

Annual Work Proposal 2003
Office of International Health Programs (EH-63)
U.S. Department of Energy

Project Indalo

Centro de Investigaciones Energeticas Medioambientales y Tecnologicas (CIEMAT)

Purpose: In 2003, we will continue to perform the radiological medical surveillance and environmental monitoring in the area of Palomares (Almería - Spain). In addition, it is intended to continue activities included in the recommendations made by the expert panel in its 1998 report.

The administrative process of ownership conveyance (from the current owners to an administrative body) of the lands, where the higher residual contamination levels from the 1966 accident remain, was not completed during 2002. This process is essential in order to assure the implementation of further long-term research activities in the more affected zones. However, during 2002, the preliminary phase of the research plan started. This phase mainly consists of updating and improving the radiological characterization of the global area of Palomares. The planned radiological characterization will also contribute to identify hot points of secondary accumulation of the contamination through wind or water erosion. Work in this phase consists of combining extensive radiometric surveys and soil sampling and analyses. During 2003 this type of activities will continue, together with other soil activities as described below.

In relation to air monitoring, sampling and analyses will continue during 2003 at three of the established locations (stations 2-1, 2-2 and P). Work in station 2-0 will depend on availability of power supply and permission of the owner of the plot, where the station is located. This permission is strongly associated to the process of ownership conveyance mentioned above.

Concerning vegetation studies, the historical review data analysis will continue, in order to refine risk assessment for the ingestion pathway. In addition, sampling and analyses of representative cultures will be performed during 2003.

Progress in the statistical significance of Pu and Am content in relevant animal consumption products will continue by sampling and analyses of cow and goat milk and snails.

Effort on hot particles will continue to put emphasis in its separation from soil samples and in the determination of their realistic isotopic composition. Activity estimates of radioactive particles and their contribution to the soil activity will also continue during 2003.

Concerning the evolution of the Pu and Am solubility in Palomares soils, the influence of animal excretion fertilizing agricultural practices will be studied

Also, it is intended to resume the risk assessment study in 2003.

The following is a general description of work to be performed.

General Description of Work to be Performed:

I. Concise Statement of Goals

The former goals remain unchanged since the signing of the Hall-Otero Agreement. They are:

- To determine the magnitude of the risk of internal contamination in the inhabitants of the zone during the period immediately following the accident and the subsequent emergency phase.
- To assess the short, medium, and long-term risk of internal contamination for those people living in and around Palomares, those who cultivate the contaminated land and those who consume vegetable products grown in this area, as well as products from animals which have been given cereals and other vegetables grown in the area as fodder.

In addition to these objectives and as a consequence of the new management plan that is being negotiated, it is intended to implement a research plan with the final goal of determining the most suitable options for environmental restoration.

II. Background (includes relevance to DOE programs)

As a consequence of the accident which occurred on January 17, 1966, a radiological medical surveillance and environmental monitoring program has been conducted in Palomares, Spain. This work has been performed pursuant to the Hall-Otero Agreement of February 25, 1966. In Spain, the Centro de Investigaciones Energeticas Medioambientales y Tecnologicas (CIEMAT; Center for Energy, Environmental, and Technological Investigations) is the organization responsible for all technical aspects of this project. CIEMAT provides semi-annual reports to the Spanish Consejo de Seguridad Nuclear (CSN; Nuclear Safety Board) which, in turn, provides summaries of the activities in Palomares to the Spanish Parliament. The CSN is the Spanish organization responsible for nuclear safety and radiation protection in general (Regulatory Body).

III. Methods and Approach

The medical monitoring program consists of clinical examinations and radio-bioassays of Pu and Am collected from 24-hour urine samples of 150 residents from Palomares every year. The individuals examined differ each year unless some Pu or Am in urine was detected from the previous year's examination. If necessary, individuals with high potential internal contamination are examined by CIEMAT's lung radioactivity counter. The details of the clinical examinations are on record at DOE. The examinations are performed during the spring and autumn of each year. Approximately 10 individuals are examined each week.

