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COMPUTER CODES FOR PROCESSING DATA FROM COAL-FIRED POWER PLANTS

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CONTENTS

Abstract	1
Introduction.	1
Input Files	2
Execution of Programs.	9
PROGE	9
PROGX	13
PROGW	15
FM77.	15
FM78.	15
References	19

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807

COMPUTER CODES FOR PROCESSING DATA FROM COAL-FIRED POWER PLANTS

ABSTRACT

Computer codes are used to assist the reduction of data from the LLL project assessing emissions of coal-fired power plants. Five programs — PROGE, PROGX, PROGW, FM77, and FM78 — have been developed recently to sort, reduce, and display data acquired from cascade impactor samples. The data include elemental concentrations, enrichment factors, standard deviations, weighted averages, and unit conversions. The procedures required to run these programs are given in this report.

INTRODUCTION

The Environmental Research Division of LLL employs a series of computer codes to assist the reduction of data collected from coal-fired power plants. The two computer codes, NADAC and MERGE, are used to process instrumental data from neutron activation analyses.¹ The gamma spectral analysis of the activated samples is accomplished with the spectral resolution code, GAMANAL.² NADAC converts the disintegration rate data provided by GAMANAL to the elemental concentration values. Program code MERGE combines the results of each analysis and gives the weighted average values for each element and each sample.

Five computer program codes — PROGE, PROGX, PROGW, FM77, and FM78 — were developed to sort and reduce the source data and to provide convenient displays. This report outlines the necessary procedure to run these programs on the LLL time-shared CDC 7600* computer. Code PROGE provides a comprehensive summary of element concentration and enrichment factor values given for impactor sample stages. Code PROGX gives a summary of element concentration values determined for bulk-type samples (e.g., coal, bottom ash, fly ash, filter). Code PROGW generates a summary of enrichment factor values for the bulk-type samples. Code FM77 provides a summary of weighted average values, reported for

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five different conversion units and given for a series of univariate samples as summarized by PROGX. Code FM78 furnishes a summary of enrichment factor values for univariate samples.

INPUT FILES

PROGE, PROGX, PROGW, FM77, and FM78 are LRLTRAN codes compiled with the CHAT compiler on the CDC 7600 computer. Controllee program files (programs capable of execution) for each code are available to the user³ with the teletype (TTY) line,

```
ELF / T V
.RDS .571200:B-PROGE
          B-PROGX
          B-PROCW
          B-FM77
          B-FM78
```

The flow charts shown in Fig. 1 illustrate the linkage connecting this series of codes.

The input to PROGE, PROGX, and PROGW consists of the output from the GAMANAL, NADAC, and MERGE codes. The input data are the results of neutron activation, atomic absorption, and x-ray fluorescence analyses of more than 40 elements. Accumulated MERGE output files (files related to the coal-fired power plant study) are saved on the LLL Photostore system and are available to the user⁴ by the TTY line,

```
ELF / T V
.RDS .728800:FILEn
```

MERGE output file names are represented here by the file name FILEn; the card-image format is shown in Table 1. In codes PROGE, PROGX, and PROGW, the desired subsets of the data files (FILEn) are chosen and manipulated with the contents of a directory file, designated as FILEA. FILEA consists of one card per sample (see Table 2 for the card-image format). Each card in FILEA relates a sample number code, the type of device code, and the field trip code with the same codes in FILEn.

Table 1. Card-image format of MERGE output files (FILEn).

IBM card column	Description
1-6	Sample-serial-number code
7-10 ^a	Field-trip code
11-16 ^a	Sample-type code
17-19 ^a	Type-of-device code
20-22 ^a	Sample-number code
24-25 ^a	Impactor stage number
26	Coated or uncoated (C, L, or U)
28 ^a	Location (e.g., inlet, outlet, aircraft, ee)
29 ^a	Unit
30 ^a	Unit section (A, B, or C)
32-36	Time of day
38-43	Date (YYMMDD)
44-53 ^a	Experimental value in $\mu\text{g}/\text{X}$ (X = units, column 68-69)
54-63 ^a	Standard deviation of value
65-66 ^a	Chemical symbol
68-69	Normalizer for value, 1 = g, 12 = ft^3
72	Machine used for NADAC computation
73-80	Date of computation

^aData used by the programs in this report.

Data manipulations controlled in FILEA are:

- Correction of back-up filter mass for particle bounce-off.
- Conversion to different units (e.g., $\mu\text{g}/\text{ft}^3$ to mg/MWh).
- Normalization of impactor stage data to the log interval. FILEA also provides the bounce-off multiplier,⁵ the standard deviation, and the unit conversion multiplier.

When the log interval corrected option is selected in PROGE, the FILEA requires an extra card after each sample number code. This extra card provides each impactor stage with the appropriate log interval correction number. The concentration value for each impactor stage is multiplied by the reciprocal of

Table 2. Card-image format for FILEA input.

IBM card column	Input to PROGE	Input to PROGX, PROGW
1-4	Field-trip code	Blank
5-7	Type-of-device code	Type-of-device code
8-10	Sample-number code	Sample-number code
11-20	Bounce-off multiplier	Unit-conversion multiplier
21-30	Standard deviation	Standard deviation
31-40	Unit-conversion multiplier	

Following each of the above cards, a second card is required when the log interval corrected option⁴ is selected in PROGE.

1-5	Log interval correction factor
6-10	
↓	Log interval correction factor
75-80	

the log interval correction number for that particular stage. This log interval is the difference of the log midpoints between the impactor stages above and below the stage of interest. When enrichment factors must be calculated, PROGE or PROGW are used to provide a normalizing file such as FC01COAL. The normalizing file (in this case, FC01COAL) consists of the average concentration and standard deviation values for each chemical element in a series of coal samples for the field trip code (in this case, FC01). The values given in FC01COAL represent the base normalizer in the enrichment calculation for programs PROGE and PROGW. The enrichment factor, EF, is obtained by

$$EF = \frac{C_i / C_j}{C'_i / C'_j},$$

where C_i is the concentration value of chemical element i in the sample, C_j is the concentration value of normalizing chemical element j in the sample, C'_i

is the concentration value of chemical element i in the normalizing material, C_j' is the concentration value of normalizing chemical element j in the normalizing material.

An example of the FC01COAL file is given in Fig. 2. PROGX generates the FC01COAL that labels the file with the field-trip code (i.e., FC01) and the sample-type code (i.e., COAL).

FM77 and FM78 allow averaging of individual impactor summations and filter samples as desired. They also provide a statistical summary and unit conversion. FM78 can be used to compute enrichment factors for the individual impactor or filter samples. The input files of FM77 are of the form FC01 shown in Fig. 3. FC01 consists of the sample concentration and standard deviation values for all chemical elements as listed for each type-of-device code and sample-number code given in FILEA.

