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Working Material

Meeting Report of

the 1st Research Coordination Meeting related to the IAEA Coordinated Research Project 1888 / F1.20.25

on

Development of an Integrated Approach to Routine Automation of Neutron Activation Analysis

Delft University of Technology

Delft, The Netherlands

27 – 31 August 2012

Vienna, Austria, October 2012

CONTENTS

1. BACKGROUND AND OBJECTIVES

1.1.Background

Neutron Activation Analysis (NAA) has been confirmed one of the most suited opportunities for the commercialisation of research reactor (RR) services [1]. However, lack of automation has been identified as a bottleneck in the capacity of NAA to meet client needs [2]. Such a constraint may limit the ability of laboratories to service the needs of specific research fields, such as archaeology and epidemiology, where large numbers of samples are required. A recent survey carried out under the auspices of the IAEA indicates that laboratories that employ a certain level of automation may analyse up to an order of magnitude more samples per year than other laboratories [3]. Indeed, in most of the cases the NAA service requests have to be rejected not because of lack of RR availability, but because of limited capacity in automation and data processing. In addition, as experience from automated NAA laboratories show, automation leads to an improvement in analytical quality through the minimisation of human error.

Automation of NAA consists of a series of components that, put together, can improve the efficiency and reliability of analysis. Although many of the components already exist commercially and in various laboratories, there is no common interface that allows them to be integrated with local systems available in specific labs. Many laboratories suffer from a lack of in-house technical and engineering support. As a consequence there is an urgent need to provide a 'framework architecture' for the entire NAA process that will allow the development of building block that may be combined into an integrated whole.

Although a few laboratories have successfully implemented systems that provide a high degree of automation, it is not easy to gather a complete picture from the literature. As a consequence, it is not easy for laboratories that would like to adopt automation to know what path of good practice to follow.

Automation of NAA requires a significant effort for the development and implementation of software, hardware and data management. This often represents an insurmountable barrier for individual NAA laboratories that are typically staffed by only a few people, hindering the efficient use of the facility. Previous Consultants Meetings (CM) [2] recommended that a Co-ordinated Research Project (CRP_ could be developed to address this pressing need within the NAA community. The IAEA has adopted this recommendation and planned and scheduled the CRP as detailed in this document.

By bringing together a range of laboratories with different skills, experience and needs, this CRP will provide an effective network to perform the significant amount of research and development required as described below. The team approach adopted in the CRP will produce a set of standardised protocols and modules that can be readily implemented at a reasonable cost. This CRP will have a modular structure in developing and implementing the hitherto missing tools for automated data processing and analysis reporting, as well as include design principles, interaction with and control of sample changers; this all with quality assurance procedures as a cross-cutting

component. It will strengthen the optimization and competitiveness of the NAA process by harmonized automation hardware and software, and ultimately result in an increased NAA service capacity and thus in enhanced RR utilization. The pursued harmonization will also render in a network of NAA laboratories and experts from different countries. Finally, benefits may be expected also in the regulatory environment arising from the adoption of a standard set of protocols for automation.

Bibliography

[1] Report of the IAEA Technical Meeting on "Commercial Products and Services of Research Reactors", July 2010, IAEA, Vienna, Austria.

[2] Reports of the IAEA CMs on Preparation of Guidelines on Implementation of Routine Automation in Advanced Neutron Activation Analysis Laboratories, December 2009 and June 2011, IAEA, Vienna, Austria.

[3] Draft report based on results of the IAEA questionnaire on "Status of Implementation of Routine Automation in Advanced Neutron Activation Analysis Laboratories", IAEA, June 2011, Vienna, Austria.

1.2. Objectives of the Coordinated Research Project (CRP)

The overall objective of this CRP is to contribute to enhanced and sustainable RR utilization by increasing NAA capacity through automation, resulting in more opportunities to engage in scientific research and commercial services.

The specific objectives of the CRP are:

- To identify centres of expertise that can be called upon by laboratories wishing to improve automation within their laboratories.
- To provide detailed examples of designs and components suitable for the automation of hardware.
- To develop standardised communication protocols (software) and make them available as open source codes.
- To develop detailed guidelines for the integration of hardware, software, data management and related QA/QC in automated NAA facilities.
- To increase the level of automation in participating laboratories, according to the guidelines produced in the CRP.
- To facilitate the establishment of long-term cooperation (network) between participating laboratories on automation in NAA.

1.3.Objectives of the 1st Research Coordinated Meeting (RCM)

The objectives of this first RCM are to:

- Share information between participants regarding the proposed projects, evaluate level of automation at different NAA laboratories
- Identify the individual projects of common interest in order to establish close collaboration of different teams and design joint activities
- Discuss and agree on the modalities for sharing the information during this CRP, elaborate the creation of a dedicated web portal
- Discuss and agree on the detailed work-plan for the 1st year and previsions for the 2nd and 3rd years
- Prepare a draft meeting report.

2. WORK PERFORMED

The meeting was attended by 20 participants from 18 Member States, as listed in Annex I. The annex also shows the title and number of the individual research contracts and research agreements. Two member states holding a research contract, China and Syria, were not represented.