The environmental monitoring program consists of sampling, analysis, and measurements of Pu and Am in air (there are four air high volume continuous samplers in the area), soil, food crops, wild vegetation, milk, and other products. For example, high volume samplers equipped with a PM-10 inlet sample the air continuously. The new lung model in ICRP 66 considers, for inhalation contamination, particles up to 100 microns size; therefore, during 2003, the PM-10 inlet used in the air samplers for particles size selection will be removed. The filters are changed weekly and monthly analyzed in composite samples. However, in order to investigate potential peaks of activity during a month, semimonthly samples, corresponding to those months where the higher mass loading is normally estimated, will be analyzed. The mass loading in all air stations will be studied in order to analyze its trend models. Soils are sampled with a frequency depending on the characteristics of the experiment to be performed. For example, the frequency of deep soil samples is less than surface soil samples. The frequency of samples in vegetables depends on the growing season and the vegetable species cultivated each year.

Air and urine samples are analyzed by sequential radiochemistry methods for Pu and Am. On separate planchets, Pu and Am are then measured by alpha spectrometry. Other samples, such as soils and vegetation, are analyzed for Pu by radiochemistry and then measured by alpha spectrometry. However, Am is measured directly (with previous drying and removal of organic matter for soils) by gamma spectrometry without previous radiochemistry. There is a need to improve the detection limit of Am activity for vegetable samples, changed the direct gamma spectrometry measurements by radiochemistry and alpha spectrometry at least for the most representative samples. For milk samples, analyses of Pu and Am by sequential radiochemistry methods are done and then alpha spectrometry measurements are decided. All radioanalyses and measurements are performed according to established procedures at CIEMAT.

The specific sampling, analysis and assessment plan for 2003 is presented below:

Soils:

As mentioned above, work on soils during 2003 will combine extensive radiometric surveys and soil sampling and analyses, dealing with the updating and improvement of the radiological characterization of the global area of Palomares.

Concerning radiometric surveys, during 2003, it is expected to carry out the following:

- The survey carried out during December 2002 at the SE part of zone 3 (cultivated area to the SE of the original contamination plume) will be extended to cover other adjacent plots to the original contamination plume of bomb 3.
- A new survey in the parcel located in the border between zones 3 and 5 (close to impact point of bomb 3, in the opposite direction to the original contamination plume), already controlled during 2001, would be considered if a new plough takes place in the parcel. The objective would be the search of new radioactive metallic fragments that could be buried more than 10 cm in depth at present.

Concerning soils sampling and analyses the following work is planned:

- To complete Pu and Am analyses and measurements in the 10 samples collected during 2002 from the bed of Jatico River (run-off area of sub-zone 2-0, southern to the impact point 2), leading to estimate the influence (extension and magnitude) of the run-off process in the spreading of the contamination.
- To complete Pu analyses and measurements in the 24 surface soils collected in 2001 from the parcel located in the border of zones 3 and 5, leading to an estimate of the radiological inventory of this parcel.
- To complete Pu and Am analyses and measurements in the 21 soils collected in December 2002 in an area close to sub-zone 2-2.
- To complete Pu analyses and measurements in the 12 surface soils collected in December 2002 in the western part of the urban area, in a zone located close to the NE border of the zone 2 with the called zero line.
- To progress in Pu and Am analyses and measurements in the soils collected in 2002 on the top of the Villaricos hills (zone 6), leading to improvements in the radiological content of this area.

Concerning the study of hot particles, it is planned to progress in the following issues:

- To start the estimation of the isotopic composition of the bomb 2 from the analysis of soils collected in an area close to sub-zone 2-2. It can be guaranteed that only contamination from bomb 2 exists in this area. Removal of radioactive particles from the samples will be made in order to determine isotopic ratios between Plutonium isotopes and between Plutonium and Americium concentration.
- To progress in determining the isotopic composition of the bomb 3 by Pu and Am analyses and measurements of the soils adhered to metallic fragments found in the parcel of the zone 3 – 5, mentioned above. A removal of radioactive particles from these soils will be made in order to determine isotopic ratios between Plutonium isotopes and between Plutonium and Americium concentration.

With respect to the study on the time evolution of the Pu and Am solubility in Palomares soils, work will continue during 2003. Specifically, the influence of animal excretion fertilizing agricultural practices will be studied.