PROGX generates the FC01 file for input to programs FM77 and FM78. The FC01 labels the file by the field-trip code FC01; other label information appearing on each card includes the type-of-device code and the sample-number code. FC01 is divided into individual files by each of the above codes with the utility routine TRIX AC.⁶ Selected individual files from FC01 serve as input for programs FM77 and FM78.

To obtain the appropriate impactor summation file for input FM77 or FM78, PROGE must be used first to generate the IMPCnn file. This file name indicates impactor samples (IMPC) with nn, a random number taken from the computer's seconds-clock counter. IMPCnn has the same format as FILEn and includes the sums and standard deviations of all impactor stages for each sample-number code and chemical element. IMPCnn is then entered into PROGX. PROGX chooses the desired samples and creates the FC01 file suitable for input into FM77 or FM78 as described above.

The necessary sample identification and conversion coefficients are entered into FM77 using FILEB. The card format for FILEB is shown in Table 3. Each card in FILEB consists of the field-trip code, the type-of-device code, the sample-number code, and five unit-conversion multipliers.

AL	2.95E+04	2.39E+03
AS	3.93E+00	3.21E+00
BA	4.20E+02	1.67E+02
BR	-9.20E+00	5.17E-01
CA	5.62E+03	8.62E+02
CE	2.70E+01	1.96E+00
CL	4.54E+00	4.88E+01
CO	2.08E+00	2.15E-01
CR	7.02E+00	1.28E+00
CS	7.24E-01	1.61E-01
UY	1.60E+00	9.23E-02
EU	2.61E-01	1.79E-02
FE	6.47E+03	5.70E+02
GA	8.48E+00	1.25E+00
HF	2.38E+00	1.11E-01
HG	1.25E+01	2.53E+01
IN	3.86E-02	6.24E-03
K	1.73E+03	2.61E+02
LA	1.34E+01	8.12E-01
LU	2.08E-01	6.98E-02
MG	2.24E+03	7.53E+02
MO	2.52E+00	5.15E-01
MN	6.02E+01	1.99E+01
NA	2.93E+03	2.48E+02
ND	1.05E+01	1.07E+00
RB	1.21E+01	1.83E+00
SB	6.14E-01	9.52E-02
SC	2.98E+00	1.95E-01
SE	1.74E+00	2.51E-01
SM	1.81E+00	1.59E-01
SR	9.77E+01	8.29E+00
TA	5.13E-01	5.61E-02
TB	2.22E-01	2.35E-02
TH	6.21E+00	6.71E-01
TI	1.23E+03	1.76E+02
U	2.12E+00	2.53E-01
UF	3.74E+00	1.66E+00
V	2.49E+01	3.08E+00
W	-1.52E-01	9.82E-02
YB	8.35E-01	6.30E-02
ZN	1.64E+01	3.22E+00
ZR	6.67E+01	9.78E+00

Fig. 2. FC01COAL file generated by PROGX.

AL	3.34E+04	9.03E+02	FC03	001***
AS	3.46E+00	1.18E-01	FC03	001
BA	2.88E+02	6.24E+00	FC03	001
BR	-9.59E+00	1.51E+00	FC03	001
CA	4.40E+03	7.07E+02	FC03	001
CE	2.86E+01	4.88E-01	FC03	001
CL	3.03E+01	3.73E+01	FC03	001
CO	2.38E+00	3.58E-02	FC03	001
CR	6.61E+00	4.54E-01	FC03	001
CS	9.25E-01	3.15E-02	FC03	001
DY	1.67E+00	6.13E-02	FC03	001
EU	2.76E-01	7.02E-03	FC03	001
FE	6.81E+03	7.46E+01	FC03	001
GA	8.75E+00	5.51E-01	FC03	001
HF	2.41E+00	4.31E-02	FC03	001
IN	4.05E-02	7.05E-03	FC03	001
K	1.84E+03	7.81E+01	FC03	001
LA	1.38E+01	1.38E-01	FC03	001
LU	2.35E-01	9.64E-03	FC03	001
MG	1.20E+03	9.80E+02	FC03	001
MO	2.82E+00	6.13E-01	FC03	001
MN	4.65E+01	7.07E-01	FC03	001
NA	3.03E+03	3.03E+01	FC03	001
ND	1.21E+01	6.18E-01	FC03	001
RB	1.51E+01	1.32E+00	FC03	001
SB	6.61E-01	2.95E-02	FC03	001
SC	3.22E+00	2.81E-02	FC03	001
SE	2.14E+00	1.61E-01	FC03	001
SM	1.98E+00	3.61E-02	FC03	001
SR	1.01E+02	9.19E+00	FC03	001
TA	5.63E-01	2.37E-02	FC03	001
TB	2.53E-01	1.19E-02	FC03	001
TH	6.88E+00	6.75E-02	FC03	001
TI	1.34E+03	1.72E+02	FC03	001
U	2.39E+00	5.38E-02	FC03	001
UF	3.74E+00	1.66E+00	FC03	001
W	-1.15E-01	1.09E-01	FC03	001
YB	8.57E-01	2.72E-02	FC03	001
ZN	2.06E+01	2.75E+00	FC03	001
ZR	5.77E+01	1.60E+01	FC03	001
AL	2.86E+04	8.61E+02	FC03	002***
AS	4.00E+00	1.16E-01	FC03	002
BA	2.74E+02	7.55E+00	FC03	002
BR	-9.60E+00	1.51E+00	FC03	002
CA	5.73E+03	6.21E+02	FC03	002
CE	2.93E+01	4.45E-01	FC03	002
CL	4.79E+01	1.73E+01	FC03	002
CO	2.19E+00	3.52E-02	FC03	002
CR	6.93E+00	4.03E-01	FC03	002
CS	8.70E-01	2.87E-02	FC03	002
DY	1.60E+00	1.03E-01	FC03	002
EU	2.75E-01	6.71E-03	FC03	002
FE	6.89E+03	6.87E+01	FC03	002
GA	9.10E+00	6.48E-01	FC03	002
HF	2.35E+00	3.74E-02	FC03	002
IN	3.30E-02	2.53E-03	FC03	002
K	1.72E+03	8.52E+01	FC03	002
LA	1.45E+01	1.43E-01	FC03	002
LU	2.37E-01	8.77E-03	FC03	002
MG	1.99E+03	3.48E+02	FC03	002

Fig. 3. FC01 file with sample concentration and standard deviation values for all chemical elements listed by the field-trip code, the type-of-device code, and the sample-number code.

Table 3. Card-image format for FILEB input.