The meeting started with welcome and opening remarks by Mr Rik Linssen, General Manager, and Mr P. Bode, host contact point, both from Reactor Institute Delft (RID) of the Delft University of Technology, followed by the self-introduction of all meeting participants. Mr P. Bode (RID) was elected to the Chair and Mr J. Bennett (ANSTO) was appointed rapporteur of the meeting. The draft agenda was adopted, with the following modifications: the technical tour was moved to Tuesday afternoon and the meeting close was rescheduled to 12 noon on Friday (Annex II). Mr D. Ridikas, the IAEA Scientific Secretary of this RCM, then set the scene for the meeting by presenting the background and objectives of the CRP and this RCM.

2.1. Individual presentations

The first two days were reserved for individual presentations. Each delegate presented information on the current status and needs for automation in their country, as a basis for subsequent discussion and evaluation of major issues in the context of the objectives of the RCM.

Copies of all presentations, papers and administrative information were distributed at the end of the meeting to all participants and may be obtained from the Scientific Secretary on request.

The contracted work plan for each participating country for the first year of the CRP is presented in Annex III.

2.2. Work matrix and group work plans

Through discussion the meeting decided that the CRP would focus on three research tasks:

i) Irradiation/measurement station (e.g. sample changer, control, mechanical/electronics/control interface) with an open database;

ii) Systems approach (modular software) (e.g. data management, communication) with open source; and

iii) E-learning tools (e.g. interactive lectures, guidelines, help capability, QA/QC, references) with open source.

Each participating country indicated which tasks it would like to participate in and the resulting work matrix is displayed in Annex IV. In the matrix, major participation is indicated by 'YES', minor participation by 'yes' and a leadership role by '**YES**'. Some countries offered 'Cooperation on request'.

The participants divided into three groups to develop plans in each of the research tasks. A spokesperson from each group reported the outcomes to a plenary session. A summary of the Year 1 work plan from each group is presented in Annex V. Information presented at the plenary session by Groups from 1 to 3 is presented in Annexes from VI to VIII, respectively.

In discussing the specification, design and construction of sample changers in Group 1, it was recommended that two or three cost-options should be offered. Different categories could be considered: samples in a stack, rotary movement and x-y table. It will be important to provide a template for contributed designs to make comparisons easier.

For the systems approach, Group 2, a questionnaire will be developed and distributed so that common approaches and common problems can be identified. One output will be best-practice guidelines for performing NAA in different situations, depending on reactor type, sample type and hardware/software resources.

A proposed approach and curriculum for e-Learning was presented by Group 3. Although the scope of the proposed curriculum is greater than might be expected, it has been noted that even basic NAA knowledge has been lost in some laboratories and this CRP presents a unique opportunity to develop materials that will persist into the future. Photos and videos of best practice automation (sample changers, sample preparation, etc.) will provide ideas and inspiration to other laboratories.

2.3. Technical tour

The participants in the meeting were treated to a tour of facilities of the host organization, RID of TU Delft, with a particular focus on automated systems for NAA. These automatic systems included pneumatic sample transfer systems in the reactor building, sample changers in the gamma-spectrometry laboratory and capsule heat sealing in the sample preparation laboratory.

3. PLENARY DISCUSSION

There was general agreement that expectations of the RCM had been surpassed, with clearly structured synergies appearing. Personal contacts made through the meeting have been valuable and will enhance collaboration.

Participants were satisfied that the approach taken through the three working groups will result in a whole-system approach to automation, with modular structures to be developed in both software and hardware. The approach will facilitate future development and maintenance, supported by networks established through the CRP. It was also observed that in the past successful networks in air pollution and k_0-NAA started as IAEA CRP's and have been sustained through regional projects and workshop series.

Communication between participants in the CRP was recognized as being a key to success. Communication mechanisms were discussed. Sheldon Landsberger's offer to set up a 'Blackboard' portal through the University of Texas web site for the sole use of this CRP was accepted. The web portal will facilitate communication, information exchange and project coordination. It was agreed that this mechanism will be tested and evaluated until the end of 2012 and then reassessed. An alternative option would be for the IAEA to establish a dedicated web portal.

The meeting held the view that the CRP is well structured and well organized. The successful achievement of early milestones and quantitative performance indicators will maximize the likelihood of ultimate success. A minimum objective is to double the capacity of participating laboratories through the implementation of the systems, products and recommendations of the CRP.

4. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Based on the final discussions the following conclusions and specific recommendations were formulated.

