-	-	-	-
a1101891024	+(+3.94 +/- .04)E-03	+(+9.69 +/- .10)E-05	+(+3.64 +/- .04)E-04	(-3.54 +/- 4.0)E-06	+(+1.78 +/- .04)E-03
a1102191030	+(+2.70 +/- .03)E-03	+(+7.96 +/- .08)E-05	+(+2.95 +/- .02)E-04	(-9.49 +/- 6.4)E-06	+(+7.43 +/- .14)E-04
a1102191038	-	-	-	-	-
a1102291029	+(+2.97 +/- .03)E-03	+(+8.84 +/- .06)E-05	+(+3.62 +/- .03)E-04	+(+3.12 +/- .03)E-04	(-2.38 +/- .81)E-04
a1102391031	+(+2.51 +/- .03)E-03	+(+7.82 +/- .09)E-05	+(+3.02 +/- .03)E-04	+(+2.73 +/- .02)E-04	+(+1.25 +/- .23)E-04
a1102491025	+(+2.51 +/- .03)E-03	+(+8.22 +/- .12)E-05	+(+3.29 +/- .04)E-04	+(+2.91 +/- .02)E-04	(-6.24 +/- 36.)E-06
a1102491034	-	-	-	-	-
a1102591025	-	-	-	-	-

NPR-1A Fuel Test Grab Sample Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	AR 41	KRM 85	KR 87	KR 88	RB 88
a1102891048	-	-	-	-	-
a1102991031	-	-	-	-	-
a1103091023	-	-	-	-	-

ID	RB 89	KR 89	XEM 131	XE 133	XE 135
a1100291042	(-1.35 +/- 2.5)E-04	-	(-4.78 +/- 5.7)E-06	(-1.00 +/- 5.9)E-07	+(+4.04 +/- .23)E-06
a1100391024	(-4.65 +/- 6.1)E-05	-	(-7.07 +/- 4.6)E-05	(+3.60 +/- 2.3)E-06	+(+3.08 +/- .06)E-05
a1100491022	(+8.50 +/- 19.)E-06	-	(+8.83 +/- 11.)E-06	(+2.19 +/- 1.9)E-06	+(+2.55 +/- .05)E-05
a1100491025	-	-	(-2.52 +/- 3.9)E-07	+(+1.96 +/- .07)E-06	+(+3.28 +/- .03)E-05
a1100791030	(+1.04 +/- .90)E-05	(-1.22 +/- 4.6)E-04	(+4.31 +/- 8.2)E-06	+(+4.50 +/- 1.4)E-06	+(+2.24 +/- .04)E-05
a1100791033	-	-	(-6.84 +/- 4.3)E-07	+(+3.29 +/- .10)E-06	+(+3.28 +/- .41)E-05
a1100891025	(+1.08 +/- 1.1)E-05	(+8.46 +/- 18.)E-04	(+1.47 +/- .97)E-05	+(+3.14 +/- 1.3)E-06	+(+1.81 +/- .04)E-05
a1100991021	(+1.79 +/- 1.1)E-05	(-4.08 +/- 12.)E-04	(-4.59 +/- 7.1)E-06	+(+4.71 +/- 1.9)E-06	+(+1.86 +/- .04)E-05
a1101091021	(+5.49 +/- 6.6)E-06	(-3.15 +/- 2.4)E-04	(+8.66 +/- 6.9)E-06	+(+4.46 +/- 1.2)E-06	+(+1.77 +/- .04)E-05
a1101091023	-	-	(+2.27 +/- 3.6)E-07	+(+4.06 +/- .11)E-06	+(+2.26 +/- .39)E-05
a1101191033	-	-	(-1.22 +/- 3.9)E-07	+(+3.50 +/- .14)E-06	(+1.12 +/- .57)E-05
a1101491031	-	-	(-3.87 +/- 4.7)E-07	+(+3.56 +/- .12)E-06	-
a1101591032	-	-	(-3.21 +/- 4.8)E-07	+(+3.58 +/- .12)E-06	-
a1101891024	(-8.64 +/- 17.)E-06	-	(+1.03 +/- .86)E-05	+(+5.32 +/- 1.5)E-06	+(+3.14 +/- .05)E-05
a1102191030	(+5.36 +/- 7.0)E-06	(+2.43 +/- 2.6)E-04	(+1.12 +/- .79)E-05	+(+7.85 +/- 1.4)E-06	+(+3.07 +/- .04)E-05
a1102191038	-	-	(-1.12 +/- 3.9)E-07	+(+5.31 +/- .16)E-06	+(+3.75 +/- .49)E-05
a1102291029	(+4.51 +/- 3.6)E-05	-	(+3.76 +/- 8.9)E-06	+(+9.16 +/- 1.3)E-06	+(+3.26 +/- .05)E-05
a1102391031	(+1.65 +/- 1.0)E-05	-	(-5.83 +/- 9.4)E-06	+(+6.05 +/- 1.5)E-06	+(+2.98 +/- .04)E-05