IBM card column	Description
1-4	Field-trip code
5-7	Type-of-device code
8-10	Sample-number code
11-20	Conversion factor, $\mu\text{g}/\text{ft}^3$
21-30	Conversion factor, g/h
31-40	Conversion factor, mg/MWh
41-50	Conversion factor, grain/MBtu
51-60	Conversion factor, ng/J

EXECUTION OF PROGRAMS

PROGE

PROGE may be executed by the user at the teletype (TTY) with the line:

PROGE FILEA OPT S1 S2 N / T V

FILEA is as described in the preceding section (Table 2) and OPT is any one of the option numbers defined in Table 4. Also, S1 is any output file name shown in Figs. 4 and 5, S2 is any output file name shown in Fig. 6, and N is the number of impactor stages per sample.

Table 4. Options available for PROGE, PROGX, PROGW, FM77, and FM78.

Option (OPT)	Output	Bounce-off correction
1	$\mu\text{g}/\text{ft}^3$	No
2	$\mu\text{g}/\text{ft}^3$	Yes
3	MWh	Yes
4 ^a	MWh	Yes
5	grain/MBtu	Yes
6	ng/J	Yes

^aLog interval correction factors are given in FILEA.

AL FC03 MK3011 04				AL FC03 MK3012 04				AL FC03 MK3014 04			
STAGE	UG/CU FT	SIGMA	FSD	UG/CU FT	SIGMA	FSD		UG/CU FT	SIGMA	FSD	
1	6.81E+02	2.77E+01	4.06E-02	1.04E+03	3.22E+01	3.10E-02		1.15E+03	4.38E+01	3.80E-02	
2	1.62E+03	4.83E+01	2.98E-02	1.52E+03	3.93E+01	2.59E-02		1.31E+03	5.10E+01	3.90E-02	
3	1.23E+03	3.43E+01	2.79E-02	9.28E+02	1.90E+01	2.05E-02		9.29E+02	1.76E+01	1.89E-02	
4	7.17E+02	2.80E+01	3.90E-02	4.12E+02	1.56E+01	3.80E-02		2.94E+02	9.72E+00	3.31E-02	
5	2.01E+02	1.19E+01	5.92E-02	2.62E+02	1.68E+01	6.41E-02		2.23E+02	9.40E+00	4.21E-02	
6	8.96E+01	2.78E+00	3.10E-02	2.09E+02	5.23E+00	2.51E-02		1.41E+02	4.23E+00	3.00E-02	
* 7	3.72E+01	1.15E+00	3.09E-02	1.16E+02	6.92E+00	5.98E-02		8.59E+01	1.62E+00	1.88E-02	
* 8	0.	1.46E+00	0.	2.14E-01	6.83E+00	3.19E+01		0.	2.64E+00	0.	
SUM	4.58E+03	7.22E+01	1.58E-02	4.48E+03	5.92E+01	1.32E-02		4.13E+03	7.09E+01	1.72E-02	
-8	4.58E+03	7.22E+01	1.58E-02	4.48E+03	5.88E+01	1.31E-02		4.13E+03	7.09E+01	1.72E-02	
AL FC03 MK3015 04				AL FC03 MK3016 04				AL FC03 MK3022 04			
STAGE	UG/CU FT	SIGMA	FSD	UG/CU FT	SIGMA	FSD		UG/CU FT	SIGMA	FSD	
1	1.40E+03	6.30E+01	4.50E-02	3.92E+03	2.00E+02	5.10E-02		1.03E+03	3.20E+01	3.10E-02	
2	5.52E+02	2.60E+01	4.71E-02	4.17E+02	1.67E+01	4.00E-02		3.76E+03	8.64E+01	2.30E-02	
3	9.78E+02	1.57E+01	1.60E-02	8.40E+02	2.19E+01	2.60E-02		1.34E+03	3.13E+01	2.34E-02	
4	7.49E+02	2.85E+01	3.80E-02	3.77E+02	1.70E+01	4.50E-02		3.09E+02	1.04E+01	3.37E-02	
5	1.74E+02	1.04E+01	6.00E-02	1.08E+02	5.19E+00	4.81E-02		3.66E+02	1.36E+01	3.70E-02	
6	1.18E+02	4.12E+00	3.50E-02	2.63E+01	1.25E+00	4.75E-02		2.36E+01	6.94E-01	2.94E-02	
* 7	4.75E+01	1.49E+00	3.14E-02	2.02E+01	1.71E+00	8.48E-02		9.54E+01	3.44E+00	3.61E-02	
* 8	0.	1.97E+00	0.	1.54E+00	1.94E+00	1.26E+00		1.29E+00	3.48E+00	2.69E+00	
SUM	4.02E+03	7.63E+01	1.90E-02	5.71E+03	2.03E+02	3.55E-02		6.92E+03	9.88E+01	1.43E-02	
-8	4.02E+03	7.63E+01	1.90E-02	5.71E+03	2.03E+02	3.55E-02		6.92E+03	9.88E+01	1.43E-02	
AL FC03 MK3025 04				AL FC03 MK3027 04							
STAGE	UG/CU FT	SIGMA	FSD	UG/CU FT	SIGMA	FSD					
1	6.73E+02	1.88E+01	2.80E-02	1.48E+03	5.92E+01	4.00E-02					
2	2.87E+03	7.46E+01	2.60E-02	2.05E+03	6.97E+01	3.40E-02					
3	1.12E+03	1.67E+01	1.50E-02	1.32E+03	8.05E+01	6.10E-02					
4	5.36E+02	1.61E+01	3.00E-02	1.02E+03	2.64E+01	2.60E-02					
5	2.73E+02	1.28E+01	4.70E-02	2.55E+02	1.08E+01	4.21E-02					
6	3.03E+02	9.39E+00	3.10E-02	2.27E+02	7.29E+00	3.21E-02					
* 7	1.68E+02	7.04E+00	4.18E-02	9.96E+01	3.66E+00	3.67E-02					
* 8	1.02E+01	8.55E+00	8.42E-01	8.64E-01	3.14E+00	3.64E+00					
SUM	5.95E+03	8.20E+01	1.38E-02	6.45E+03	1.25E+02	1.95E-02					
-8	5.94E+03	8.16E+01	1.37E-02	6.44E+03	1.25E+02	1.94E-02					

VALUES <0 TREATED AS 0 IN SUM
* INDICATES BOUNCE-OFF CORRECTION
** MEANS FSD OF THE SUM WAS >0.5 AND THE VALUE IS REPORTED AS 2(SIGMA)+VALUE

Fig. 4. PROGE output file (S1) listing sample concentration values for the cascade impactor stages.

