

ARN RESULTS IN INTERLABORATORY COMPARISON EXERCISES

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Abstract. For years, the Nuclear Regulatory Authority (ARN) has been involved in several laboratory intercomparison programmes. The objective of participating in these exercises is to assure the quality of the determinations that the radiochemical laboratories of ARN carries out as part of its regulatory activity. Most of these determinations are related to its environmental monitoring program in the vicinity of nuclear and radioactive facilities existing in the country, in operation or not. Other determinations are related with effluent samples and monitoring activities performed inside the facilities.

On the other hand, these intercomparisons are part of the requirements for the laboratories under ISO 17025. ARN laboratories are in process to obtain or maintain ISO 17025 accreditation as a priority objective.

During the development of the intercomparisons, different samples have been tested in several matrices containing alpha, beta and gamma emitters. These exercises were organized by different laboratories as the IAEA, the EML and NIST from United States, the NPL and the NRPB from England, the BFS from Germany, and so on.

The results were very satisfactory not only in direct measurements (gamma spectrometry) but also in those that require a previous intensive laboratory processing (alpha spectrometry and liquid scintillation), resulting in many cases better than the general average. This paper provides a summary of the results obtained in these exercises and the results are compared with the overall average of the participating laboratories.

KEYWORDS: *Interlaboratory, inter comparison, ARN laboratories, performance*

1. Results obtained by ARN in the intercomparison exercises during 2007

During 2007 the ARN laboratories performed several intercomparison exercises organized by laboratories from different countries. Table 1 shows a summary of these exercises with their corresponding results:

Table 1: Summary of 2007 exercises with ARN's results

Organization	Exercise	Matrix	Type analysis	Number of results	Assessment ^(*)
National Institute of Standards and Technology (NIST), USA	"NIST Radiochemistry Intercomparison Program, NRIP'07" ^[1]	Water	H-3, uranium and gamma emitters	5	A: 80,0 %
					N: 20,0 %
Health Protection Agency (HPA), UK	"2007 Intercomparison of passive radon detectors"	Air collected on Activated charcoal	Rn-222	5	Not evaluated

National Health Laboratory (NPL), UK	"NPL ENVIRONMENTAL RADIOACTIVITY PROFICIENCY TEST EXERCISE 2007" ^[2]	Water	Alpha, beta and gamma emitters	38	A: 84.2 %
					W: 10.5 %
					N: 5.3 %
International Atomic Energy Agency (IAEA)	"IAEA CU-2007-09 Proficiency Test On the Determination of Po-210 In Spiked Water" ^[3]	Water	Po-210	4	A: 100 %
International Atomic Energy Agency (IAEA)	"The IAEA-CU-2007-03 World-wide open proficiency test" ^[4]	Water, soil and vegetal	Alpha, beta and gamma emitters	24	A: 87.5 %
					W: 4.2 %
					N: 8.3 %
Comisión Nacional de Energía Atómica (CNEA), Argentina	INTERLAB RU-1 ^[5]	Water	Uranium	6	A: 100 %
Total of results:				82	

(*) **A** = "Accepted", "traceable", "in agreement", etc.
W = "Accepted with warning", "questionable", etc.
N = "Not accepted", "discrepant", etc.
according to the exercise organizer.

In summary, the intercomparison exercises resulted in the following general averages (Fig. 1):

Figure 1: 2007 - ARN's general averages.