4.1. Conclusions

a) All participants identified the need for a significant increase in the capacity of NAA laboratories to analyse samples, many indicating a desire to double throughput in order to meet present and potential customer demand.

b) Most NAA laboratories identified that the absence of mechanical and electronic support and the lack of software-hardware integration are significant hindrances in achieving automation in NAA.

c) A number of participants confirmed the need to improve the interface between reactor operations and NAA users in order to maximise the effective utilisation of the facility.

d) Illustrative concrete examples were provided of successful automation of NAA hardware and software.

e) Three working groups were established, addressing needs identified through individual presentations and discussion. Opportunities for synergies were recognised and this guided the development of the work plans. Activities, deliverables and responsibilities have been defined for the first year of the CRP.

f) Participants were satisfied that their individual work plans, supported by the joint activities of the working groups, will contribute to reaching the overall objectives of the CRP.

g) The meeting concluded that expansion of NAA services for increased RR utilisation depends not only on increasing sample throughput capacity but equally on improving and fostering the technical competence of staff.

h) There was a consensus that at least a proportion of revenue generated by a NAA laboratories should be returned to them. This is needed to cover the running costs of the analyses, and would allow equipment and software to be purchased, both to anticipate on ageing thereof as well as to improve sample throughput and quality. It would also act as an incentive for NAA staff to continuously improve the service.

4.2. Recommendations

To the IAEA:

- A second RCM should be held 2-6 December 2013 in Vienna.

- The Agency is requested to continue and expand NAA-related activities, especially focused on the development and preservation of metrological expertise through education

and training, support of interlaboratory comparison and proficiency test exercises, and organization of topical workshops and meetings.

To the Member States:

- To expand the sensibilization at a national level on the analytical characteristics and opportunities of NAA in anticipation of future expansion of NAA capacity

- To develop a mechanism for the return of revenues from products and services of RRs, such as NAA to the orgaizational unit providing such products and services, for covering the running costs thereof and for timely replacement of instrumentation needed for safe and reliable continuation of these services.

5. ACKNOWLEDGEMENTS

The meeting was most appreciative of the high level of support that the host agency, Delft Technical University, had provided for the RCM. Particular thanks were expressed to Mr Peter Bode and Mr John Bennet for the role they played as Chairman and Rapporteur of the meeting respectively, and to the staff of TU Delft/RID who acted as guides during the technical tour.

ANNEX I. LIST OF PARTICIPANTS

Country	Number	Title of project	Represented during the meeting by
IAEA	-	-	RIDIKAS, Danas (M) Physics Section, Division of Physical and Chemical Sciences, VIC, A2302, Ext.21751, D.Ridikas@iaea.org
1. Algeria	RC17355	Achievement of Routine Automation of NAA Systems around Algeria Research Reactors	TOUIZA Maamar (M) Commissariat à l'énergie atomique (COMENA); Centre de recherche nucléaire de Birine (CRNB) B.P. 180 17230 BIRINE, Djelfa, ALGERIA touiza_maamar@yahoo.fr
2. Bangladesh	RC17309	Development of an Auto Sample Exchanger for Gamma Counting to Increase NAA Capacity of BAEC	HOSSAIN Syed Mohammod (M) Bangladesh Atomic Energy Commission (BAEC); Atomic Energy Research Establishment (AERE); Institute of Nuclear Science and Technology (INST) Ganakbari, Savar P.O. Box 3787 DHAKA 1000, BANGLADESH syed9495@yahoo.com
3. Brazil	RC17393	Sample Changer: for better neutron activation analysis efficiency at CDTN/CNEN, Brazil	DUTRA NETO, Aimoré (M) CENTRO DE DESENVOLVIMENTO DA TECNOLOGIA NUCLEAR / COMISSÃO NACIONAL DE ENERGIA NUCLEAR, CDTN/CNEN Avenida Presidente Antônio Carlos, no 6627, CEP 31270-901 Caixa Postal 941, CEP 30161-970 Belo Horizonte, Minas Gerais, BRAZIL dutraa@cdtn.br
4. Chile	RC17190	Updates and Improvements in the Automation of the Neutron Activation Analysis Laboratory in Chile	MUÑOZ ANRIQUE Luis (M) Comisión Chilena de Energía Nuclear (CCHEN) Amunátegui 95 Casilla 188-D SANTIAGO, CHILE lmunoz@cchen.cl
China	RC17284	Development of Automation System of Neutron Activation Analysis at China Advance Research Reactor	Not represented in this meeting
5. Egypt	RC17361	Development of an Integrated Approach to Routine Automation of Neutron Activation Analysis at ETRR-2	MOHAMED Nader (M) Atomic Energy Authority (AEA); Egypt Second Research Reactor ETRR-2 13759 ABO ZABAL, Kalubya EGYPT mnader73@yahoo.com

