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Working Material

Regional Workshop on Inter-Comparison Feedback of Neutron Activation Analysis Proficiency Tests Performed in 2011-2012

Report of a workshop under regional TC project RER1007

Delft, Netherlands, 22–25 May 2012

Contents

1. Background

European and one Middle East neutron activation analysis (NAA) laboratories, under the IAEA Technical Cooperation project RER 4/032, participated in the periods September–December 2011 and January–April 2012 in two consecutive proficiency testing rounds by inter-laboratory comparison organized by the Wageningen Evaluating Programs for Analytical Laboratories (WEPAL). In each round four soil samples of the International Soil Analytical Exchange (ISE) and four botanical samples of the International Plant Analytical Exchange (IPE) were provided for analysis. WEPAL reported the results of these exercises within three weeks after the closing date for submission of data. This evaluation was made on basis of standard deviation (z) scores, i.e., the difference among laboratory results and an assigned value divided by an assigned standard deviation. Satisfactory performance is attained for consistently reporting z-scores < 3, and bias values < 20%. The participating laboratories are listed below in Table 1.

TABLE 1. LABORATORIES PERFORMING PROFICIENCY TESTS WEPAL ISE/IPE 2011-4 AND 2012-1

Institution	Location
Nuclear Physics Institute, Academy of Sciences of the Czech Republic	Řež, Czech Republic
Aristotle University of Thessaloniki	Thessaloniki, Greece
Laboratory of Applied Nuclear Energy (LENA), University of Pavia	Pavia, Italy
Institute of Nuclear Techniques, Budapest University of Technology and Economics	Budapest, Hungary
Atomic Energy Research Institute (KFKI)	Budapest, Hungary
National Nuclear Center	Almaty, Kazakhstan
Nuclear and Technological Institute (ITN/IST)	Lisbon, Portugal
Institute for Nuclear Research Piteşti	Piteşti, Romania
Petersburg Nuclear Physics Institute	Gatchina, Russian Federation
Petersburg Nuclear Physics Institute	Gatchina, Russian Federation
Jožef Stefan Institute	Ljubljana, Slovenia
Atomic Energy Commission of Syria	Damascus, Syrian Arab Republic
Energy Institute, Istanbul Technical University	Istanbul, Turkey

Most laboratories performed satisfactory to excellent tests for the majority of elements surveyed, though still some extreme outliers occurred. In the first round, labelled 2011-4, substandard performance was observed for laboratories from Hungary, the Russian Federation and Turkey. After the second round, 2012-1, some improvement has been observed, but the results from the laboratories in Russian Federation and Turkey were still somewhat below the state of the practice of the other NAA laboratories.

This workshop was proposed as a feedback exercise for the laboratories in order to promote further improvement of their degree of trueness while conducting NAA. Specifically, the objectives of the workshop were to:

- Present status reports of the NAA performed during the two rounds of proficiency testing;
- Analyze the test results and possible sources of error with the help of experts and peer exchange;
- Discuss the lessons learned and suggest remedies to improve forthcoming NAA and other analytical technique proficiency tests; and
- Draft a meeting report and formulate recommendations to proficiency test participants.

Among the expected recommendations derived from discussion, the participants were tasked with developing technique related guidelines useful for laboratory performance in the future and actions plans for improvement of both independent verification measures and customer relations with regard to reporting and assurance of data.

2. Introductory session

The Regional Workshop began with a welcome to the 10 proficiency test participants from the local host, Mr Peter Bode of the Delft University of Technology, the General Manager of Reactor Institute Delft, Mr Rik Linssen, and the IAEA representative, Mr Nathan D Peld of the Department of Nuclear Energy. Mr Peld proceeded to give a presentation highlighting the global situation of research reactors and the IAEA's programmes related to NAA. The latter included a nearly completed coordinated research project on large sample neutron activation analysis and a forthcoming coordinated research project on enhancing automation in the NAA process in addition to several sponsored regional proficiency tests.