IMPACTOR SUMMARY FOR ALL DATA SETS												
STAGE	N	MEAN UG/CU FT	SIGMA	HIGHEST INDIV. SIG.	N	MEAN UG/CU FT	SIGMA	HIGHEST INDIV. SIG.	N	MEAN UG/CU FT	SIGMA	HIGHEST INDIV. SIG.
ELEMENT AL				ELEMENT AS				ELEMENT BA				
1	8	1.42E+03	1.12E+03	2.00E+02	8	2.15E-01	2.02E-01	3.77E-02	8	1.89E+01	2.05E+01	1.03E+00
2	8	1.76E+03	1.20E+03	8.64E+01	8	2.63E-01	2.13E-01	3.76E-02	8	2.18E+01	2.23E+01	8.03E-01
3	8	1.08E+03	2.06E+02	8.05E+01	8	4.42E-01	1.69E-01	2.81E-02	8	2.09E+01	6.47E+00	5.61E-01
4	8	5.51E+02	2.73E+02	2.85E+01	8	3.52E-01	1.95E-01	1.32E-02	8	1.39E+01	7.56E+00	4.31E-01
5	8	2.33E+02	8.18E+01	1.68E+01	8	2.07E-01	3.85E-02	6.25E-03	8	7.08E+00	4.31E+00	1.73E-01
6	8	1.42E+02	1.06E+02	9.39E+00	8	1.48E-01	9.55E-02	4.57E-03	8	4.69E+00	2.92E+00	1.20E-01
7	8	8.37E+01	5.12E+01	7.04E+00	8	1.17E-01	7.22E-02	1.06E-02	8	3.64E+00	2.10E+00	2.79E-01
8	0	0.	0.	0.	8	1.62E-01	6.08E-02	1.11E-02	8	1.85E+00	1.26E+00	2.98E-01
SUM	-8	5.28E+03	1.69E+03		SUM	1.91E+00	4.15E-01		SUM	9.27E+01	3.24E+01	
	-8	5.28E+03	1.69E+03		-8	1.75E+00	4.10E-01		-8	9.08E+01	3.24E+01	
ELEMENT BR				ELEMENT CA				ELEMENT CE				
1	4	3.15E-02	4.92E-02	2.87E-02	7	2.94E+02	2.87E+02	3.07E+02	8	1.36E+00	1.34E+00	9.80E-02
2	4	3.76E-02	5.82E-02	5.58E-03	7	4.13E+02	2.53E+02	1.54E+02	8	1.48E+00	1.01E+00	8.35E-02
3	2	4.34E-02	5.56E-02	1.41E-02	6	2.28E+02	4.71E+01	3.57E+01	8	1.13E+00	3.08E-01	4.56E-02
4	5	1.82E-02	1.41E-02	4.52E-03	6	1.11E+02	6.15E+01	3.58E+01	0	5.83E-01	3.12E-01	2.86E-02
5	5	1.71E-02	1.65E-02	3.63E-03	5	6.70E+01	3.22E+01	2.62E+01	8	2.29E-01	7.19E-02	1.03E-02
6	5	1.20E-02	1.05E-02	1.85E-03	7	3.78E+01	2.62E+01	1.43E+01	8	1.46E-01	1.09E-01	7.74E-03
7	7	1.23E-02	1.94E-02	4.91E-03	7	2.47E+01	1.08E+01	5.09E+00	8	8.56E-02	5.28E-02	5.09E-03
8	5	8.90E-03	5.31E-03	5.69E-03	4	6.66E+00	3.44E+00	1.95E+00	0	0.	0.	0.
SUM	-8	3.80E-01	9.94E-02**		SUM	1.18E+03	3.93E+02		SUM	5.01E+00	1.74E+00	
	-8	3.71E-01	9.93E-02**		-8	1.18E+03	3.93E+02		-8	5.01E+00	1.74E+00	
ELEMENT CL				ELEMENT CO				ELEMENT CR				
1	1	4.56E+00	0.	1.08E+00	8	1.20E-01	9.44E-02	5.24E-03	8	5.50E-01	4.91E-01	8.00E-02
2	1	3.32E+00	0.	1.25E+00	8	1.46E-01	1.01E-01	5.01E-03	8	6.58E-01	3.77E-01	5.25E-02
3	4	1.87E+00	1.60E+00	7.64E-01	8	1.64E-01	2.54E-02	5.09E-03	8	1.15E+00	1.11E+00	5.97E-02
4	3	1.53E+00	1.74E+00	1.38E+00	8	8.92E-02	4.04E-02	4.29E-03	8	7.62E-01	1.06E+00	6.79E-02
5	2	8.90E-01	1.13E-01	3.88E-01	8	4.30E-02	1.63E-02	1.88E-03	8	4.53E-01	7.00E-01	2.77E-02
6	1	1.47E+00	0.	2.68E-01	8	2.49E-02	1.84E-02	1.27E-03	8	2.02E-01	1.82E-01	1.25E-02
7	0	0.	0.	0.	8	1.55E-02	7.74E-03	1.39E-03	8	3.12E-01	4.77E-01	1.18E-01
8	0	0.	0.	0.	0	0.	0.	0.	7	3.67E-01	3.75E-01	1.31E-01
SUM	-8	1.36E+01	2.37E+00		SUM	6.02E-01	1.49E-01		SUM	4.46E+00	1.91E+00	
	-8	1.36E+01	2.37E+00		-8	6.02E-01	1.49E-01		-8	4.09E+00	1.87E+00	

Fig. 5. PROGE output file (S2) listing element concentration values for the cascade impactor stages.