6. Indonesia	RC17317	Improvement of Neutron Activation Analysis Laboratory by Applying the Automation System	SUTISNA Sutisna (M) National Nuclear Energy Agency (BATAN); R & D Centre for Materials Science & Technology P3IB Kawasan Puspiptek SERPONG, Tangerang 15314, INDONESIA sutisna@batan.go.id
7. Jamaica	RC17362	Development of Standardized Protocols for Communication between Various Components of the NAA Process	PRESTON John Aston (M) University of the West Indies; International Center for Environmental and Nuclear Sciences Mona Campus, Mona Road P.O. Box 104 KINGSTON 7 JAMAICA john.preston@uwimona.edu.jm
8. Malaysia	RC17399	Development of Process Automation in the Neutron Activation Analysis Facility in Malaysian Nuclear Agency	YUSSUP Nolida (F) Malaysian Nuclear Agency (Nuclear Malaysia) Bangi Komplex Selangor Darul Ehsan 43000 KAJANG, Selangor MALAYSIA nolida@nuclearmalaysia.gov.my
9. Morocco	RC17323	Development of an Integrated Approach to Routine Automation of Neutron Activation Analysis	BOUNAKHLA Moussa (M) Centre national de l'énergie, des sciences et des techniques nucléaires (CNESTEN) B.P. 1382 10001 RABAT, Agdal MOROCCO moussabounakhla@yahoo.fr
10. Peru	RC17392	Improving Effectiveness Of Instrumental Neutron Activation Analysis By Means Of Automation	MONTOYA Eduardo (M) INSTITUTO PERUANO DE ENERGÍA NUCLEAR (IPEN) AV. CANADA Nº 1470 – Lima 41 PERU emontoya@IPEN.GOB.PE
11. Russia-1 **12. Russia-2**	RC17363	Automation of Reactor Neutron Activation Analysis	Mr Sergey PAVLOV E-mail: pavlov@nf.jinr.ru & Mr Andrey DMITRIEV E-mail: ru-day@list.ru Joint Institute for Nuclear Research, JINR Joliot-Curie ulitsa 6 141980 DUBNA, Moskovskaya Oblast RUSSIAN FEDERATION
13. Slovenia	RC17279	Automation of a Pneumatic Transport System for Neutron Activation Analysis	SMODIS Borut (M) Jozef Stefan Institute Jamova cesta 39 1000 LJUBLJANA SLOVENIA borut.smodis@ijs.si

Syria	RC17328	Automated Cyclic Neutron Activation Analysis System and Connecting the Sample Changer with Gamma Spectroscopy System	Not represented in this meeting
14. Australia-1 **15. Australia-2**	RA17306	Development of an Integrated Approach to Routine Automation of Neutron Activation Analysis	BENNETT John W. (M) John.BENNETT@ansto.gov.au & STOPIC Attila (M) attila.stopic@ansto.gov.au Australian Nuclear Science and Technology Organisation (ANSTO) New Illawarra Road LUCAS HEIGHTS, NSW 2234 AUSTRALIA
16. Canada	RA17313	Automation of NAA Software with the Direct Approach	CHILIAN Cornelia (F) Ecole Polytechnique de Montreal 2900, boul. Édouard-Montpetit Université de Montréal Campus 2500, Chemin de Polytechnique MONTRÉAL, Québec H3T1J4 CANADA cornelia.chilian@polymtl.ca
17. Japan	RA17360	Development of Efficient and Use-Friendly Counting Facility in the Inter-University Laboratory at Japan Atomic Energy Agency	EBIHARA Mitsuru (M) Tokyo Metropolitan University; Department of Chemistry Minami-Ohsawa, Hachioji TOKYO 104-0053 JAPAN ebihara-mitsuru@tmu.ac.jp
18. Netherlands	RA17324	Input for e-learning for Laymen's Use of Automated Neutron Activation Analysis	BODE Peter (M) Delft University of Technology; Faculty of Applied Sciences; Department Radiation, Radionuclies and Reactors Mekelweg 15 2629 JB DELFT, NETHERLANDS p.bode@tudelft.nl
19. USA	RA17333	Comprehensive Assessment of Short-Lived Neutron Activation Analysis for Thermal, Epithermal Neutrons	LANDSBERGER Sheldon (M) University of Texas at Austin; Nuclear Engineering Laboratory PRC 159, 10100 Burnet Road AUSTIN, TX 78712 UNITED STATES OF AMERICA s.landsberger@mail.utexas.edu

ANNEX II. MEETING AGENDA

Monday, 27 August 2012

08:30-09:00	Arrival of participants
09:00-9:30	**Welcome & Opening Address by the representatives of IAEA and host organization, followed by** Self introduction of the participants, Election of Chairperson(s) and *Rapporteur(s)* Discussion and Approval of the Agenda, Administrative Arrangements
09:30-10:00	**Background and objectives of the CRP/RCM** *Mr D. Ridikas, IAEA*
Session A	**Individual Country Presentations**
10:00-10:30	*Algeria, Bangladesh,*
10:30-11:00	Coffee break
11:00-12:30	*Brazil, Chile, Egypt*
12:030-14:00	Lunch break
14:00-15:30	*Indonesia, Jamaica, Malaysia*
15:30-16:00	Coffee break
16:00-17:30	*Morocco, Peru, Russia*
~19:00	**Hospitality Event**

Tuesday, 28 August 2012

08:30-09:00	Arrival of participants
Session B	**Individual Country Presentations**
09:00-10:30	*Slovenia, Syria, Australia*
10:30-11:00	Coffee break
11:00-13:00	*Canada, Japan, the Netherlands, USA*
13:00-14:00	Lunch break
14:00-15:30	**Technical tour to TU Delft RR and its facilities**
15:30-16:00	Coffee break
Session C	**Plenary discussions**
16:00-17:30	*Start of discussion on joint interests, definition of modules and collaboration matrix*

