CALORIMETRY EXCHANGE PROGRAM

ANNUAL DATA REPORT

FOR 1991

EG&G MOUND APPLIED TECHNOLOGIES

P.O. BOX 3000 MIAMISBURG, OHIO 45343-3000 513-865-4020

operated for the UNITED STATES DEPARTMENT OF ENERGY Contract No. DE-AC04-88-DP43495

MASTER

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The Calorimetry Sample Exchange Program

The goals of the Calorimetry Sample Exchange Program are:

1. Discuss measurement differences
2. Review and improve analytical measurements and methods
3. Discuss new measurement capabilities
4. Provide data to DOE on measurement capabilities to evaluate shipper-receiver differences
5. Provide characterized or standard materials as necessary for exchange participants
6. Provide a measurement control program for plutonium analysis

A sample of PuO₂ powder is available at each participating site for NDA measurement, including either or both calorimetry and high-resolution gamma-ray spectroscopy, the elements which are typically combined to provide a calorimetric assay of plutonium. The facilities measure the sample as frequently and to the level of precision which they desire, and then submit the data to the Exchange for analysis. Statistical tests are used to evaluate the data and to determine if there are significant differences from accepted values for the exchange sample or from data previously reported by that facility. This information is presented, in the form of a quarterly report, intended for use by Exchange participants in measurement control programs, or to indicate when bias corrections may be appropriate. No attempt, however, has been made to standardize methods or frequency of data collection, calibration, or operating procedures. Direct comparisons between laboratories may, therefore, be misleading since data have not been collected to the same precision or for the same time periods.

A meeting of the participants of the Calorimetry Exchange is held annually at EG&G Mound Applied Technologies. The purposes of this meeting are to discuss measurement differences, problems, and new measurement capabilities, and to determine the additional activities needed to fulfill the goals of the Exchange.

NOTE: The next Calorimetry Exchange Program Annual Meeting is scheduled for April 28 - 29, 1993 at EG&G Mound Applied Technologies.

DISCLAIMER

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**SUMMARY TABLE**

**% DIFFERENCE FROM ACCEPTED VALUES FOR THE CALORIMETRY EXCHANGE SAMPLE**

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<thead>
<tr>
<th>POWER</th>
<th>LIVERMORE</th>
<th>LOS ALAMOS</th>
<th>MOUND</th>
<th>HANFORD</th>
<th>ROCKY</th>
<th>FLATS</th>
<th>SAVANNAH RIVER</th>
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**No data was reported for this measurement.**
## RESULTS OF ANALYSIS OF POWER DATA

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LAWRENCE LIVERMORE NATIONAL LABORATORY
CALORIMETER DATA 1991

Measured/Accepted vs. Date
# Calorimeter Data 1991

Los Alamos National Laboratory

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<th>WHO</th>
<th>RFP</th>
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EG&G MOUND
P-EFFECTIVE 1991

Measured/Accepted

Date
RESULTS OF ANALYSIS OF 238-Pu/239-Pu DATA

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238-Pu/239-Pu 1991

Los Alamos National Laboratory
### RESULTS OF ANALYSIS OF 240-Pu/239-Pu DATA

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LAWRENCE LIVERMORE NATIONAL LABORATORY
240-Pu/239-Pu 1991

Measured/Accepted

Date

8-Jan-91
14-Jan-91
23-Jan-91
14-Feb-91
22-Feb-91
5-Mar-91
10-Apr-91
3-May-91
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18-Nov-91
19-Nov-91
20-Nov-91
21-Nov-91
25-Nov-91
10-Dec-91
WESTINGHOUSE HANFORD
240-PU/239-PU 1991
## RESULTS OF ANALYSIS OF 241-Pu/239-Pu DATA

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<th>LLNL</th>
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<th>WHO</th>
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## RESULTS OF ANALYSIS OF 241-Am/239-Pu DATA

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<td>-0.09%</td>
<td>-0.99%</td>
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41-AM/239-Pu 1991