SAMPLE	DATE	AL		AS		BA		BR		CA	
		CONC	SIGMA	CONC	SIGMA	CONC	SIGMA	CONC	SIGMA	CONC	SIGMA
001	760201	3.34E+04	9.02E+02	3.46E+00	1.17E-01	2.86E+02	6.24E+00	-9.59E+00	1.51E+00	4.40E+03	7.07E+02
002	760207	2.86E+04	8.61E+02	4.00E+00	1.16E-01	2.74E+02	7.55E+00	-9.60E+00	1.51E+00	5.73E+03	6.21E+02
003	760215	3.20E+04	5.43E+02	2.08E+00	1.33E-01	5.69E+02	1.04E+01	-9.77E+00	1.52E+00	6.60E+03	7.16E+02
004	760104	2.84E+04	8.82E+02	2.35E+00	2.33E-01	6.81E+02	8.48E+00	-8.55E+00	1.52E+00	6.57E+03	1.38E+03
005	760111	2.83E+04	5.96E+02	1.04E+01	2.72E-01	4.15E+02	7.13E+00	-8.76E+00	1.53E+00	5.09E+03	8.53E+02
006	760118	2.86E+04	9.17E+02	1.93E+00	2.15E-01	4.09E+02	6.97E+00	-8.85E+00	1.53E+00	5.73E+03	6.34E+02
007	760125	2.76E+04	9.44E+02	3.23E+00	1.87E-01	3.05E+02	8.98E+00	-9.29E+00	1.53E+00	5.23E+03	3.83E+02
MEAN		2.95E+04 (7)	2.39E+03	3.93E+00 (7)	3.21E+00	4.20E+02 (7)	1.67E+02	-9.20E+00 (7)	5.17E-01	5.62E+03 (7)	8.62E+02
SAMPLE	DATE	CE		CL		CO		CR		CS	
		CONC	SIGMA	CONC	SIGMA	CONC	SIGMA	CONC	SIGMA	CONC	SIGMA
001	760201	2.86E+01	4.88E-01	3.03E+01L	3.73E+01	2.38E+00	3.58E-02	6.61E+00	4.53E-01	9.25E-01	3.15E-02
002	760207	2.93E+01	4.45E-01	4.79E+01	1.73E+01	2.19E+00	3.52E-02	6.93E+00	4.03E-01	8.70E-01	2.87E-02
003	760215	2.56E+01	6.10E-01	1.70E+01L	4.22E+01	2.08E+00	3.34E-02	6.16E+00	7.17E-01	5.93E-01	4.57E-02
004	760104	2.42E+01	6.65E-01			1.77E+00	3.54E-02	5.36E+00	7.06E-01	5.27E-01	2.48E-02
005	760111	2.81E+01	7.13E-01	-3.04E+01	3.81E+01	2.06E+00	3.72E-02	7.18E+00	9.38E-01	6.86E-01	6.10E-02
006	760118	2.59E+01	5.27E-01	1.70E+01L	3.89E+01	1.91E+00	5.37E-02	7.92E+00	3.39E-01	6.49E-01	3.05E-02
007	760125	2.73E+01	6.92E-01	-3.83E+00	3.34E+01	2.15E+00	4.09E-02	9.01E+00	9.17E-01	8.20E-01	5.25E-02
MEAN		2.70E+01 (7)	1.96E+00	4.54E+00 (3)	4.88E+01	2.08E+00 (7)	2.15E-01	7.02E+00 (7)	1.28E+00	7.24E-01 (7)	1.61E-01
SAMPLE	DATE	DY		EU		FE		GA		HF	
		CONC	SIGMA	CONC	SIGMA	CONC	SIGMA	CONC	SIGMA	CONC	SIGMA
001	760201	1.66E+00	6.13E-02	2.76E-01	7.02E-03	6.81E+03	7.46E+01	8.75E+00	5.51E-01	2.41E+00	4.31E-02
002	760207	1.60E+00	1.03E-01	2.75E-01	6.71E-03	6.89E+03	6.87E+01	9.10E+00	6.48E-01	2.35E+00	3.74E-02
003	760215	1.75E+00	1.48E-01	2.74E-01	7.33E-03	5.85E+03	8.74E+01	6.91E+00	1.73E+00	2.31E+00	5.49E-02
004	760104	1.50E+00	4.72E-02	2.31E-01	9.86E-03	5.76E+03	9.20E+01	7.11E+00	1.20E+00	2.35E+00	6.32E-02
005	760111	1.56E+00	5.84E-02	2.53E-01	9.04E-03	7.16E+03	1.07E+02	8.14E+00	1.11E+00	2.59E+00	7.22E-02
006	760118	1.59E+00	9.31E-02	2.55E-01	8.42E-03	6.42E+03	5.78E+01	9.28E+00	1.12E+00	2.28E+00	4.77E-02
007	760125	1.52E+00	4.23E-02	2.66E-01	8.92E-03	6.41E+03	8.97E+01	1.00E+01	8.76E-01	2.34E+00	6.53E-02
MEAN		1.60E+00 (7)	9.23E-02	2.61E-01 (7)	1.79E-02	6.47E+03 (7)	5.70E+02	8.48E+00 (7)	1.25E+00	2.38E+00 (7)	1.11E-01

(*) INDICATES HIGHEST SIGMA (L) MEANS FSD OF THE SUM WAS >0.5 AND THE VALUE IS REPORTED AS 2(SIGMA)+VALUE

Fig. 6. HSP0 output file from PROGX listing sample and element concentration values for bulk-type samples.

Next, the user must type a title message at the TTY:

TTY : GIVE TITLE (60-CHAR)

User: FOUR CORNERS POWER PLANT SURVEY (CR)

TTY : GIVE TITLE (50-CHAR)

User: CASCADE IMPACTOR JAN. 12, 1976 (CR)

The user then types the first FILEn file name:

TTY : GIVE FILE NAME OR CR

User: FILE NAME (CR)

TTY : GIVE FILE NAME OR CR

User: (CR)

TTY : RECORDS 400

TTY returns a record count indicating the total number of stored FILEn cards. Only samples with codes given in FILEA are selected from FILEn.

The user can request enrichment factor output in the next TTY line:

TTY : IF YOU WANT ENRICHMENT FACTORS TYPE YES.

User: YES (CR)

TTY : GIVE INPUT FILE NAME AND NORMALIZING ELEMENT

User: FC01COAL AL (CR)

If all goes well, the user should receive the message:

TTY : ALL DONE

The file names S1, S2 (given in the execute line) and IMPCnn will appear in the user's private files. S1, S2 output may be listed with the utility routine ALLOUT (see Ref. 7). ALLOUT is called for with the line:

ALLOUT HSP S1 S2 BOX T16 MARTIN / T V

PROGX

PROGX may be executed by the user at the TTY with the line:

PROGX COAL FILEA / T V

FILEA is as described in the input section and COAL is a sample type code as listed below.