Wednesday, 29 August 2012

08:30-09:00	Arrival of participants
Session C	**Plenary discussion**
09:00-10:30	*Continue discussion on joint interests, definition of modules and sign up for working groups*
10:30-11:00	Coffee break
Session D	**Discussions in groups**
11:00-12:30	*Definition of detailed action plan within the groups: parallel sessions*
12:030-14:00	Lunch break
14:00-15:30	*Definition of detailed action plan within the groups: parallel sessions*
15:30-16:00	Coffee break
Session E	**Plenary discussion**
16:00-17:30	*Reporting at plenary session from parallel sessions by group leaders*

Thursday, 30 August 2012

08:30-09:00	Arrival of participants
Session F	**Discussions in groups**
09:00-10:30	• *Finalization of detailed action plan within the groups in parallel sessions* • *Drafting group reports including conclusions and recommendations*
10:30-11:00	Coffee break
11:00-12:30	• *Finalization of detailed action plan within the groups in parallel sessions* • *Drafting group report including conclusions and recommendations*
12:030-14:00	Lunch break
Session G	**Plenary discussion**
14:00-15:30	• *Reporting at plenary session from parallel sessions by group leaders* • *Drafting overall project work-plan, including deadlines and responsibilities*
15:30-16:00	Coffee break
16:00-17:30	• *Finalizing overall project work-plan, including deadlines and responsibilities* • *Drafting meeting report*

Friday, 31 August 2012

08:30-09:00	Arrival of participants
Session H	**Plenary discussion**
09:00-10:30	• *Drafting meeting report, including overall conclusions and recommendations*
10:30-11:00	Coffee break
11:00-12:00	• *Finalization of meeting report, including overall conclusions and recommendations*
12:00	End of the meeting

ANNEX III. INDIVIDUAL WORK PLANS – YEAR 1, CONTRACTUAL

Country, name of Chief Scientific Investigator, contract number

Algeria, Touiza Maamar, research contract 17355

Activity	Expected output	Delivery date	Responsibility
Contribution to developing software to interface between Genie 2000 and sample changer	Program software guideline	June 2013	Touiza Maamar
Conception of mechanical design of sample changer related to provided guideline	Design drawings	July 2013	Salhi Mhamed
Design of an automated pneumatic sub-system to transfer irradiated samples for counting	Design and Implementation details	December 2013	Mohamedi Bousaad
Control of the pneumatic sub-system to transfer irradiated samples for counting and automation of measurement	Implementation details	December 2013	Berrahal Abdelrazek

Australia, John Bennett, research agreement 17306

Activity	Expected output	Delivery date	Responsibility
Establish working relationship with 'whole system' team	Practical information is exchanged	continuing	Attila Stopic
Implement database approach for software-software and hardware-software communication	Database is set up and data exchange has been demonstrated	March 2013	Attila Stopic
Demonstrate the integration of weighing balance with the database	Weighing information is transferred electronically and is available for access by other software.	June 2013	Attila Stopic

Bangladesh, Syed Mohammod Hossain, research contract 17309

Activity	Expected output	Delivery date	Responsibility
Conceptual design of sample changer depending on the space available in the counting room	Design will be fixed	October-2012	Syed Mohammod Hossain
Detail design of the sample changer and counting vials	Detail design will be fixed	December-2012	Syed Mohammod Hossain
Searching of raw materials/equipments for **Mechanical** (sample loading and unloading stations/rotary rack with motor/conveyer belt, transfer mechanism, detector and sample storage shielding, etc.), **Electrical** (e.g., transfer system driving mechanism and control system, power supply system, etc.) **Electronics** (optical sensors for vial positioning and count starting, etc.) and procurement of some materials/equipments	Prices for all the materials/equipments will be assessed and providers will be selected and some of them will be procured	June-2013	Syed Mohammod Hossain

Canada, Cornelia Chilian, research agreement 17313

Activity	Expected	Delivery date	Responsibility
Finish developing neutron self-shielding module and incorporate into EPAA package	Self-Shielding Module	1 October 2012	Cornelia Chilian
Transfer revised EPAA software and new modules to new users	User distribution list	1 December 2013	Cornelia Chilian
Feedback from new users, discussions with users	Report on feedback	1 Mars 2013	Cornelia Chilian
Develop uncertainty calculations considering all sources of uncertainty	Uncertainty Module	1 May 2013	Cornelia Chilian
Use of the new software for various automated NAA applications	Validation report	1 July 2013	Cornelia Chilian

Chile, Luis Muñoz, research contract 17190

Activity	Expected output	Delivery date	Responsibility
To establish a working group that provides technical advice to the activation analysis laboratory to evaluate and improve automation	Working group established.	October 2012	Luis Muñoz
Evaluation of new technologies and commercially available computer programs applicable to the improvements of the automation.	Report on the evaluation of new technologies and commercial programs available	December 2012	Luis Muñoz
Design of an automatic sample changer for gamma spectrometer with Compton suppressor.	Sample changer designed	March 2013	Luis Muñoz
Design of a new computer program for data processing, integrated a counting system.	Computer program designed	May 2013	Luis Muñoz
Evaluation of the pneumatic irradiation system by the working group for improvement	Report on improvements of the pneumatic irradiation system	June 2013	Luis Muñoz