Air:

Weekly samples from 3 stations will be collected (meaning about 150 samples during the year in an optimal way). Additional samples from another station could be obtained if the problems of power supply are solved and the permission of the owner of the plot, where the station is located, is obtained. However, unexpected stops of the samplers and difficulties of repairing in situ, could lead to the collection of a lower number of samples. During 2003, the total of the samples corresponding to 2002 sampling will be analyzed for Pu (130 samples). Also, about 50 samples will be analyzed for Am by radiochemistry and measured by alpha spectrometry (about 50 samples). The samples are analyzed individually and accumulated in a monthly basis for measurement. However, in order to investigate potential peaks of activity during a month, semimonthly samples will be analyzed from those months where the higher mass

loading is normally estimated. The mass loading in all air stations will be studied in order to analyze its trend models.

Vegetation:

The historical review data analysis will continue during 2003. This should allow refining risk assessment for the ingestion pathway. Also sampling, analyses and measurements of representative crops of the most potentially affected zones will be performed during 2003, as a part of the routine area surveillance program. Specifically, sampling of watermelons (around 10 samples) is foreseen in zones 2, 3 and 5-3 B, involving at least 30 Pu and Am analyses. Another type of sampling is also foreseen at the end of 2003, in order to collect representative winter crop samples.

Urine:

In the same way as in preceding years, 150 people from Palomares will be transported to CIEMAT headquarters in Madrid for medical examinations, sampling of 24-hour urine collections and further bioassay analyses leading to internal dosimetric assessments. In total, 300 samples will be analyzed, 150 for Pu and the same 150 for Am by radiochemistry followed by alpha spectrometry.

Other:

About 5 cow milk samples will be collected and analyzed by radiochemistry and alpha spectrometry for Pu and Am during 2003. This work will contribute to improve the statistical significance of Pu and Am content in relevant animal consumption products. Also snail samples will be collected if possible, but, in any case, the analyses will be delayed to the year 2004.

IV. Milestones and Deliverables (include dates)

By December 31, 2003, we intend to achieve the following Milestones:

- Perform clinical examinations and radiobioassays of Pu and Am collected from 24-hour urine samples of 150 residents from Palomares.
- Perform sampling, analysis, and measurements of Pu and Am in air, soil, food crops, wild vegetation, milk, and other products. The number of analyses is listed above in Section III.
- Perform studies on the time evolution of the Pu and Am solubility in Palomares soils.
- Perform separation, identification, characterization and isotopic composition of hot particles in soils.

By April 15, 2003, we will provide the semi-annual progress reports for the first and second halves of 2002. By October 15, 2003, we will provide the semi-annual progress report for the first half of 2003.

V. Suggested Performance Indicators

- Provide the personal results from clinical examinations and radiobioassays of Pu and Am collected from 24-hour urine samples to the 150 residents from Palomares who were examined during the year, by April 2003.
- Provide the results from the sampling, analysis, and measurements of Pu and Am in air, soil, food crops, wild vegetation, milk, and other samples to CSN by September 2003 (semi-annual report for the first half of 2003) and by March 2004 (semi-annual report for the second half of 2003). These reports will also be provided to DOE. The number of analysis is listed above in Section III.
- Provide the information obtained on the time evolution of Pu and Am solubility in soils.
- Provide results concerning hot particles in soils to CSN and DOE by April 2004.

VI. References

Radiochemical analytical procedures were provided to DOE in 1992. Please see Annex I, Methodologies for Analysis and Measurements in "Summary Report on the Palomares Surveillance Program," July, 1992.

VII. CV's of Investigators (short 1-2 pages, if possible, including only relevant publications for the last 5-10 years)

Short CV's of persons working in the Palomares Project were submitted in 1999.

VIII. Budget Request (see attached form)

IX. Addendum Containing Relevant Publication Preprints, etc

- Vigilancia Radiológica en la Zona de Palomares. Informe al Consejo de Seguridad Nuclear (Segundo Semestre del Año 2002) CIEMAT/DIAE/PPRI/51100/02-2003.
- Vigilancia Radiológica en la Zona de Palomares. Informe al Consejo de Seguridad Nuclear (Primer Semestre del Año 2003) CIEMAT/DIAE/PPRI/51100/03-2003

- Tesis doctoral. Radiología de transuranidos: caracterización y comportamiento de partículas de combustible nuclear en suelos afectados por el accidente de Palomares. Autor A. Aragón.

It is also intended to send for publication a paper comparing solubility of radionuclides in Palomares and Chernobyl areas and another one on characterisation and isolation of fuel particles in Palomares.

X. Other Sources of Funding

None