This welcome and introduction was followed by a general overview of the PT results conducted by Mr Bode, who noted that seven laboratories reported excellent results in at least 1 of the 2 cycles. Additionally, the results portrayed generally the testing of a wide variety of elements with low standard deviation, which was set by WEPAL for $-3 < z < 3$. The Institute of Nuclear Techniques at the Budapest University of Technology and Economics in Hungary demonstrated marked improvement between the two cycles. However, for a variety of reasons, prominently, limited access to irradiation time at the reactor, the participants submitted their results very close to the target deadline determined by WEPAL.

3. Discussion of proficiency tests and results

3.1. Individual country reports

Each of the eight participating laboratories presented its testing conditions, process, and in some instances, results according to a template distributed prior to the Regional Workshop. Most laboratories utilized the relative or k_0 method of NAA to analyze the biological and inorganic samples, and one performed both methods. Approximately one month was required for the laboratories to complete the cycle of analysis regardless of the size and experience of laboratory staff assigned to NAA testing. Furthermore with regard to staff size, some laboratories have trained their entire complement of technicians in NAA methods, while one possesses just a single trained technician.

The participants described the implementation of sample preparation, irradiation and analysis. Sample preparation included oven heating for dry mass determination, which resulted in generally commendable wet-to-dry mass ratios varying from very close to unity for soil to up to 15% for plant material, and assembling of test capsules containing the samples of concern, various reference materials and blanks. Sample masses, irradiation times and neutron flux values were listed. Finally, detector descriptions, software used for analysis and internal quality control methods illustrated the analytical portion of the proficiency test. Quality management systems, closely following the requirements of the standard ISO/IEC 17025:2005 have been implemented at different levels in the laboratories and several of them intend applying for eventual accreditation thereof; others have less robust quality assurance programmes. Some participants also discussed their own evaluation of their results, demonstrating their accuracy and occurrence of outliers, leading to a preliminary discussion of possible sources of error and recommendations for minimization.

The second day of the workshop commenced with a lecture by Mr Bode summarizing the lessons learned from this inter-laboratory comparison. He noted that external measures for quality control contribute to an independent view of a laboratory's performance, but internal programmes are still essential to enable immediate remedial and corrective actions if criteria are not met; also because of the gap in time between reporting results and receipt of feedback. There is also a potential for errors in the extensive documentation required by proficiency testing. Furthermore, laboratories were recommended to initiate a culture of self-assessment to accommodate variations in laboratory capacity and typical customer demands in addition to developing procedures for method validation, heightening internal quality control and raising the quality of calibrators. The fidelity to WEPAL instructions demonstrated by the laboratories was commended. On the other hand, in one instance where heating conditions for dry mass determination were followed inexactly, no significant difference in results could be observed. Concluded from these observations was the success of the proficiency test experiment in terms of the satisfactory results and in illustrating the potential for improvement by participant review and discussion during the workshop, given the open minded attitude of the technicians regardless of the quality of their results. Also, the participants agreed with this assessment.

3.2. Dialogue with WEPAL

Manager of WEPAL Mr Bram Eijgenraam was invited to discuss his organization's methods for preparing test samples and to receive feedback from the participants. He described the lengthy experience, extending through some decades and numerous tests, of WEPAL in programmes for proficiency testing of laboratory analysis of soil and organic matter. With a massive electronic database of test results, he was able to show a trend of lower standard deviation scores since 1990, indicating, when taken as a whole, improved analytical quality by laboratories. He then explained WEPAL's technique for collecting, mixing and distributing samples.

During a brief question session, the participants indicated a preference to receive information on sample homogeneity, which would be taken under consideration according to Mr Eijgenraam. However, he emphasized that WEPAL assumes laboratories process and analyze the samples following the laboratory's own common procedures, just like any other sample. He then indicated his organization would most likely not require the reporting of uncertainty values, nor would it establish a programme to track performance by a single laboratory or group of laboratories.

Concerning data itself, he stressed the importance of reporting in prescribed units for a sufficient number of significant digits in each value, and that statistical outliers are given little weight in WEPAL's evaluation.