China, Bangfa Ni, research Contract 17284

Activity	Expected output	Delivery date	Responsibility
sample changer design	Design of sample changer	Oct. 2012	Bangfa Ni
sample changer mechanism machining	Sample changer	March- 2013	Bangfa Ni
CARR reactor vertical irradiation channel design for pneumatic transfer	Design of irradiation systems	March-2013	Bangfa Ni
irradiation channel mechanism machining	irradiation channel	June 2013	Bangfa Ni
Batch sample holder design	Design of sample holder	June 2013	Bangfa Ni

Egypt, Nader Mohamed, research contract 17361

Activity	Expected output	Delivery date	Responsibility
Put a design for a sample changer	The design is fixed	November 2012	Nader Mohamed
Providing the component required for the sample changer	The components are provided	June 2013	Nader Mohamed
Transfer knowledge with other participates about the interface between the sample changer and the counting system	It is clear, how the interference between the sample changer and the counting system will be carried out.	June 2013	Nader Mohamed

Indonesia, Sutisna, research contract 17317

Activity	Expected output	Delivery date	Responsibility
Establishment of sample changer			
a). Conceptual design	Design of sample changer	February 2013	Sutisna
b). Detail design	Technical specification of sample changer.	June 2013	Bharoto
Flux and Comparator factor mapping on capsule irradiation for hydraulic rabbit.	Map of thermal neutron and comparator factor on capsule irradiation	March-2013	Sutisna
Validation of k_0-method for short half-life radionuclide.	Rabbit system could use for short half life radionuclide determination base k_0-method.	April 2013	Sutisna
Development of Epithermal Neutron Activation Analysis (ENAA) Phase I	Facility for ENAA.	June 2013	Sutisna

Jamaica, John Preston, research contract 17362

Activity	Expected output	Delivery date	Responsibility

Development of standardized protocols for control of data acquisition systems, spectrum analysis, uncertainty estimates, and data management associated with NAA.	Software specification documentation	Jan 2013	John Preston
Development of software that implements the data acquisition and control protocols.	Software	March 2013	John Preston
Development of software that implements the spectrum analysis and uncertainty estimates protocols.	Software	May 2013	John Preston
Development of software that implements the data management protocols.	Software	July 2013	John Preston

Japan, Mitsuru Ebihara, research agreement 17360

Activity	Expected output	Delivery date	Responsibility
Implementation of k_0 method at inter-university lab of Univ. of Tokyo	Shortening of the data processing (0%?)	June-2013	Mitsunori Ishimoto Mitsuru Ebihara

Malaysia, Nolida Yussup, research contract 17399

Activity	Expected output	Delivery date	Responsibility
Conceptual design of the system automation (sample preparation, counting & data analysis)	Overview drawing & specifications of the system automation	Nov 2012	Nolida Yussup
Detail design of the sample changer (hardware & software).	Detail drawing & software specifications of the sample changer.	Feb 2013	Nolida Yussup
Detail design of the sample preparation software.	Sample preparation software flowchart/block diagrams	March 2013	Nolida Yussup

Detail design of the data analysis software.	Data analysis software flowchart/block diagrams	March 2013	Nolida Yussup
Design of the system interfacing & database.	Interfacing protocols & database structure	June 2013	Nolida Yussup
Identification of the necessary tools/components for the system automation (hardware & software).	List of the tools/components, price & manufactures.	April 2013	Nolida Yussup

Morocco, Moussa Bounakhla, research contract 17323

Activity	Expected output	Delivery date	Responsibility
Bibliography of the world-wide automated NAA	Information on Automation in NAA facilities world-wide	January 2012	Moussa Bounakhla
Identification of elements in main matrixes without problems (interferences, LDL, etc…)	Establish Library on elements for calculation and validation	March 2013	Moussa Bounakhla
Elaboration of a platform calling main files to be used in calculation of concentration, uncertainty, LDL, etc…	Own program of concentration calculation	June 2013	Hamid Amsil / Moussa Bounakhla

Netherlands, Peter Bode, research agreement 17324

Activity	Expected output	Delivery date	Responsibility
Compilation of pitfalls experienced by newcomers in training of NAA, errors made and misinterpretations of training guidelines.	List of problems; Input for test spectra in e-learning tools	1st list July 2013 2nd list December 2013	Peter Bode
Compilation of sources of error in gamma-ray spectrum analysis, spectral interferences, isotope-specific problems and recommendations for dealing with them in the practice.	List of errors Input for packages in e-learning tools	1st list July 2013 2nd list December 2013	Peter Bode
Compilation of sources of error in spectrometer performance verification and methodologies for monitoring	List of problems; Input for test spectra in e-learning tools	1st list July 2013 2nd list December 2013	Peter Bode

and correction.			
Development of input for e-learning tools on quality control and quality assurance in NAA	List of problems; Input for test spectra in e-learning tools	1st list July 2013 2nd list December 2013	Peter Bode
Information exchange with other CRP participants on routes of implementation in different existing software packages	Not relevant given outcome of 1st RCM		Peter Bode