ECBC ROCKY FLATS - ANALYTICAL LAB
### RESULTS OF ANALYSIS OF PERCENT 238-Pu DATA

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<th>WHO</th>
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<th>SRS</th>
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<td>0.0005%</td>
<td>0.0005%</td>
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<td>0.0005%</td>
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<td>Std. Dev. (%)</td>
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<td>9.70%</td>
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<td>4.87%</td>
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EC&G MOUND
PERCENT 238-Pu 1991

Measured/Accepted

Date

## RESULTS OF ANALYSIS OF PERCENT 239-Pu DATA

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<td>0.0770%</td>
<td>0.1719%</td>
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<td>0.0389%</td>
<td>0.1053%</td>
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<td>0.0177%</td>
<td>0.0104%</td>
<td>0.0026%</td>
<td>0.0179%</td>
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Date

1991

LOS ALAMOS NATIONAL LABORATORY

PERCENT 239-PU 1991

21-Feb-91
21-Feb-91
21-Feb-91
25-Feb-91
27-Feb-91
4-Mar-91
7-Mar-91
15-Mar-91
22-Mar-91
26-Mar-91
3-Apr-91
24-Apr-91
1-May-91
8-May-91
15-May-91
29-May-91
5-Jun-91
27-Jun-91
7-Aug-91
14-Aug-91
30-Aug-91
4-Sep-91
18-Sep-91
25-Sep-91
25-Sep-91
2-Oct-91
4-Oct-91
9-Oct-91
9-Oct-91
16-Oct-91
23-Oct-91
30-Oct-91
30-Oct-91
6-Nov-91
12-Nov-91
18-Nov-91
27-Nov-91
3-Dec-91
10-Dec-91
18-Dec-91
23-Dec-91
23-Dec-91
# RESULTS OF ANALYSIS OF PERCENT 240-Pu DATA

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<th>WHO</th>
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</thead>
<tbody>
<tr>
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<td>****</td>
<td>-0.0147%</td>
<td>-0.0153%</td>
<td>-0.0186%</td>
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<td>-0.0472%</td>
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<td>0.0280%</td>
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<td>0.0644%</td>
<td>0.0385%</td>
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<td>0.0172%</td>
<td>0.0117%</td>
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### RESULTS OF ANALYSIS OF PERCENT 241-Pu DATA

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<th>WHO</th>
<th>RFP</th>
<th>SRS</th>
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<tbody>
<tr>
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<td>**** -0.0011%</td>
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<td>-0.0006%</td>
<td>-0.0018%</td>
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<td><strong>Std. Dev. (weight %)</strong></td>
<td>**** 0.0012%</td>
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<td>0.0007%</td>
<td>0.0007%</td>
<td>0.0015%</td>
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<tr>
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<td>0.0001%</td>
<td>0.0003%</td>
<td>0.0001%</td>
<td>0.0004%</td>
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<td><strong>Mean Error (%)</strong></td>
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<td>-0.31%</td>
<td>-0.90%</td>
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<td><strong>Std. Dev. (%)</strong></td>
<td>**** 0.55%</td>
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<td>0.35%</td>
<td>0.35%</td>
<td>0.72%</td>
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<td><strong>Unc. in Mean (%)</strong></td>
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<td>0.15%</td>
<td>0.03%</td>
<td>0.20%</td>
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EG&G MOUND
PERCENT 241-PU 1991

Date
16-Jan-91  6-Feb-91  7-Feb-91  8-Feb-91  9-Mar-91  10-Mar-91  11-Mar-91  12-Mar-91
29-Mar-91  30-Mar-91  31-Mar-91  1-Apr-91  2-Apr-91  3-Apr-91  4-Apr-91  5-Apr-91
6-Apr-91  7-Apr-91  8-Apr-91  9-Apr-91  10-Apr-91  11-Apr-91  12-Apr-91  13-Apr-91
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1-Jun-91  2-Jun-91  3-Jun-91  4-Jun-91  5-Jun-91  6-Jun-91  7-Jun-91  8-Jun-91
3-Jul-91  4-Jul-91  5-Jul-91  6-Jul-91  7-Jul-91  8-Jul-91  9-Jul-91  10-Jul-91
4-Aug-91  5-Aug-91  6-Aug-91  7-Aug-91  8-Aug-91  9-Aug-91  10-Aug-91  11-Aug-91
28-Aug-91  29-Aug-91  30-Aug-91  31-Aug-91  1-Sep-91  2-Sep-91  3-Sep-91  4-Sep-91
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31-Oct-91  1-Nov-91  2-Nov-91  3-Nov-91  4-Nov-91  5-Nov-91  6-Nov-91  7-Nov-91
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18-Dec-91  19-Dec-91  20-Dec-91  21-Dec-91  22-Dec-91  23-Dec-91  24-Dec-91  25-Dec-91
26-Dec-91  27-Dec-91  28-Dec-91  29-Dec-91  30-Dec-91

