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RESULTS OF THE ARN PARTICIPATION IN THE QUALITY ASSESSMENT PROGRAM OF THE EML-DOE DURING PERIOD 2000-2001

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ABSTRACT

The Autoridad Regulatoria Nuclear (ARN) participates every six months in the Quality Assessment Program (QAP), carried out by the Environmental Measurements Laboratory - United States Department of Energy (EML – USDOE). The aim of this participation is to assess the quality of the radiochemical determinations and alpha, beta, gamma measurements, that ARN realises routinely. The analysed matrix are: water, filter, soil and vegetable.

In the present work, the results of the ARN participation in the last four intercomparisons, period 2000-2001, are detailed and analysed statistically. The results are compared with obtained ones by all the laboratories.

RESUMEN

La Autoridad Regulatoria Nuclear (ARN) participa semestralmente en el Quality Assessment Program (QAP) organizado por el Environmental Measurements Laboratory - United States Department of Energy (EML – USDOE). La participación en este programa tiene como objetivo la evaluación de la calidad en las determinaciones radioquímicas y mediciones alfa, beta, gama, que la ARN realiza rutinariamente a los fines de protección radiológica. Las matrices que se analizan son: agua, filtro, suelo y vegetal.

En el presente trabajo se detallan los resultados obtenidos en las últimas cuatro intercomparaciones, correspondientes al período 2000-2001. Se comparan dichos resultados con los obtenidos por el resto de los laboratorios participantes.

INTRODUCTION

The Nuclear Regulatory Authority, ARN, (Autoridad Regulatoria Nuclear) of Argentina participates in several programs of intercomparison of results aimed at preserving the quality of measurements and radiochemical analysis carried out as part of occupational or environmental surveillance programs. The most important of them is the Quality Assessment Program (QAP), established by the United States Environmental Laboratory (EML) and carried out every six months. The results obtained from 1995, when ARN started its participation in the program, up to 1999 have been published previously [1]. On this second report, results corresponding to the four exercises of period 2000-2001 are published.

DESCRIPTION

The Quality Assessment Program of EML (QAP)

The Environmental Measurement Laboratory (EML) [2], is a government entity created within the United States Department of Energy (DOE).

The QAP program comprises alpha, beta and gamma measurements and is applied to four kinds of environmental matrixes: water, filter, vegetation and soil. The EML delivers for each intercalibration a total number of six samples containing a wide variety of radionuclides in concentrations compatible with environmental levels. Around 52 determinations are usually requested and more than 140 laboratories participate in this program.

This program consists of carrying out different types of measurements: by alpha and gamma spectrometry, liquid scintillation, ZnS detectors, proportional counters and the determination of uranium mass by fluorimetry.

As the organization responsible for nuclear and radiation safety in Argentina, including safeguards and physical protection of nuclear materials, and due to the long experience in measurements and radiochemical analysis, the ARN participates in the semi-annual exercises set up by the EML. So far, it has participated 14 times.

Table 1 shows the different types of samples and radionuclides analyzed on each matrix:

Type of Sample	Amount of Radionuclides	Radionuclide
WATER 1	13	^3H , ^{55}Fe , ^{60}Co , ^{63}Ni , ^{90}Sr , ^{137}Cs , ^{234}U , ^{238}U , U (Bq), U (μg), ^{238}Pu , ^{239}Pu , ^{241}Am
WATER 2	2	Gross alpha, gross beta
FILTER 1	13	^{54}Mn , ^{57}Co , ^{60}Co , ^{90}Sr , ^{106}Ru , ^{137}Cs , ^{234}U , ^{238}U , U (Bq), U (μg), ^{238}Pu , ^{239}Pu , ^{241}Am
FILTER 2	2	Gross alpha, gross beta
VEGETATION	8	^{40}K , ^{60}Co , ^{90}Sr , ^{137}Cs , ^{238}Pu , ^{239}Pu , ^{241}Am , ^{244}Cm
SOIL	14	^{40}K , ^{90}Sr , ^{137}Cs , ^{212}Pb , ^{212}Bi , ^{214}Pb , ^{214}Bi , ^{228}Ac , ^{234}U , ^{238}U , U (Bq), U (μg), ^{239}Pu , ^{241}Am

Table 1 Types of samples and radionuclides to be analyzed.

Evaluation criteria

According to the statistical methodology selected by the EML [3] results are classified as:

<i>Acceptable</i>	<i>Acceptable with Warning</i>	<i>Not acceptable</i>
Class A	Class W	Class N

RESULTS

General results

Figure 1 and Figure 2 show a comparison between the results obtained by the ARN and the obtained by others labs.

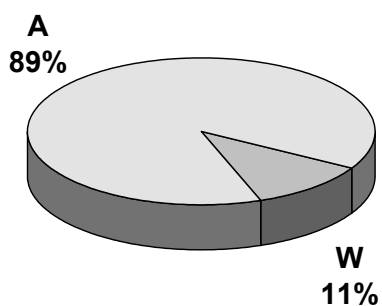


Figure 1. Mean of ARN results (period 2000-2001).