Peru, Eduardo Montoya, research contract 17392

Activity	Expected output	Delivery date	Responsibility
Elaborate plans and instructions for replication of our homemade counting sample changer.	File with set of documents in electronic format, ready for distribution.	End of March 2013	Eduardo Montoya / Patricia Bedregal
Distribution of elaborated documentation	Confirmation of reception by every CRP participant	End of April 2013	Eduardo Montoya / Patricia Bedregal
To collect, organized and distribute proposals for build homemade sample changers, contributed by CRP participants	Collected information in standardized electronic format. Reception confirmation by CRP participants.	End of November 2013	Eduardo Montoya / Patricia Bedregal
To elaborate the basic engineering for a homemade irradiation automatic sample changer	Report for internal and IAEA use.	End of November 2013	Eduardo Montoya / Patricia Bedregal
To document and distribute the software applications developed for sample changer control and NAA data processing	Ready to use applications, complete documentation and program source listings in electronic format. Reception confirmation by CRP participants.	End of June 2013	Eduardo Montoya / Patricia Bedregal

Russia, Frontasyeva Marina, research contract 17363

Activity	Expected output	Delivery date	Responsibility
To prepare proposal for construction of sample changer, type of controller and program for control.	The report for final decision	01.12.2012	M.V. Frontasyeva
The development of design	Design drawing	19.07.2013	M.V. Frontasyeva

drawing of sample changer			
To development of the software for automation of measurement for Genie 2k	Software	19.07.2013	M.V. Frontasyeva
To development of the software for calculation of concentration of elements and estimation of uncertainty	Software	19.07.2013	M.V. Frontasyeva

Slovenia, Borut Smodiš, research contract 17279

Activity	Expected output	Delivery date	Responsibility
Control system for recording of the accurate sample irradiation time	Control system developed and tested	07 – 2013	Darko Kavšek
Direction discriminating capsule sensor located close to irradiating position (reactor pool at the end of PT tube)	Capsule sensor developed and tested	07 – 2013	Darko Kavšek
Radiological monitor for detecting unexpectedly high capsule radioactivity following the irradiation	Radiological monitor developed and tested	07 – 2013	Darko Kavšek

USA, Sheldon Landsberger, research agreement 17333

Activity	Expected output	Delivery date	Responsibility
Decide on (interim) template for PowerPoint presentations	Electronic template	7 September 2012	Peter Bode
Final list of modules needs to be agreed (around 40, 30 mins each)	List circulated	1 October 2012	Sheldon Landsberger
Presenters invited to prepare PowerPoint lectures	Final list of presenters	1 November 2012	Sheldon Landsberger
Select reviewers of packages	List of reviewers	1 November 2012	Sheldon Landsberger
PowerPoint packages completed and sent for review	40% of packages completed 90% completed	1 May 2013 1 September 2013	Peter Bode & Sheldon Landsberger

ANNEX IV. JOINT WORK MATRIX

Task / Partner	**Irradiation and Measurement Station** (e.g. sample changer, control, mechanical/electronics/control interface); open data base	**Systems Approach (Modular Software)** (e.g. data management, communication); open source	**e-Learning Tools** (e.g. interactive lectures, guidelines, help capability, QA/QC, References); open source
Australia	-	YES	yes
Canada	Cooperation on request	YES	YES
Japan	Cooperation on request	YES	yes
Netherlands	Cooperation on request	Cooperation on request	YES
USA	Cooperation on request	Cooperation on request	**YES**
Algeria	YES	yes	yes
Bangladesh	YES	yes	yes
Brazil	YES	yes	yes
Chile	Cooperation on request	YES	yes
China	YES	yes	Cooperation on request
Egypt	YES	yes	yes
Indonesia	YES	yes	yes
Jamaica	-	**YES**	yes
Malaysia	YES	yes	Cooperation on request
Morocco	yes	YES	yes
Peru	**YES**	yes	yes
Russia	yes	YES	YES
Slovenia	yes	YES	YES
Syria	YES	yes	Cooperation on request

Key: green highlight — country with research agreement
yellow highlight — country with research contract
YES — major contributor
yes — minor contributor
YES — task leader
blank entry — country not in attendance

ANNEX V. GROUP WORK PLANS – YEAR 1 AND PROVISIONAL YEAR 2

Group 1 – Irradiation and Measurement Station

Group coordinator: Eduardo Montoya

Year 1 work plan (contractual)

Activity	Expected output	Delivery date	Responsibility
Questionnaire to every NAA laboratory	Report with processed data, conclusions and recommendations.	End February 2013	Sutisna
Proposal of selected sample changer designs – I (Conceptual design)	Basic engineering (conceptual design + technical specifications)	End October2012	Eduardo Montoya
Proposal of selected sample changer designs – II (Detail design)	Complete building instructions, including detailed plans, list of components (with providers and prices), detailed procedures.	End February 2013	Eduardo Montoya
Microcontroller driven interface for bidirectional PC to sample changer communication	List of suggested microcontrollers + tested source program listings.	End March 2013	Nolida Yussup
Buying & distribution of S561 programming package for Canberra's genie 2000	Packages available for each participant NAA lab that uses genie 2000.	ASAP	IAEA Project Officer
Control software for Canberra's Genie 2000 and sample changer communication	Example of end user application	End March 2013	Sergey Pavlov