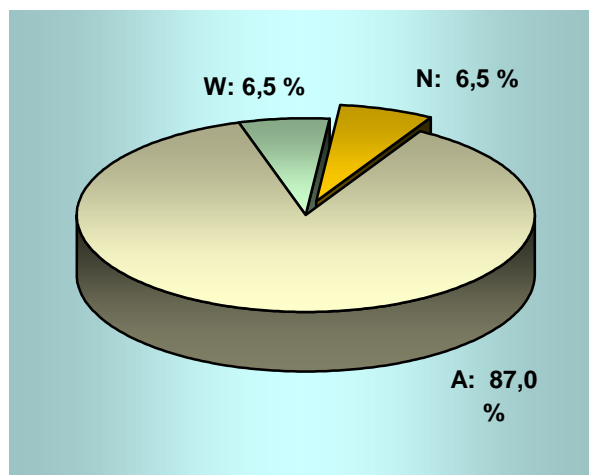
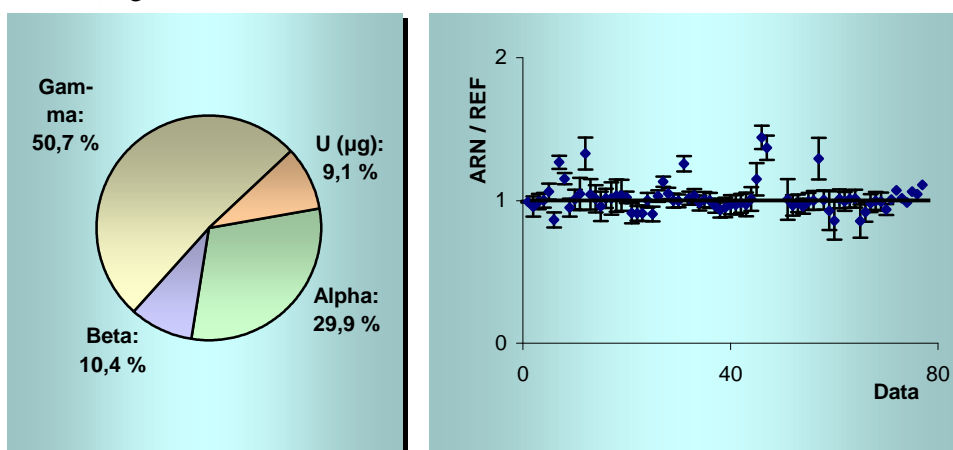


Figure 2 shows the percentage distribution of the reported results, presented by type of emission: gamma emitters (direct measurements), alpha and beta emitters (indirect measurements). Figure 3 presents a distribution of all the results in relation with the reference values. It is also shown the difference between each result and the corresponding reference value.

Figure 2: Percentage distribution of the reported results, presented by type of emission: gamma emitters, alpha and beta emitters (Left) and **Figure 3:** Distribution of all the results in relation with the reference values (Right).



In the figure 2, the sum of the percentages is not 100% due to the rounding.

Table 2 shows the radionuclides analyzed by type of emission, as well as the evaluated results achieved in each category, and the total reported results for each group of emitters.

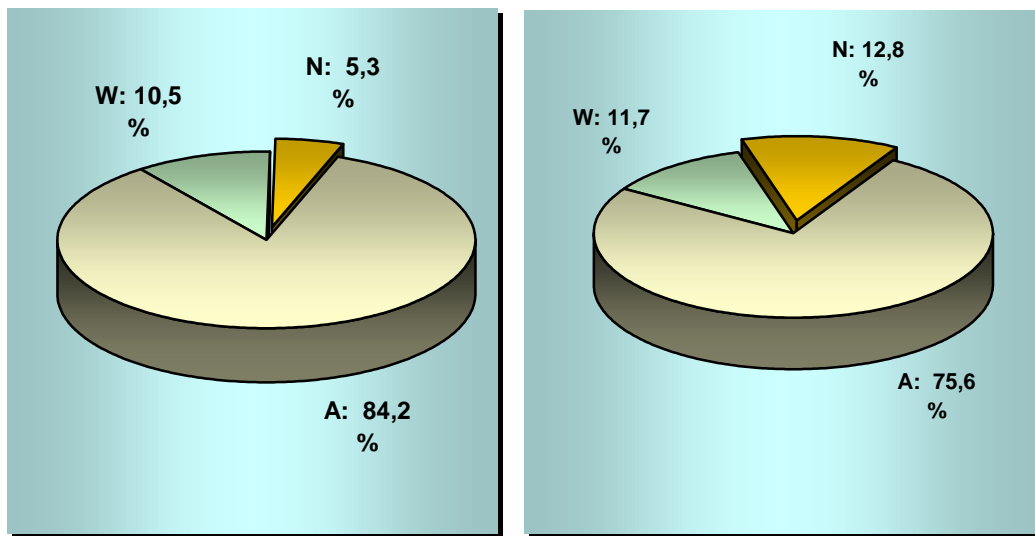
Tabla 2: Radionuclides analyzed by the ARN, by type of emission.