This presentation was followed by another describing the conceptual background of proficiency testing, which was undertaken by Mr Jan Kučera of the Nuclear Physics Institute in Řež, Czech Republic. Mr Kučera outlined the various International Organization for Standardization (ISO) guidelines applicable to proficiency testing, which form the technical basis of such experiments. Assigned values and uncertainties, following these guides, should be determined using formulation, the mixing of constituents in specified proportions; certified reference values taken from experiments involving certified reference materials; reference values from certified material testing in one calibration laboratory; consensus values from expert laboratories; or consensus values from laboratories participating in a proficiency test, which can be used by WEPAL. Laboratories seeking an effective evaluation of their performance must consider laboratory bias, stability and repeatability. In a proficiency testing scenario, the relationship between these three aspects must be taken into account, noting that laboratory bias is only determined by certified reference material testing. Finally, he reiterated the priority of conducting self-assessment rather than relying solely upon WEPAL data distribution. Ms Kubešová, also of the Nuclear Physics Institute, presented a novel method for the assessment of uncertainties in k_0 NAA using the Kragten spreadsheet technique, which was designed in the NPI. The results attained were compared with other approaches, namely with Kayzero®, k0-IAEA v. 5.22. and ERON software. The differences observed were discussed in terms of how the above tools take into account uncertainty sources and their correlations.

3.3. Conclusions from proficiency test results

All proficiency test results from the cycles WEPAL ISE/IPE 2011-4 and 2012-1 were reviewed by the group for the purpose of identifying trends and outliers and determining possible sources of error. Most laboratories' results showed a small positive bias toward consensus, suspected by the participants to be sourced in the large number of laboratories using destructive techniques that may not have complete recovery. The large volume of data provided by the 14 laboratories contained several common errors as well as certain anomalies that must be specially anticipated, although the results in general were very successful. These errors can be classified by where they occurred in the NAA process, whether in sample preparation, irradiation or analysis, as illustrated in the table below. Some solutions to these difficulties are given in Section 5 among the participants' recommendations.

TABLE 2. POSSIBLE SOURCES OF ERRORS ENCOUNTERED IN PROFICIENCY TESTS 2011-4 AND 2012-1

Soil samples		
Sample preparation	Irradiation	Analysis
• Too few reference materials • Possible contamination • Verification of balance functioning	• Irradiation period too short for precise timing • Improper channel temperatures • Range of elements limited by low neutron flux • Technical problems with rabbits • Interference from fast neutron reactions • Inadequate transfer system • Inadequate accounting for axial and radial flux gradients • No simultaneous irradiation of samples, calibrators and flux monitors • No re-assessment of *f* and alpha values after new reactor core setup for k_0 NAA, and of their stability with reactor operation cycle/burn-up • Irradiations may have been done in non-calibrated irradiation channels	• Geometrical differences between test portion and calibrator in close-to-detector positioning • Certain isotopes like ^{85}Sr and other well known spectral interferences are difficult to fit during spectrum evaluation • Improper or absent calibration for neutron flux, detector efficiency or transfer time • Incompatibility of detector parameters if two or more Ge detectors are used • Typing errors • Internal quality control materials (reference materials and blanks) not included in the same run as the PT samples
Plant samples		
Sample preparation	Irradiation	Analysis
• Sample sizes too small • Verification of balance functioning • Contamination from labels • External contamination of Na • Inadequate homogeneity • Inadequate performance of relative standardization • Dry mass determination on same samples as analyzed	• Range of elements limited by low neutron flux • Interference from nuclear reactions involving P • Inadequate accounting for axial and radial flux gradients • No simultaneous irradiation of samples, calibrators and flux monitors • No re-assessment of *f* and alpha values after new reactor core setup for k_0 NAA, and of their stability with reactor operation cycle/burn-up • Volatilization of, e.g., Br and Hg, during irradiation in high flux reactors • Irradiations may have been done in non-calibrated irradiation channels	• Geometrical differences between test portion and calibrator in close-to-detector positioning • Typing errors • Improper calibration for neutron flux or k factors • Incompatibility of detector parameters if two or more Ge detectors are used • Mix up of samples • Internal quality control materials (reference materials and blanks) not included in the same run as the PT samples • Blank not accounted for (e.g., Cr interference) • Unanticipated background radiation (e.g., ^{60}Co from stainless steel)