COAL = COAL

FILTER = FILTER

FLY ASH = FA

BOTTOM ASH = BA

IMPACTOR = IMPC

SAMPLE	DATE	AL		AS		BA		BR		CA	
		EF	SIGMA	EF	SIGMA	EF	SIGMA	EF	SIGMA	EF	SIGMA
001	760201	1.00E+00	1.21E-01	7.77E-01	6.39E-01	6.02E-01	2.45E-01	9.22E-01	1.73E-01	6.92E-01	1.65E-01
002	760207	1.00E+00	1.22E-01	1.05E+00	8.64E-01	6.74E-01	2.75E-01	1.08E+00	2.03E-01	1.05E+00	2.18E-01
003	760215	1.00E+00	1.17E-01	4.88E-01	4.02E-01	1.25E+00	5.08E-01	9.79E-01	1.81E-01	1.08E+00	2.22E-01
004	760104	1.00E+00	1.23E-01	6.22E-01	5.15E-01	1.68E+00	6.86E-01	9.65E-01	1.99E-01	1.21E+00	3.33E-01
005	760111	1.00E+00	1.18E-01	2.77E+00	2.27E+00	1.03E+00	4.19E-01	9.92E-01	2.00E-01	9.43E-01	2.28E-01
006	760118	1.00E+00	1.23E-01	5.07E-01	4.21E-01	1.00E+00	4.09E-01	9.92E-01	2.00E-01	1.05E+00	2.19E-01
007	760125	1.00E+00	1.24E-01	8.79E-01	7.24E-01	7.77E-01	3.17E-01	1.08E+00	2.11E-01	9.96E-01	1.91E-01
MEAN		1.00E+00 (7)	0.	1.01E+00 (7)	8.64E-01	1.00E+00 (7)	4.06E-01	1.00E+00 (7)	6.33E-02	1.00E+00 (7)	1.74E-01
SAMPLE	DATE	CE		CL		CO		CR		CS	
		EF	SIGMA	EF	SIGMA	EF	SIGMA	EF	SIGMA	EF	SIGMA
001	760201	9.34E-01	1.06E-01	5.89E+00	6.38E+01	1.01E+00	1.37E-01	8.32E-01	1.77E-01	1.13E+00	2.72E-01
002	760207	1.12E+00	1.28E-01	1.09E+01	1.17E+02	1.09E+00	1.48E-01	1.02E+00	2.14E-01	1.24E+00	2.99E-01
003	760215	8.73E-01	9.84E-02	3.45E+00	3.81E+01	9.22E-01	1.23E-01	8.09E-01	1.87E-01	7.56E-01	1.89E-01
004	760104	9.33E-01	1.09E-01			8.81E-01	1.20E-01	7.93E-01	1.91E-01	7.56E-01	1.84E-01
005	760111	1.08E+00	1.23E-01	-6.98E+00	-7.56E+01	1.03E+00	1.39E-01	1.07E+00	2.55E-01	9.86E-01	2.50E-01
006	760118	9.87E-01	1.14E-01	3.87E+00	4.25E+01	9.48E-01	1.31E-01	1.16E+00	2.40E-01	9.24E-01	2.25E-01
007	760125	1.08E+00	1.26E-01	-9.04E-01	-1.25E+01	1.11E+00	1.52E-01	1.37E+00	3.11E-01	1.21E+00	3.00E-01
MEAN		1.00E+00 (7)	1.01E-01	2.70E+00 (6)	6.68E+00	9.99E-01 (7)	9.21E-02	1.01E+00 (7)	2.33E-01	1.00E+00 (7)	2.19E-01
SAMPLE	DATE	DY		EU		FE		GA		HF	
		EF	SIGMA	EF	SIGMA	EF	SIGMA	EF	SIGMA	EF	SIGMA
001	760201	9.20E-01	1.01E-01	9.35E-01	1.05E-01	9.30E-01	1.15E-01	9.12E-01	1.66E-01	8.96E-01	8.87E-02
002	760207	1.03E+00	1.26E-01	1.09E+00	1.23E-01	1.10E+00	1.36E-01	1.11E+00	2.05E-01	1.02E+00	1.01E-01
003	760215	1.01E+00	1.33E-01	9.69E-01	1.07E-01	8.33E-01	1.01E-01	7.51E-01	2.27E-01	8.97E-01	8.78E-02
004	760104	9.73E-01	1.06E-01	9.18E-01	1.09E-01	9.24E-01	1.15E-01	8.71E-01	2.09E-01	1.02E+00	1.05E-01
005	760111	1.02E+00	1.10E-01	1.01E+00	1.15E-01	1.15E+00	1.41E-01	1.00E+00	2.17E-01	1.13E+00	1.13E-01
006	760118	1.02E+00	1.23E-01	1.01E+00	1.16E-01	1.02E+00	1.27E-01	1.13E+00	2.37E-01	9.88E-01	9.98E-02
007	760125	1.02E+00	1.11E-01	1.09E+00	1.27E-01	1.06E+00	1.33E-01	1.27E+00	2.44E-01	1.05E+00	1.09E-01
MEAN		9.99E-01 (7)	4.32E-02	1.00E+00 (7)	7.42E-02	1.00E+00 (7)	1.22E-01	1.01E+00 (7)	1.90E-01	1.00E+00 (7)	9.18E-02

Fig. 7. HSP0 output file from PROGW, listing enrichment factor (EF) values for bulk-type samples.

The user next must type a title message at the TTY and give the FILEn file name(s) as described for PROGE. The file names FC01, FC01COAL, HSP0 will appear in the user's private files upon completion of the program (see Figs. 2, 3, and 7).

PROGW

PROGW may be executed by the user at the TTY with the line:

PROGW FILEA FILTER A1 / T V

Again, FILEA is as described in the input section, FILTER is a sample type code as listed above, and A1 is a normalizing chemical element symbol. The user must type the FILEn filenames as described in PROGE.

The user types the normalizing filenames after the following TTY request:

TTY : GIVE NORMALIZING FILENAMES

User: FC01COAL FC02COAL FC03COAL (CR)

The filename HSP0 will appear in the user's private files upon completion of the program (see Fig. 8).

FM77

FM77 may be executed by the user at the TTY with the line:

FM77 FILEB A1 A2 A3 END / T V

Here, FILEB is as described in the input section and A1, A2, and A3 are FC01 divided into individual files by the type-of-device and sample-number code. Upon completion of the programs, the results are transferred to the HSP0 file (see Fig. 9).

FM78

FM78 may be executed by the user at the TTY with the line:

FM78 A1 A2 A3 / T V

Here, A1 is a file containing the concentration and standard deviation values from one sample in FC01, used as the numerator in the enrichment calculation. A2 is a file of the concentration and standard deviation values from one sample in FC01, used as the denominator in the enrichment calculation, and A3 is a normalizing chemical element symbol. Upon completion of the programs, the results are placed in the HSP0 file (see Fig. 10).

