

Action Sheet No. 2
The United States Department of Energy (DOE)
and
The Commissariat à l’Energie Atomique (CEA) of France
for
Isotopic Analysis Evaluation Using the PC/FRAM Physics Isotopics Software

1. INTRODUCTION

Pursuant to Article 3 of the Agreement, signed on December 27, 1997, between DOE and CEA concerning research and development in the field of nuclear material control and accounting measures, DOE and CEA (the Parties) undertake to carry out a cooperative effort on evaluation of isotopic analyses using the PCYFRAM software.

2. DESCRIPTION

Fixed energy Response function Analysis with Multiple efficiencies, for a PC (PC/FRAM) is an isotopic analysis code used for measuring gamma-ray signatures from arbitrary samples. As a single code, PC/FRAM has the most capability of any available isotopic analysis software package. Analysis codes traditionally use lower energy gamma rays for determining parameters of interest such as ^{235}U enrichment or plutonium isotopic fractions. In some cases, materials are packaged in containers that attenuate the lower energy gamma rays. Attenuation skews results of the analyses. Since higher energy gamma rays are not as affected by the attenuation, analyses of these gamma ray energies can provide more accuracy. The PC/FRAM code is configurable to analyze both low- and high-energy ranges. Most high resolution gamma spectroscopy (HRGS) systems used for safeguards are set up for effectively measuring low-energy gamma rays. Often these systems are not as efficient for measuring higher energy gammas. Different detectors are needed. With an appropriate detector and the PC/FRAM code, inspectors can effectively measure and analyze UF_6 cylinders without having to measure and correct for wall thickness. They will also be able to measure plutonium packaged in thick-walled, lead-lined containers. The PC/FRAM code has been validated with measurements of various samples, but further validation is needed.

Through this Action Sheet, the PC/FRAM code will be provided to CEA, and CEA personnel will be trained to use PC/FRAM. The code will then be used by CEA personnel for measuring various types of uranium and plutonium samples, including typically hard-to-measure waste materials or materials stored in thick-walled containers.

3. SCOPE OF WORK

This Action Sheet provides for collaboration on the application of the PC/FRAM physics isotopics software. The work shall be divided among the Los Alamos National Laboratory (LANL), the Centre d’Etudes de Cadarache (Cadarache), and the Institut de Protection et de Sûreté Nucléaire (IPSN) at Fontenay-aux-Roses. LANL shall provide the PC/FRAM code and documentation to the two CEA laboratories. LANL shall provide assistance by participating in a PC/FRAM training and measurement exercise visit to a French facility and through telephone,

e-mail, and FAX transmissions. The CEA laboratories shall provide the gamma-ray instrumentation and nuclear materials for use with PC/FRAM. CEA shall apply the code to isotopics measurements of CEA nuclear materials, in particular plutonium with a range of burnups and UF6 and provide LANL the results of the measurements, problems encountered, and suggestions for improvements.

4. PROGRAM MANAGEMENT

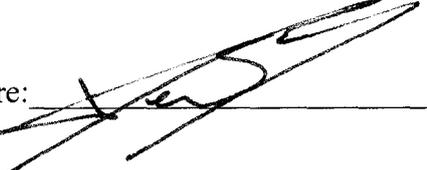
LANL is responsible for providing the current version of PC/FRAM along with existing documentation. CEA is responsible for computer hardware, nuclear materials, and personnel needed to use PC/FRAM and for transmitting questions, suggestions, and measurement results to LANL. CEA and LANL will work together (during a PC/FRAM exercise in France and by telephone, e-mail, and FAX) to resolve questions and to evaluate the isotopic measurement results. At the end of the project, LANL and CEA are jointly responsible for a summary report. Appendix I outlines the work to be done and Appendix II identifies the key personnel involved.

5. FINANCIAL MANAGEMENT

DOE and CEA shall bear their own expenses associated with their individual responsibilities.

6. DURATION AND TERMINATION

This action sheet shall enter into force upon the later date of signature, and shall continue in force for one year, or until mutually agreed by the Parties that all activities under this Action Sheet are completed.