4. Integrated management systems in NAA

First invited expert Ms Marcella Cagnazzo of the University of Pavia, Italy, and subsequently Mr Bode presented their laboratories' experiences with establishing and implementing management systems with particular attention to consequences encountered by NAA laboratories. Ms Cagnazzo's presentation described the Laboratory of Nuclear Applied Energy's integrated management system that overlooks every aspect of reactor and laboratory operation and maintenance as well as staff training and qualification. Particular to instrumental NAA at the laboratory, the management system administers groups of procedures within the relevant areas of operation and maintenance, safety, lab activities and analysis. Quality control tests verify the operation and upkeep of the pertinent reactor systems and laboratory equipment, for example, the gamma detection equipment. The rest of the integrated management system, from procedure to addressing non-conformities to horizontal and vertical auditing, was also explained. Despite the significant effort, cost and time required for proper implementation, the system is favored for improved ability to identify and investigate errors and malfunctions in addition to heightened traceability. The former is accomplished for instance through control charts of test and equipment performance, while for traceability, the laboratory practices unique coding, independent verification, regular review and dated records.

Mr Bode on the other hand reviewed the two decades of a functioning accredited quality management system at the NAA laboratory of the Reactor Institute Delft. Such a system was necessitated by an increase in services to the Dutch government and private sector actors and some instances of poor documentation or performance, and its deployment led to ISO accreditation in about two years. The system designed incurs low costs for establishment and maintenance, and has resulted in the minimization of failures and time lost to repetition and traceability. The basic problems with quality management are the tendency for redundant or extraneous documentation and typically more stringent audits following accreditation. In summary, accreditation for quality management is an important symbol for laboratory prestige and effectiveness as well as a distinctive responsibility for staff to sustain.

5. Conclusions and future actions

The participants of the above programme agreed that the two rounds of proficiency testing, consisting of analyses of four plant materials and four soil materials in each run, which were provided by WEPAL, was a very useful tool of external quality control (EQC) and provided good insight into the performance of the individual laboratories concerning the analytical quality, planning of analyses and reporting. For some of the participating laboratories it was the first occasion to take part in this kind of EQC. Some other laboratories participate in such an endeavour on a more or less regular basis. The majority of the participants agreed that a continuation of this kind of proficiency testing would be very helpful in checking or improving their laboratory performance. It is an indispensable step to any intended laboratory accreditation. Additionally, the participants concluded in some laboratories deficiencies resulted from insufficient awareness on the potential sources of error in the practical execution of NAA, which is partly a consequence of young staff with only a few years of practical experience. This situation may expand to many NAA laboratories worldwide.

Each of the participants devised an action plan for corrections to be taken for deficiencies encountered during the proficiency test. The participants aim to implement the measures prior to the next round of proficiency testing, expected to begin in Q1 2013. These plans are given in Appendix 1.

In order to be able to fully exploit the outcome of the proficiency test organized (and evaluated) by WEPAL it is necessary:

1. The IAEA should implement such a project before the first samples are routinely dispatched by the proficiency test provider. In the first run the samples were delivered to the participating laboratories only six weeks before the deadline, at the time period which was close to the end of the year, and some reactors were going for a shutdown within one or two weeks. This bad timing prevented several laboratories from performing the analyses before the approach of the deadline.

2. For the laboratories that participated for the first time the analytical instructions provided by WEPAL were considered incomplete. Therefore, it is suggested that the IAEA provide additional instructions for analysis of next test runs organized by WEPAL, which should contain the following information:

   — Laboratories should strictly adhere to all instructions given by WEPAL on sample preparation and reporting;
   — The samples provided by WEPAL may not be sufficiently homogeneous for all components at sample masses typically used in INAA (50–150 mg). Therefore the samples should be treated as received from a customer. This may imply that additional milling and homogenization should be carried out with adequate measures to prevent contamination;
   — Some laboratories carried out analyses of various (certified) reference materials simultaneously with the WEPAL test samples to prove the trueness of their results, while some did not do these control analyses, because they did not have suitable CRMs or RMs. It will be very helpful in the next proficiency test if the IAEA facilitates the provision of one suitable CRM of soil and one CRM of plant material to allow the laboratories to perform an internal quality control exercise;
   — The drying instructions of WEPAL (moisture content should be determined on separate, on analysed aliquots, by oven drying at 105°C for at least 3 hours) should be followed. Changing this drying procedure would not contribute to an improvement of the outcome of proficiency test if all participating laboratories (not only those participating within this IAEA programme) apply another drying procedure;
   — There is no recommendation concerning the number of replicates analysed in the individual laboratories within a proficiency run. This should be governed by the individual laboratories' rules and procedures;
   — The analyses in a proficiency test should be performed in a way other samples are analysed in a particular laboratory. No special measures are needed in performing these analyses to be able to show "routine laboratory performance;" and
   — In addition, the participating laboratories should receive a copy of Table 2 from this Meeting Report to inform them of possible sources of error.

6. Recommendations

To the IAEA:

1. To consider facilitating participation of laboratories in the European region in another set of two consecutive proficiency testing rounds organized by WEPAL, preferably within the same calendar year, and to organize a feedback meeting for assessment of the effectiveness of the corrective actions taken by the participants in the WEPAL ISE/IPE 2011-4 and ISE/IPE 2012-1 proficiency testing rounds.
2. To continue supporting the fostering of human capacity building in the metrology of NAA in MS laboratories, e.g., via research fellowships, training courses and a potential CRP on "Metrological Practices in Analytical Services by Research Reactors."

To the laboratories:

1. To design procedures for internal evaluation of results of participation in proficiency testing rounds, based on pre-defined quantitative criteria and taking into account the uncertainty of measurement. The procedure should include at least a root cause analysis prior to a remedial or corrective action, if relevant.
2. To establish a policy for participation in proficiency testing and inter-laboratory comparison programmes, with attention to the frequency of participation and style of participation (routine or best measurement capabilities).
3. To consider investing in human capacity building in the metrology of NAA.

To the governments:

1. To sustain or increase financial support for education and training in applied nuclear sciences in order to foster human capacity in these fields, given their role in socio-economic development.

Appendix 1. Laboratory action plans

1. NUCLEAR PHYSICS INSTITUTE, CZECH REPUBLIC

— To optimize the procedure for Sr determination, preferably by using short lived nuclides.
— Determination of DL determination has to be checked and corrected for possible systematic errors (underestimating of DLs in case of S).
— Procedure for checking the reports with results before sending them to customers should be developed to avoid the typing errors.

Actions to be implemented by the end of the year.

2. INSTITUTE OF NUCLEAR TECHNIQUES, BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS, HUNGARY

— In general: keep on participating in proficiency tests to maintain and improve the quality of analytical work in the laboratory.
— In particular, concerning lessons learned from this proficiency test:
    1) Check the spectra of analyzed IPE and ISE samples and find the possible sources of error for the outlining results.
    2) Decide on a procedure for dry mass determination.
    3) Find RMs for plant materials.
    4) Check k factors for in-well position.
    5) Use blanks.
    6) Find solution for labeling.
    7) Re-analyze some of the IPE samples using sample weighs of about 200 mg.

1–3 can be completed by 31 Aug 2012.
4–7 can be completed by the end of 2012.

3. LABORATORY OF APPLIED NUCLEAR ENERGY (LENA), UNIVERSITY OF PAVIA, ITALY

— Review the procedure used for sampling preparation taking into account the lessons learned from sharing information with other participants (example, homogenization of the sample, evaluation of the best amount of sample to be analyzed and standardization of geometry/position of the sample). Evaluate the quality of the reference materials currently utilized.
— Evaluate the convenience of starting application of k_0 method (neutron spectra are well known in different irradiation facility).
— Perform again an internal test using some of the samples used in the 2 ISE and IPE runs.

Actions to be implemented by the end of the year.