AS FC03 MK3011 04			AS FC03 MK3012 04			AS FC03 MK3014 04		
STAGE	EF	SIGMA	EF	SIGMA		EF	SIGMA	
1	7.79E-01	6.42E-01	7.75E-01	6.37E-01		9.44E-01	7.79E-01	
2	6.78E-01	5.60E-01	5.87E-01	5.65E-01		7.23E-01	5.97E-01	
3	3.84E+00	3.15E+00	3.45E+00	2.83E+00		5.18E+00	4.26E+00	
4	6.97E+00	5.73E+00	5.18E+00	4.25E+00		6.18E+00	5.08E+00	
5	7.73E+00	6.36E+00	6.60E+00	5.43E+00		7.80E+00	6.41E+00	
6	8.90E+00	7.31E+00	7.87E+00	6.46E+00		9.11E+00	7.49E+00	
* 7	1.30E+01	1.07E+01	1.23E+01	1.02E+01		1.18E+01	9.74E+00	
* 8	1.07E-01	3.38E-03 ***	4.30E+03	1.37E+05		1.20E-01	4.54E-03 ***	
SUM	3.27E+00	2.69E+00	2.88E+00	2.36E+00		3.29E+00	2.70E+00	
-8	3.10E+00	2.54E+00	2.67E+00	2.19E+00		3.08E+00	2.52E+00	
AS FC03 MK3015 04			AS FC03 MK3016 04			AS FC03 MK3022 04		
STAGE	EF	SIGMA	EF	SIGMA		EF	SIGMA	
1	8.41E-01	6.93E-01	9.29E-01	7.67E-01		8.79E-01	7.24E-01	
2	1.62E+00	1.34E+00	2.71E+00	2.23E+00		1.31E+00	1.08E+00	
3	2.63E+00	2.16E+00	4.78E+00	3.93E+00		2.24E+00	1.84E+00	
4	5.76E+00	4.73E+00	7.25E+00	5.96E+00		5.03E+00	4.13E+00	
5	7.58E+00	6.24E+00	1.22E+01	1.00E+01		5.55E+00	4.56E+00	
6	9.08E+00	7.47E+00	1.04E+01	8.62E+00		8.87E+00	7.28E+00	
* 7	1.22E+01	1.01E+01	1.06E+01	8.83E+00		7.53E+00	6.19E+00	
* 8	2.35E-01	4.73E-03 ***	1.28E+03	1.93E+03		8.51E+02	2.39E+03	
SUM	3.41E+00	2.80E+00	2.68E+00	2.20E+00		2.09E+00	1.71E+00	
-8	2.97E+00	2.44E+00	2.33E+00	1.92E+00		1.93E+00	1.58E+00	
AS FC03 MK3025 04			AS FC03 MK3027 04					
STAGE	EF	SIGMA	EF	SIGMA				
1	9.67E-01	7.99E-01	2.79E+00	2.29E+00				
2	7.89E-01	6.51E-01	1.69E+00	1.39E+00				
3	2.72E+00	2.23E+00	9.23E-01	7.60E-01				
4	4.82E+00	3.96E+00	1.01E+00	8.35E-01				
5	5.45E+00	4.48E+00	4.86E+00	4.00E+00				
6	7.09E+00	5.83E+00	6.58E+00	5.41E+00				
* 7	1.04E+01	8.58E+00	8.61E+00	7.08E+00				
* 8	1.05E+02	1.24E+02	1.34E+03	5.00E+03				
SUM	2.52E+00	2.07E+00	2.26E+00	1.86E+00				
-8	2.34E+00	1.92E+00	2.08E+00	1.71E+00				

** MEANS FSD OF THE SUM WAS >0.5 AND THE VALUE IS REPORTED AS 2(SIGMA)*VALUE
*** MEANS BASE NORMALIZER DATA IS ZERO OR MISSING

Fig. 8. PROGE output file (S1), listing enrichment factor (EF) values for cascade impactor samples.

SAMPLE	AL	AS	BA	BR	CA					
FC03 001	3.34E+04	9.03E+02	3.46E+00	1.18E-01	2.86E+02	6.24E+00	9.59E+00	1.51E+00	4.40E+03	7.07E+02
FC03 002	2.86E+04	8.61E+02	4.00E+00	1.16E-01	2.74E+02	7.55E+00	9.60E+00	1.51E+00	5.73E+03	6.21E+02
FC03 003	3.20E+04	5.43E+02	2.08E+00	1.33E-01	5.69E+02	1.04E+01	9.77E+00	1.52E+00	6.60E+03	7.16E+02
FC03 004	2.84E+04	8.82E+02	2.35E+00	2.33E-01	6.81E+02	8.48E+00	8.55E+00	1.52E+00	6.57E+03	1.38E+03
FC03 005	2.83E+04	5.96E+02	1.04E+01	2.72E-01	4.15E+02	7.14E+00	9.76E+00	1.53E+00	5.09E+03	8.53E+02
FC03 006	2.86E+04	9.17E+02	1.93E+00	2.15E-01	4.09E+02	6.97E+00	9.85E+00	1.53E+00	5.73E+03	8.34E+02
FC03 007	2.75E+04	9.44E+02	3.23E+00	1.87E-01	3.05E+02	8.98E+00	9.29E+00	1.53E+00	5.22E+03	3.83E+02
N + NADAC =	7	3.10E+02	7	7.21E-02	7	3.05E+00	7	5.75E-01	7	3.06E+02
AVG + SD =	2.95E+04	2.23E+03	3.92E+00	2.96E+00	4.20E+02	1.54E+02	9.20E+00	4.80E-01	5.62E+03	7.98E+02
WT AVG + SD =	3.01E+04	2.86E+02	5.86E+00	9.00E-02	4.90E+02	3.40E+00	9.25E+00	5.77E-01	5.59E+03	2.42E+02
MAXIMUM =	3.34E+04		1.04E+01		6.81E+02		9.77E+00		6.60E+03	
MINIMUM =	2.750E+04		1.930E+00		2.740E+02		8.550E+00		4.400E+03	
MEDIAN =	2.860E+04		3.230E+00		4.090E+02		9.290E+00		5.730E+03	
QUP =	2.860E+04		3.460E+00		4.150E+02		9.590E+00		5.730E+03	
QLOW =	2.830E+04		2.080E+00		2.860E+02		8.760E+00		5.090E+03	
QSPRD =	3.000E+02		1.380E+00		1.290E+02		8.300E-01		6.400E+02	
SAMPLE	CE	CL	CO	CR	CS					
FC03 001	2.86E+01	4.88E-01	3.03E+01	3.73E+01	2.38E+00	3.58E-02	6.61E+00	4.54E-01	9.25E-01	3.15E-02
FC03 002	2.93E+01	4.45E-01	4.79E+01	1.73E+01	2.19E+00	3.52E-02	6.93E+00	4.03E-01	8.70E-01	2.87E-02
FC03 003	2.56E+01	6.10E-01	1.70E+01	4.22E+01	2.08E+00	3.34E-02	6.16E+00	7.17E-01	5.94E-01	4.57E-02
FC03 004	2.43E+01	6.65E-01	0.	0.	1.76E+00	3.54E-02	5.36E+00	7.06E-01	5.27E-01	2.48E-02
FC03 005	2.91E+01	7.13E-01	3.04E+01	3.81E+01	2.06E+00	3.72E-02	7.18E+00	9.38E-01	6.86E-01	6.10E-02
FC03 006	2.59E+01	5.27E-01	1.70E+01	3.89E+01	1.91E+00	5.37E-02	7.92E+00	3.39E-01	6.49E-01	3.05E-02
FC03 007	2.73E+01	6.92E-01	3.83E+00	3.34E+01	2.15E+00	4.09E-02	9.01E+00	9.17E-01	8.21E-01	5.25E-02
N + NADAC =	7	2.27E-01	6	1.45E+01	7	1.49E-02	7	2.56E-01	7	1.56E-02
AVG + SD =	2.70E+01	1.81E+00	2.44E+01	1.52E+01	2.08E+00	1.99E-01	7.02E+00	1.19E+00	7.25E-01	1.49E-01
WT AVG + SD =	2.75E+01	2.15E-01	4.42E+01	1.45E+01	2.12E+00	1.44E-02	7.33E+00	2.00E-01	7.80E-01	1.37E-02
MAXIMUM =	2.930E+01		4.790E+01		2.380E+00		9.010E+00		9.250E-01	
MINIMUM =	2.430E+01		3.830E+00		1.760E+00		5.360E+00		5.270E-01	
MEDIAN =	2.730E+01		2.365E+01		2.080E+00		6.930E+00		6.860E-01	
QUP =	2.810E+01		3.030E+01		2.150E+00		7.180E+00		8.210E-01	
QLOW =	2.560E+01		1.700E+01		1.910E+00		6.160E+00		5.940E-01	
QSPRD =	2.500E+00		1.330E+01		2.400E-01		1.020E+00		2.270E-01	
SAMPLE	DY	EU	FE	GA	HF					
FC03 001	1.67E+00	6.13E-02	2.76E-01	7.02E-03	6.81E+03	7.46E+01	8.75E+00	5.51E-01	2.41E+00	4.31E-02
FC03 002	1.60E+00	1.03E-01	2.75E-01	6.71E-03	6.89E+03	6.87E+01	9.10E+00	6.48E-01	2.35E+00	3.74E-02
FC03 003	1.75E+00	1.48E-01	2.74E-01	7.33E-03	5.85E+03	8.74E+01	6.91E+00	1.73E+00	2.31E+00	5.49E-02
FC03 004	1.50E+00	4.72E-02	2.31E-01	9.86E-03	5.76E+03	9.20E+01	7.11E+00	1.20E+00	2.35E+00	6.32E-02
FC03 005	1.56E+00	5.84E-02	2.53E-01	9.04E-03	7.16E+03	1.07E+02	8.14E+00	1.11E+00	2.59E+00	7.23E-02
FC03 006	1.59E+00	9.31E-02	2.55E-01	8.42E-03	6.42E+03	5.78E+01	9.28E+00	1.12E+00	2.28E+00	4.78E-02
FC03 007	1.53E+00	4.23E-02	2.66E-01	8.92E-03	6.41E+03	8.97E+01	1.00E+01	8.77E-01	2.34E+00	6.53E-02
N + NADAC =	7	3.27E-02	7	3.12E-03	7	3.17E+01	7	4.14E-01	7	2.12E-02
AVG + SD =	1.60E+00	8.56E-02	2.61E-01	1.64E-02	6.47E+03	5.26E+02	8.47E+00	1.14E+00	2.38E+00	1.03E-01
WT AVG + SD =	1.57E+00	2.35E-02	2.66E-01	3.02E-03	6.55E+03	2.97E+01	8.95E+00	3.26E-01	2.37E+00	1.93E-02
MAXIMUM =	1.750E+00		2.760E-01		7.160E+03		1.000E+01		2.590E+00	
MINIMUM =	1.500E+00		2.310E-01		5.760E+03		6.910E+00		2.280E+00	