NPR-1A Fuel Test Grab Sample Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	RB 89	KR 89	XEM 131	XE 133	XE 135
a1102491025	(+2.59 +/- 1.6)E-05	-	(+3.25 +/- 7.4)E-06	+(+7.88 +/- 2.0)E-06	+(+3.03 +/- .04)E-05
a1102491034	-	-	(-3.18 +/- 3.7)E-07	+(+6.16 +/- .12)E-06	+(+3.27 +/- .40)E-05
a1102591025	-	-	(-4.32 +/- 3.7)E-07	+(+7.52 +/- .24)E-06	+(+3.34 +/- .88)E-05
a1102891048	-	-	(-5.45 +/- 4.3)E-07	+(+5.95 +/- .24)E-06	-
a1102991031	-	-	(-3.06 +/- 4.2)E-07	+(+6.99 +/- .15)E-06	-
a1103091023	.-	-	(+1.67 +/- ***)E-09	+(+5.94 +/- .14)E-06	-

ID	XEM 135	CS 137	XE 137	XE 138	CS 138
a1100291042	(-5.76 +/- 5.7)E-05	+(+4.95 +/- 2.4)E-07	-	(+2.26 +/- 13.)E-05	+(+5.46 +/- .65)E-05
a1100391024	+(+4.20 +/- 1.7)E-05	+(+2.07 +/- .97)E-06	-	+(+1.68 +/- .32)E-04	(+2.08 +/- 2.1)E-05
a1100491022	+(+5.62 +/- .47)E-05	(+1.48 +/- .74)E-06	(-6.09 +/- 7.1)E-04	+(+1.78 +/- .10)E-04	+(+2.78 +/- .59)E-05
a1100491025	-	+(+3.54 +/- .23)E-07	-	-	-
a1100791030	+(+4.01 +/- .24)E-05	(+1.15 +/- .70)E-06	(+1.63 +/- 1.0)E-04	+(+1.28 +/- .05)E-04	+(+2.28 +/- .28)E-05
a1100791033	-	+(+2.25 +/- .18)E-07	-	-	-
a1100891025	+(+4.09 +/- .30)E-05	(+4.09 +/- 4.8)E-07	(+3.15 +/- 3.1)E-04	+(+1.42 +/- .06)E-04	+(+7.64 +/- 3.6)E-06
a1100991021	+(+3.70 +/- .26)E-05	(+7.29 +/- 5.8)E-07	(+1.81 +/- 2.5)E-04	+(+1.59 +/- .05)E-04	(+3.98 +/- 3.2)E-06
a1101091021	+(+2.71 +/- .19)E-05	(+4.97 +/- 4.5)E-07	(+3.46 +/- 5.8)E-05	+(+1.01 +/- .03)E-04	+(+2.99 +/- .23)E-05
a1101091023	-	+(+3.75 +/- .20)E-07	-	-	-
a1101191033	-	+(+3.35 +/- .28)E-07	-	-	-
a1101491031	-	+(+3.64 +/- .28)E-07	-	-	-
a1101591032	-	+(+2.04 +/- .18)E-07	-	-	-
a1101891024	+(+4.57 +/- .94)E-05	(+2.35 +/- 5.5)E-07	-	+(+2.15 +/- .09)E-04	(-3.14 +/- 5.9)E-06
a1102191030	+(+5.00 +/- .25)E-05	(+8.82 +/- 4.9)E-07	(+1.26 +/- 6.7)E-05	+(+1.47 +/- .04)E-04	+(+2.65 +/- .26)E-05

NPR-1A Fuel Test Grab Sample Radionuclide Concentrations

SAMPLE ACTIVITY (uCi/CC) CONTINUED

ID	XEM 135	CS 137	XE 137	XE 138	CS 138
a1102191038	-	+(+6.18 +/- .24)E-07	-	-	-
a1102291029	+(+1.11 +/- .11)E-04	(+9.18 +/- 5.7)E-07	-	+(+3.58 +/- .22)E-04	(-7.56 +/- 1.5)E-05
a1102391031	+(+5.04 +/- .31)E-05	(+5.58 +/- 5.0)E-07	(+3.78 +/- 3.7)E-04	+(+1.45 +/- .06)E-04	+(+2.84 +/- .39)E-05
a1102491025	+(+7.76 +/- .46)E-05	(-4.66 +/- 4.7)E-07	-	+(+2.77 +/- .09)E-04	(-1.98 +/- .62)E-05
a1102491034	-	+(+6.52 +/- .24)E-07	-	-	-
a1102591025	-	+(+8.11 +/- .26)E-07	-	-	-
a1102891048	-	+(+8.53 +/- .26)E-07	-	-	-
a1102991031	-	+(+5.40 +/- .22)E-07	-	-	-
a1103091023	-	+(+6.87 +/- .24)E-07	-	-	-

NOTE: a plus sign before a parenthesis "+(" indicates the activity is greater than 2 standard deviations, i.e. true positive.