4. NUCLEAR AND TECHNOLOGICAL INSTITUTE (ITN/IST), PORTUGAL

Technique applied: Neutron activation analysis using k_0 method

1. Sampling preparation:
   - Follow carefully the indications given by the PT organizers (e.g. calculation of moisture).
   - Sampling preparation should be done according to the standard operational procedures and these procedures should be optimized taking into account the lessons learn from sharing information with other participants (e.g. homogenization of the sample, evaluation of the best amount of sample to be analyzed and standardization the geometry of the sample).

1.1. Homogeneity
   - If a small amount of sample (<100 mg, depending on the material) is used additional milling may have to be done.

1.2. Moisture
   - Moisture should be measured according to the instructions.
   - Different samples should be used for moisture calculation and analysis.

1.3. Blanks
   - Blank contents should be assessed before starting the utilization of each set of containers.

1.4. Reference materials
   - Attention should be paid to the expiration date of the reference materials especially for the biological reference materials.

2. Irradiation

2.1. Comparator
   - More comparators should be used between the samples in order to control do flux gradient.
   - Comparators should be co-irradiated with the samples, even in short irradiations.
   - The re-use of comparators can be problematic.

2.2. Short irradiations
   - In short irradiations longer irradiation times should be performed.

3. Measurement
   - In the short irradiation dead time correction should be assessed by increasing the distance between detector and sample.

4. Reporting
   - At least two people should check the input of data in order to avoid typing errors.

5. Participation in PT
   - Establish regular participation in proficiency tests (at least once a year) and in follow up meetings.

6. Training

— Improve the qualification of personal by promoting scientific visits in different laboratories.

7. Management

— Improvement of management within the organization is essential for the effectiveness and efficiency of the laboratory (e.g. documentation of the activities, definition of responsibilities and traceability of the activities).

5. INSTITUTE FOR NUCLEAR RESEARCH-PITEŞTI, ROMANIA

Technique applied: Neutron activation analysis using k_0 standardization method

— Irradiation channel neutron characterization:
  - Neutron flux measurement;
  - R_{Cd} remeasurement;
  - f (thermal to epithermal ratio) measurement;
  - α parameter evaluation.

— Gamma ray detector full energy peak calibration;
— Evaluation of external sample holder contamination,
— Purchase of reference materials,
— Irradiation and evaluation of soil, plant and other reference material;
— Purchase and implementation in INR laboratory of K0 for Windows software (urgently), as soon as possible;
— Training of lab. personnel in K0 for Windows software utilization (3–5 weeks in Ljubljana?).

Actions to be completed by the end of the year, except items 6 and 7, which will be completed by the end of 2013.

6. JOŽEF STEFAN INSTITUTE, SLOVENIA

— For critical evaluation of WEPAL proficiency test samples, documents and publications provided by JSI will be distributed.
— For elements Cr, Zr and Hg in soil samples, analysis will be repeated in cases of inhomogeneity.
— Investigate values above the mean of Ga in soil samples.

7. ATOMIC ENERGY COMMISSION OF SYRIA

1. Not mixing of data between the two INAA methods (Relative& k_0-standardized).

— Results should be report individually.

2. Sample preparation:
   - Sample preparation (grinding, homogenize);
   - Dry mass factor (24 hours instead of 4 hours);
   - Preparation of standard reference from standard solution (We need to improve);
   - Train the people who responsible to prepare samples.

3. Irradiation
   - Recalculate the parameters *f* and alpha;
   - Optimize the irradiation conditions, longer irradiation it will.

4. Measurement
   - Checking the environmental conditions at measurement laboratory;
   - Optimize the measurement conditions (geometry, long measurement);
   - Correction for some elements such as Hg, Mg, P, etc.

5. I will not participate with the elements I am not sure of.

8. ENERGY INSTITUTE, ISTANBUL TECHNICAL UNIVERSITY, TURKEY

1. Modifying sample preparation procedure:

   - Dry mass factor determination;
   - Weighing of original sample for irradiation;
   - Standard solutions preparation;
   - Pellet preparation for plant samples.

2. Sample irradiation:

   - Increasing irradiation time for long lived nuclides;
   - Repeating sample analyses (duplicate or triplicate);
   - Using CRMs for internal quality control and sandwich samples between flux monitors;
   - Irradiation of blank.