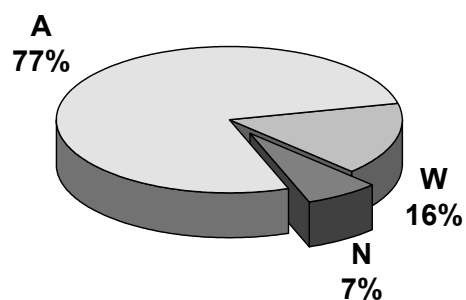


Figure 2 . Mean from all labs results (period 2000-2001).

These performances show that the percentage of ARN class A results for the considered period was 12% higher than class A results from all participating laboratories.

It can also be seen that during this period the number of ARN class N results was zero. It means that all the 179 values reported were accepted.

Table 2 displays general ARN results based on the analysis performed by EML [4 - 7]:

Year	QAP (*)	N (**)	n%	Class A		Class W		Class N	
				ARN %	All labs %	ARN %	All labs %	ARN %	All labs %
2000	52	43	84.3	86	73	14	18	0	9
2000	53	47	92.2	94	76	6	16	0	9
2001	54	45	88.2	84	79	16	16	0	5
2001	55	44	86.3	93	81	7	14	0	5
Mean:				89	77	11	16	0	7
Total determinations: 179									

Table 2. Results of ARN participation as compared with results from all participating laboratories

(*) Quality Assessment Program. Number assigned by EML to each intercomparison exercise.

(**) Number of results reported by ARN; n % corresponds to the percentage of reported results in relation to the number of data requested by EML.

Observing the percentage of class A results one by one, it can be seen that for all exercises, the values reported by ARN are higher than the corresponding mean from all participating laboratories. The differences fluctuate between 5.4 % and 17.6 %.

It is also worthwhile emphasizing the steadiness of results for the different A, W and N classes, that in the case of class A results this is an increasing tendency, as it will be shown in figures 5 and 7. The number of reported data was kept elevated all times and they represent a high percentage (n%) of the values requested by EML.

Results according to the type of emitting radionuclide

Table 3 shows a pronounced similarity in the percentage of class A and W results:

Emitter	n	Class A		Class W		Class N	
		n _A	n _A %	n _W	n _W %	n _N	n _N %
Alpha	95	84	88.4	11	11.6	0	0
Beta	20	18	90	2	10	0	0
Gamma	64	58	90.6	6	9.4	0	0

Table 3. Distribution of ARN results according to the type of emitting radionuclide.

n: number of total results reported by ARN.

n_A %, n_W %, n_N %: percentage of results reported by ARN related to the total number of data reported.

The difference in the number of data reported n , is due to different requirements of EML for each of the matrixes.

Figure 3 shows the distribution, in percentage, of the number of values reported for each type of emitter:

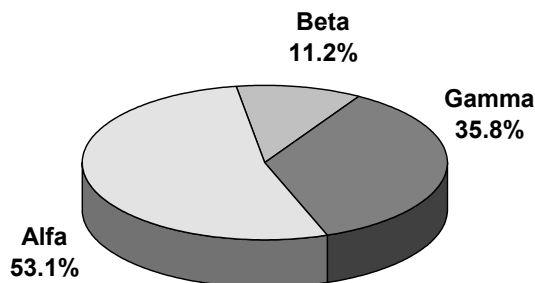


Figure 3. Number of data reported by ARN, in percentage, according to the type of emitting radionuclide (period 2000-2001).

Results according to the kind of matrix

Table 4 displays data distributed according to the type of matrix:

Matrix	n	Class A		Class W		Class N	
		n_A	$n_A\%$	n_W	$n_W\%$	n_N	$n_N\%$
Filter	47	42	89.4	5	10.6	0	0
Soil	51	46	90.2	5	9.8	0	0
Vegetation	31	27	87.1	4	12.9	0	0
Water	50	45	90	5	10	0	0

Table 4. Distribution of ARN results according to the type of matrix and qualifications achieved.

n : number of total results reported by ARN.

$n_A\%$, $n_W\%$, $n_N\%$: percentage of results reported by ARN and related to the total amount of reported results.

In this case, also, a very small change in the percentages of results classes A, W and N for the different kinds of matrixes may be observed.

Figure 4 displays the distribution, in percentage, of the number of data reported for each type of matrix:

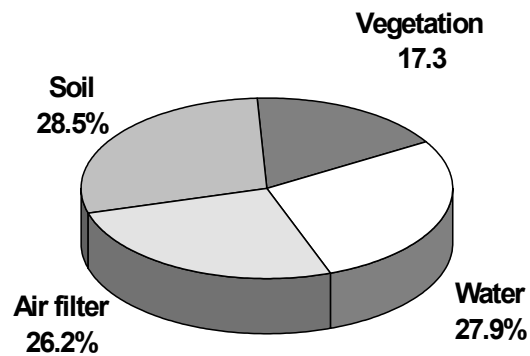


Figure 4. Number of data reported by ARN, in percentage, according the type of matrix (period 2000-2001).

Evolution of class A results with time

In Figure 5, the percentage of class A results corresponding to period 1995-2001 is plotted against the number assigned to the intercomparison. The tendency line obtained by lineal regression clearly shows the improvement achieved during this period.