Type of emission	Radionuclides	A %	W %	N %	Total of results
Alpha	Ra-226 U-238 Pu-238 Pu-239 Am-241 Cm-244 Po-210	87.0	4.3	8.7	23 (+5 not evaluated)
Beta	Ni-63 Sr-90 H-3	50.0	37.5	12.5	8
Gamma	Co-60 Zr-95 Nb-95 Sb-125 Ba-133 Cs-134 Cs-137 Ce-144 Eu-152 Eu-155 K-40 Cd-109 Mn-54 Pb-210 Zn-65 Co-57	94.9	2.6	2.6	39
U (µg)	U	85.7	0	14.3	7

2. Results obtained by ARN in the intercomparison exercise organized by the NPL (2007)

The 2007 NPL report is the most complete and it allows comparing ARN results with all participating laboratories. In Figure 4 are shown the results obtained by ARN and in Figure 5 the average results obtained for all the laboratories in this exercise, being “non reported” gamma isotopes excluded.

Figure 4: NPL 2007- Results obtained by ARN (Left) and **Figure 5:** NPL 2007- Results obtained by all laboratories (Right).

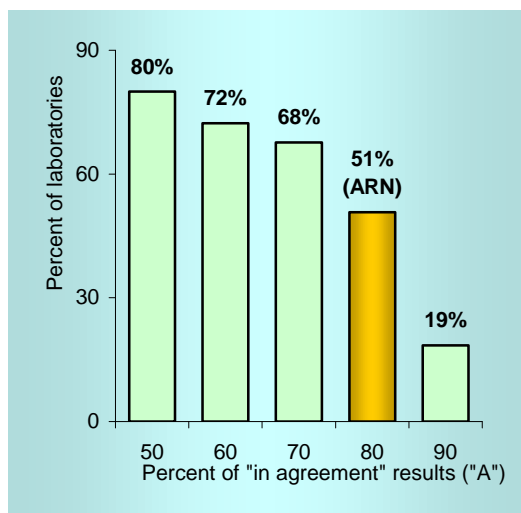


In the figure 5, the sum of the percentages is not 100% due to the rounding.

The results described as “in agreement” ranged from 25% to 100%. As it can be seen, the average of all laboratories for grade “A” was 75.6%.

Figure 6 shows the number of laboratories that exceed a certain percentage of accepted results. It is important to point out that ARN is one of the 51% of participating laboratories that achieved more than 80% of accepted results. Only 19% of the laboratories had more than 90% of accepted results.

Figure 6: NPL 2007- Laboratories with a percent of accepted dates better than...



When the participating laboratories are sorted by the percentage of results “in agreement”, it is important to remark that the laboratories of ARN are located in position number 27 when the total number of participating laboratories was 65.

3. Results obtained by ARN in several intercomparison exercises prior to 2007

Table 3 shows an overview of the intercomparison activities carried out by ARN’s laboratories from 1994 until 2006:

Table 3: Overview of the intercomparison activities of the ARN's laboratories from 1994 until 2006.