3. Gamma spectroscopic measurement:

   - Testing and developing sample-detector end cap distance, decay time, irradiation time procedures.

4. Implementation statistical evaluation of results:

   - E_n or z score calculation;
   - Average, uncertainty calculation;
   - Check the results for typing errors.

5. Repeat the analysis of proficiency testing after modifying our procedure.

Appendix 2. List of participants

1	**IAEA**	Mr Nathan Daniel Peld International Atomic Energy Agency Department of Nuclear Energy Division of Nuclear Fuel Cycle and Waste Technology Research Reactor Section A2621 Vienna International Centre Wagramer Straße 5 P.O. Box 100 1400 VIENNA AUSTRIA Tel.: 0043 1 2600 22470 Fax: 0043 1 26007 EMail: N.D.Peld@iaea.org Internet: http://www.iaea.org
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Appendix 3. Agenda of the workshop

RER1007/9002/01
Regional Workshop on Inter-Comparison Feedback of Neutron Activation Analysis Proficiency Tests Performed in 2011-2012
Delft, Netherlands
2012-05-22 - 2012-05-25

Tuesday May 22, 2012
Morning

9:00–9:10 Opening of the Meeting by **Host Country and IAEA representatives**

9:10–9:40 Self-Introduction of **participants**: scientific background & function in the institute, max. 3 minutes each

9:40–10:00 Introductory Presentation "Enhanced NAA Services" by **Mr Nathan D Peld** (IAEA)

10:00–10:30 Coffee break

10:30–11:30 Lecture: Presentation of PT results (by elements and/or methods) by **Mr Peter Bode** (The Netherlands)

11:30–12:30 **Presentation*** by **each country** on the methods used for PT sample measurement: Information on sample preparation, measurement details and Quality Control applied. (2 countries; ca. 30 minutes each) as well as their own follow-up activities (root cause analysis of deficiencies and corrective actions, if applicable).

Afternoon

14:00–17:00 **Presentation*** (Continued) by **each country** on the methods used for PT sample measurement: Information on sample preparation, measurement details and Quality Control applied. (6 countries; ca. 30 minutes each) as well as their own follow-up activities (root cause analysis of deficiencies and corrective actions, if applicable).

Strictly according to the provided presentation template

Wednesday May 23, 2012
Morning

9:00–10:00 Lecture: Lessons to be learned from PT reports by **Mr Peter Bode** (The Netherlands).

10:00–10:30 Coffee break

10:30–12:30 Discussion on the applied methods, review of experimental conditions and potential sources of errors and pathways to improvements (if possible participants shall allow an identification of their anonymous results to allow judgment of the quality of method) (**All participants and experts**)

Afternoon

14:00–15:00 Drafting conclusions on these PT for meeting report.

15:00–15:30 Coffee break

15:30–16:00 Lecture: WEPAL: organization, approaches and results by **Mr Ben Eijgenraam** (The Netherlands)

16:00–17:00 Lecture: Terminology and Use of Calibrators (RMs and standards) **Mr Peter Bode** (The Netherlands)

Strictly according to the provided presentation template

Thursday May 24, 2012
Morning

09:00–09:30 Lecture: The role of an Integrated Management System in the management of NAA by **Ms Marcella Cagnazzo** (Italy)

09:30–10:00 Lecture: 20 Years' of experience with quality management systems in an NAA laboratory, by Mr. **Peter Bode** (The Netherlands)

10:00–10:30 Coffee break

10:30–11:30 Technical tour to Reactor

11:30–12:30 Technical tour to NAA facilities

Afternoon

14:00–15:00 Plenary discussion on the position and collaboration of NAA laboratories in Europe, and opportunities within national metrology schemes.

15:00-17:00 Drafting meeting report and drafting action plans

Friday May 25, 2012

Morning

09:00–10:00 Discussion on recommendations for follow-up

10:00–10:30 Coffee break

10:30–11:30 Presentation of action plans

11:30-12:30 Final discussion and agreement on meeting report

Closing of the Meeting