For the United States Department of Energy (US DOE)	For the Commissariat à l'Énergie Atomique (CEA) of France
Signature: 	Signature: 
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Title: <u>Department Head</u>	Title: <u>Division Director</u>
Date: <u>20 Janvier 2000</u>	Date: <u>07 Jan. 2000</u>

APPENDIX I

Description of Tasks

1. OBJECTIVE

The Safeguards Science and Technology (NIS-5) group of LANL has developed an isotopics computer physics code, PC/FRAM, that provides accurate nondestructive measurements of the isotopic composition of nuclear materials that are important for safeguards purposes. PCYFRAM uses gamma rays emitted by uranium and plutonium to calculate the percentages of the isotopes of these two elements. These percentages are needed to determine total nuclear material content from assays using passive neutron, active neutron, gamma-ray, and calorimeter measurements. In the case of plutonium measurements on samples covering a wide range of burnups, the isotopics determination depends on a correlation function for ^{242}Pu . Since the advanced French fuel cycle and plutonium fuel materials cover a wide burnup range, measurements taken can be used to enhance the ^{242}Pu correlation function. They will also allow evaluation of PC/FRAM capabilities over a broader spectrum of isotopic variations.

Independent evaluation of the code and associated isotopic correlation function is important for validating PCYFRAM capabilities and for extending the capability of the software to measure higher burnup plutonium materials accurately. Also important is evaluation of PC/FRAM capabilities for measuring uranium enrichment in difficult UF₆ geometries such as through thick container walls. Evaluations will provide a basis for customizing the code for specific French applications.

LANL personnel will provide the code and documentation to Cadarache and IPSN for measurement tests and evaluation. LANL will participate in a measurement exercise in France to train CEA and IPSN on the use of PC/FRAM. LANL and the CEA laboratories will collaborate in the evaluation of the PC/FRAM applications.

2. SCOPE

LANL will supply the latest version of the code along with existing documentation and exchange information on the use of the code and analysis of data via the telephone, e-mail, and FAX. A joint exercise on isotopic measurements to be held at a French facility will be attended by a LANL PCYFRAM expert. Cadarache and IPSN will use the code on safeguards isotopic measurement evaluations over a range of plutonium burnups and on UF₆ materials and provide measurement results to LANL.

3. TASKS

3.1. Distribution of Code

LANL will provide the latest version (with documentation) of PC/FRAM to Cadarache and IPSN.

3.2. Interlaboratory Communication

Throughout the project CEA and LANL will communicate on the appropriate instrumentation and data sets to use for PCYFRAM for isotopics measurements and analysis.

3.3. Safeguards Application Studies

CEA will apply and jointly evaluate with LANL PC/FRAM measurements on uranium and plutonium materials. Plutonium isotopic measurements over a range of burnups will be evaluated. The capability of the current correlation function for ^{242}Pu will be assessed for high burnup samples. UF_6 materials in containers with wall thickness up to 16 mm will be measured to determine ^{235}U enrichment. The effects of gamma attenuation in the UF_6 and of deposits on the walls of the container (uranium and its thorium daughter) will be independently evaluated. The influence of UF_6 physical and chemical properties on enrichment measurements will also be studied. A joint exercise on gamma-ray isotopic measurements will be organized by CEA at a French facility, and a LANL PC/FRAM expert will participate. Questions, difficulties, and improvements will be communicated to LANL personnel who will respond appropriately.

3.4. Application Results

CEA will share results of measurements with LANL for the purpose of enhancing the range of experience with the isotopics physics measurements. LANL and CEA will jointly evaluate and discuss potential enhancements and additions to PC/FRAM. A joint summary report will be provided on the measurement exercises and results.

4. PROJECT SCHEDULE

Date	Action	Responsible Party
Month 1	LANL complies with USA export regulations; ships PC/FRAM to CEA.	LANL
Month 3	CEA laboratories begin measurements upon receipt of PC/FRAM.	CEA
Month 4	Training session and joint CEA/LANL exercise on PC/FRAM.	CEA, LANL
Month 8	CEA laboratories provide results of measurements to LANL	CEA
Month 9	Joint evaluation (via telephone, e-mail, FAX) of the results.	CEA, LANL
Month 10	Joint summary paper prepared.	CEA, LANL
Month 12	End of project.	-----

APPENDIX II
Key Personnel

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