Year	Organism	Exercise	Matrix	Type analysis	Number of results	Assessment(*)
1994	Laboratoire D'Analyses de Biologie Medicale de Commissariat a L'Energie Atomique (CEA), France	"Radiological Intercomparison Exercise - Quality Control Tritium in Urine and water" ^[6]	Water and urine	H-3	5	A: 100 %
1995 to 2004	Environmental Measurements Laboratory (EML), USA.	"Quality Assessment Program (QAP)" ^[7-9]	Water, soil, vegetables and filters	Alpha, beta and gamma	718	A: 82.9 %
						W: 13.4 %
						N: 3.8 %
1994, 1995 and 1996	Environmental Measurements Laboratory (EML), USA	-	Scintillation cells	Rn-222	12	Not evaluated
1998	American Association of Radon Scientists and Technologists (AARST), USA	-	Scintillation cells, Activated charcoal and Electrets	Rn-222	14	Not evaluated
1999	Bundesamt für Strahlenschutz-Federal Office for Radiation Protection (BFS), Germany	BFS-RV-1999-Am-241 ^[10]	Urine	Am-241	1	A: 100 %
1999	Environmental Measurements Laboratory (EML), USA	"Eml gamma spectrometry data evaluation program"	-	Software of gamma spectrum analysis	-	Not evaluated
2000	Bundesamt für Strahlenschutz-Federal Office for Radiation Protection (BFS), Germany	BFS-RV-2000-Pu-240 ^[11]	Urine	Pu-240, U-238 and U-234	3	A: 100 %
2001	International Atomic Energy Agency (IAEA)	"Alpha emitters in urine samples"	Urine	Alpha emitters	11	Not evaluated

2003	Bundesamt für Strahlenschutz-Federal Office for Radiation Protection (BFS), Germany	BFS-RV-2003-Th/U	Urine	Uranium and thorium	10	A: 80 %
						N: 20 %
2003	National Radiological Protection Board (NRPB), UK	-	Activated charcoal and Electrets	Rn-222	15	Not evaluated
2004	Environmental Measurements Laboratory (EML), USA	"Eml gamma spectrometry data evaluation program"	-	Software of gamma spectrum analysis	-	Not evaluated
2005	Health Protection Agency (HPA), UK	"2005 Intercomparison of passive radon detectors"	Activated charcoal	Rn-222	10	A: 100 %
2005	Bundesamt für Strahlenschutz-Federal Office for Radiation Protection (BFS), Germany	BFS-RV-2005-H-3 and BFS-RV-2005-Sr-90	Urine	H-3 and Sr-90	4	A: 75 %
						N: 25 %
2006	International Atomic Energy Agency (IAEA)	"The IAEA-CU-03 2006 worldwide proficiency test (PT)"	Water, grass and soil	Gamma emitters	18	A: 83.3 %
						W: 5.6 %
						N: 11.1 %
2006	National Institute of Standards and Technology (NIST), USA	"NIST Radiochemistry Intercomparison Program, NRIP'07"	Water	H-3, uranium and gamma emitters	6	A: 66.7%
						N: 33.3 %
Total of results:					827	A: 89.0 %
						W: 2.1 %
						N: 8.9 %

(*) **A** = "Accepted", "traceable", "in agreement", etc.
W = "Accepted with warning", "questionable", etc.
N = "Not accepted", "discrepant", etc.
according to the exercise organizer.

Combining the values calculated for 2007 and those that come out from the above table, the following values are obtained for the period 1994-2007 produced from 909 results (Table 4):

Table 4: Combining averages for ARN from 1994 until 2007.

A (%)	W (%)	N (%)
88.0	4.3	7.7
Total of results:		909

4. Conclusions

In general, the performance of the ARN laboratories was very satisfactory not only in direct measurements (gamma spectrometry) but also in those that require a previous intensive laboratory processing (alpha spectrometry and liquid scintillation), resulting in many cases better than the general average.

During 2007, the laboratories of ARN obtained 87.0% of accepted results, with 82 reported data (and 77 evaluated data) in 6 intercomparison exercises.

In the participation in the exercise organised by the NPL, the ARN reached 84.2% of accepted results, being one of the 51% of participating laboratories that achieved more than 80% of accepted result. The average result achieved for grade “A” was better than the average of all laboratories, which was 75.6%.

Since 1994 the ARN has participated in 40 intercomparison exercises and has produced 909 results with 88.0% of them qualified as grade “A”.

These results confirm the quality of the determinations carry out by the ARN laboratories as part of its regulatory activities.

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