Measured/Accepted
0.900  0.920  0.940  0.960  0.980  1.000  1.020  1.040  1.060  1.080

EG&G MOUND
PERCENT 241-PU 1991
**RESULTS OF ANALYSIS OF PERCENT 241-Am DATA**

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<th>MOUND</th>
<th>WHO</th>
<th>RFP</th>
<th>SRS</th>
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<td>****</td>
<td>-0.0028%</td>
<td>-0.0016%</td>
<td>-0.0001%</td>
<td>-0.0018%</td>
<td>-0.0027%</td>
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<td>0.0003%</td>
<td>0.0016%</td>
<td>0.0007%</td>
<td>0.0008%</td>
<td>0.0023%</td>
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<td>0.0002%</td>
<td>0.0003%</td>
<td>0.0001%</td>
<td>0.0004%</td>
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<td>-1.64%</td>
<td>-0.96%</td>
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<td>-1.05%</td>
<td>-1.54%</td>
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<td>Std. Dev. (%)</td>
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<td>0.20%</td>
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<td>0.42%</td>
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<td>Unc. in Mean (%)</td>
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<td>0.05%</td>
<td>0.14%</td>
<td>0.16%</td>
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<td>0.26%</td>
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<td>74</td>
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CALORIMETRY EXCHANGE SAMPLE ON 01/01/89

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<tr>
<th>Isotope</th>
<th>PPM Isotope / 239-Pu</th>
<th>% Isotope / Pu</th>
<th>% Uncertainty *</th>
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<tr>
<td>238-Pu</td>
<td>101</td>
<td>0.00944</td>
<td>0.6</td>
</tr>
<tr>
<td>239-Pu</td>
<td>1,000,000</td>
<td>93.8676</td>
<td>0.003</td>
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<tr>
<td>240-Pu</td>
<td>62,168</td>
<td>5.8600</td>
<td>0.06</td>
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<tr>
<td>241-Pu</td>
<td>2471</td>
<td>0.2338</td>
<td>0.57</td>
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<tr>
<td>242-Pu</td>
<td>306</td>
<td>0.0291</td>
<td>5.0</td>
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<tr>
<td>241-Am</td>
<td>1509</td>
<td>0.1429</td>
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Power = 0.9759 Watts +/- 0.07%
P-effective = 2.450 mW/g +/- 0.05%

* Uncertainties shown for Pu isotopes are one standard deviation, as found using the data reported by four labs which made the reference measurements on the sample in 1982.

CONSTANTS

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<th>Decay Constant (day)**</th>
<th>Specific Power (W/g)</th>
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<td>4.3768E-06</td>
<td>0.11420</td>
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** Reference: ANSI 15.22-1987 (Plutonium Bearing Solids - Calibration Techniques for Calorimetric Assay), page 22 (Table 4)
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<tr>
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<th>Institute</th>
<th>Address 1</th>
<th>Address 2</th>
<th>City, State, Zip</th>
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<tr>
<td>Chris Ortel</td>
<td></td>
<td>EG&amp;G Rocky Flats</td>
<td>Bldg. 750</td>
<td>P.O. Box 464</td>
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<tr>
<td>Larry Navratil</td>
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<td>Louis Perez</td>
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<td>P.O. Box 5400</td>
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<td>John West</td>
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