Fig. 9. HSP0 output file from FM77, listing element concentration values.

AL	1.000E+00	5.722E-02
AS	7.407E-01	6.034E-02
BA	8.938E-01	5.360E-02
BR	8.554E-01	2.262E-01
CA	6.575E-01	1.980E-01
CE	8.358E-01	4.647E-02
CL	5.417E-01	1.284E+00
CO	9.306E-01	4.606E-02
CR	8.167E-01	9.867E-02
CS	9.104E-01	6.233E-02
DY	8.938E-01	8.443E-02
EU	8.594E-01	5.366E-02
FE	8.463E-01	4.309E-02
GA	8.234E-01	1.033E-01
HF	8.782E-01	4.701E-02
IN	1.051E+00	1.945E-01
K	9.160E-01	7.676E-02
LA	8.149E-01	4.283E-02
LU	8.491E-01	6.848E-02
MG	5.164E-01	8.362E-01
MO	9.147E-01	2.906E-01
MN	8.848E-01	4.425E-02
NA	9.266E-01	4.336E-02
ND	9.594E-01	8.368E-02
RB	9.722E-01	1.305E-01
SB	7.872E-01	7.106E-02
SC	8.809E-01	4.195E-02
SE	9.397E-01	1.206E-01
SM	8.311E-01	4.834E-02
SR	8.316E-01	1.178E-01
TA	8.089E-01	6.661E-02
TB	8.842E-01	7.564E-02
TH	8.452E-01	4.257E-02
TI	9.978E-01	1.769E-01
U	8.186E-01	5.060E-02
UF	1.862E+00	7.465E-01
W	7.754E-01	1.322E+00
YB	8.190E-01	6.167E-02
ZN	9.000E-01	1.603E-01
ZR	9.018E-01	3.648E-01

Fig. 10. HSP0 output file from FM78, listing enrichment factor (EF) values.

REFERENCES

1. R. Gunnink and J. B. Niday, *Computerized Quantitative Analysis by Gamma-Ray Spectroscopy*, Lawrence Livermore Laboratory, Rept. UCRL-51061 (1972).
2. R. E. Heft and W. H. Martin, *Computer Codes for Processing Instrumental Neutron Activation Data*, Lawrence Livermore Laboratory, Rept. UCRL-52249 (1977), in press.
3. J. T. Engle, *ELF*, Lawrence Livermore Laboratory, Internal Document UC-202 (June, 1970). Readers outside the Laboratory who desire further information on LLL internal documents should address their inquiries to the Technical Information Department, Lawrence Livermore Laboratory, Livermore, California 94550.
4. R. Ralston, Power Plant Data Base (Instructions for use of Power Plant Data Base), unpublished memorandum (November, 1976).
5. J. M. Ondov, R. C. Ragaini, and A. H. Biermann, *Elemental Particle-Size Emissions from Coal-Fired Power Plant: Use of an Inertial Cascade Impactor*, Lawrence Livermore Laboratory, Rept. UCRL-78963, Rev. 1 (1977), in press.
6. A. Cecil, H. Moll, and J. Rinde, *TRIX AC: A Set of General-Purpose Test Editing Commands*, Lawrence Livermore Laboratory, Rept. UCID-30040, Ed. 8 (1976).
7. D. W. Thompson, *ALLOUT*, Lawrence Livermore Laboratory, Internal Document UR-405, Rev. 1 (November, 1973).

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