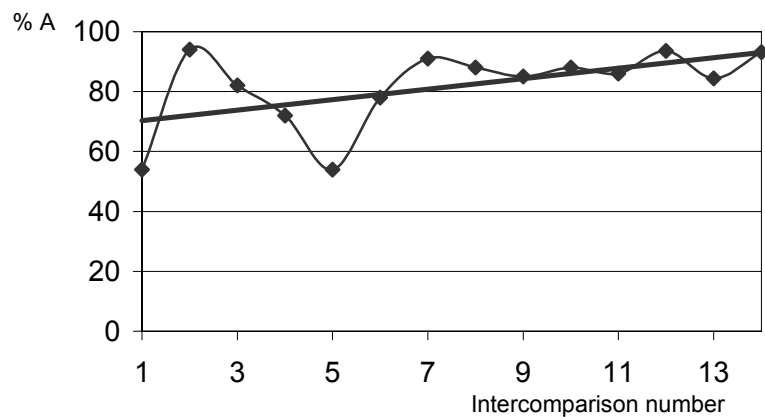


Figure 5. Evolution of ARN class A results (period 1995-2001)

The analysis of the data reported by all laboratories (Figure 6) clearly shows a steady improvement in the quality of results. Therefore, this outcome proves the usefulness of this kind of programs.

The difference in the slopes of both tendency lines shows that ARN not only improved its performance, as all other labs, but also achieved an extra improvement, because the oscillation of the percentage of class A results decreased during the last exercises.

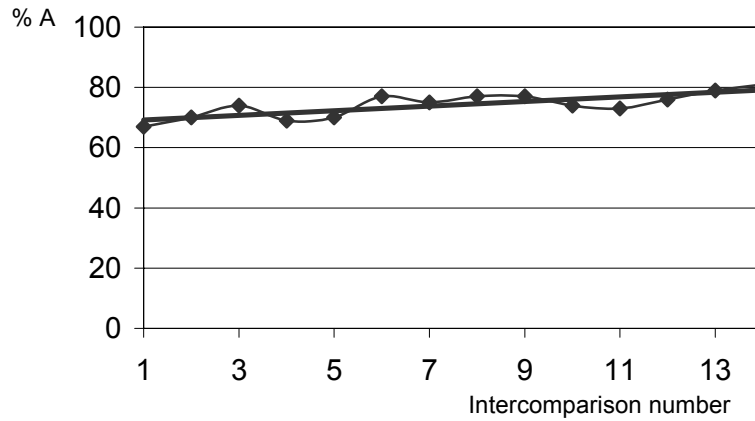


Figure 6. Evolution of class A results from all laboratories (period 1995-2001)

The same tendency may be seen in Figure 7 for the last eight exercises. The percentage achieved, one hundred, means that all results were accepted.

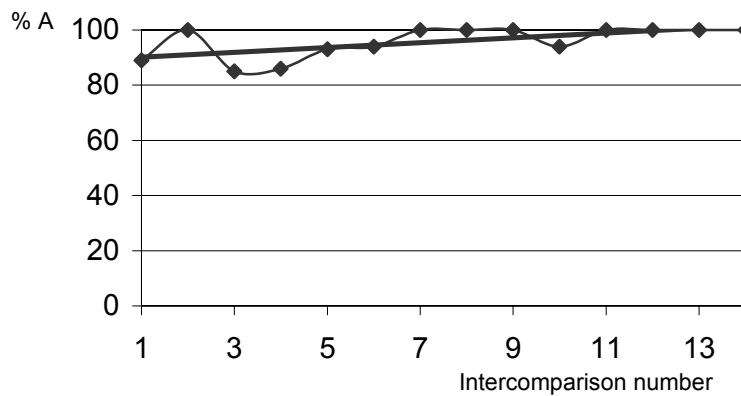


Figure 7. Evolution of ARN class A+W results (period 1995-2001)

CONCLUSIONS

The mean of class A results during the last 2 years was higher than the mean corresponding to all participating laboratories.

There were no class N results, since all data were accepted.

The number of reported data was kept high at all times during this period.

When considering not only the emitting radionuclide but also the matrix, the quality of all data was similar.

The graph of class A data against time from 1995 up to 2001 shows that the slope surpasses the corresponding slope for all laboratories. It can also be seen that there is an improvement in the steadiness of data.

NOTE

Up to the date of issuing this paper in the QAP Report-EML 611 [5] data informed by each laboratory are shown truncated by EML in the second decimal. This fact made that many of the values, mainly the very small ones, were considered class N or W instead of class A and conversely.

This erroneous methodology was observed not only by ARN but also by several other laboratories that were also damaged in their qualifications. Because of this fact, results are published in this paper as they were reported and as registered on our records.

BIBLIOGRAPHY

[1] Publicación interna ARN PI-2/00.

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[5] QAP Report-EML611, Greenlaw, P.; Berne, A., 2000.

[6] QAP Report-EML613, Greenlaw, P.; Berne, A., 2001.

[7] QAP Report-EML615, Greenlaw, P.; Berne, A., 2001.