Group 2 – Systems Approach (Modular Software)

Group coordinator: John Preston

Year 1 work plan (contractual)

Activity	Expected output	Delivery date	Responsibility
Preparation of questionnaire on group Naa automation details.	Data on : – automation status of CRP participants – equipment and software in use – analysis approaches	Jan 2013	John Preston
Analysis of automation status data.	Metrics of automation of CRP participants for: – Sample handling – irradiation, counting and analysis – QA/QC – data management	March 2013	Moussa Bounakhla
Generation of guidelines on best practices for automation of various aspects of NAA.	Document identifying best practices and gaps	July 2013	Borut Smodis
Generation of report on questionnaire responses	Document circulated to CRP participants.	July 2013	Luis Munoz

Year 2 work plan (provisional)

Activity	Expected output	Delivery date	Responsibility
Development of software to fill the gaps identified.	Software	2014	John Preston
Development of e-learning materials that fill gaps identified.	PowerPoint, short video clips,	July 2014	Borut Smodis
Implementation of automation guidelines developed in select facilities	Demonstration of improved automation	July 2014	All

Group 3 – e-Learning Tools

Group coordinator: Sheldon Landsberger

Year 1 work plan (contractual)

Activity	**Deliverable**	**Completion date**	**Responsibility**
Decide on (interim) template for PowerPoint presentations	Electronic template	7 September 2012	Peter Bode
Final list of modules needs to be agreed (around 40, 30 mins each)	List circulated	1 October 2012	Sheldon Landsberger
Presenters invited to prepare PowerPoint lectures	Final list of presenters	1 November 2012	Sheldon Landsberger
Select reviewers of packages	List of reviewers	1 November 2012	Sheldon Landsberger
PowerPoint packages completed and sent for review	40% of packages completed 90% completed	1 May 2013 1 September 2013	Peter Bode & Sheldon Landsberger
Receive reviews	90% of reviews received	1 October 2013	Sheldon Landsberger
Implement recommendations for revision	95% of revised packages received	1 November 2013	Peter Bode & Sheldon Landsberger
Progress report presented at CRP meeting, Vienna	Memory stick of packages distributed to CRP delegates	2-6 December 2013	Sheldon Landsberger

ANNEX VI. GROUP 1 PRESENTATION ON IRRADIATION AND MEASUREMENT STATION

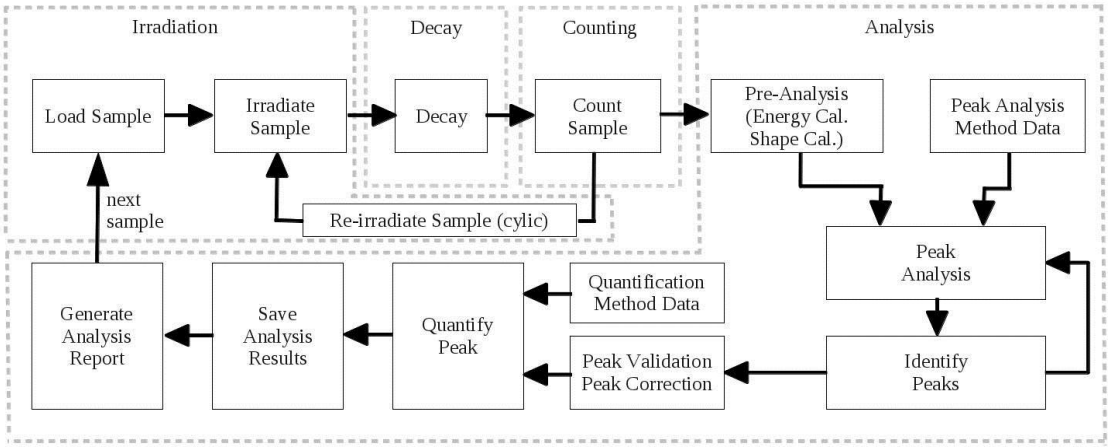
The feasibility of using home-made or non-expensive commercial components in the automation projects of the participants was discussed and was found achievable.

In the first stage, participants will be invited to contribute possible designs for consideration by the group. The designs should elaborate the level of technological facilities and expertise required, as well as indicative costs. A loading capacity of 50 samples is suggested. The proposals should include the detailed engineering plans (mechanical drawings and electronic schematics), lists of components with possible suppliers and prices, detailed instructions for assembly, etc. The designs might also be suitable for NAA teams that already have some commercial facilities. Every proposed design, including hardware & software, should be freely available, even for those NAA groups not taking part of this CRP.

Every design must be capable of being easily interfaced with NAA software packages.

ANNEX VII. GROUP 2 PRESENTATION ON SYSTEM APPROACH (MODULAR SOFTWARE)

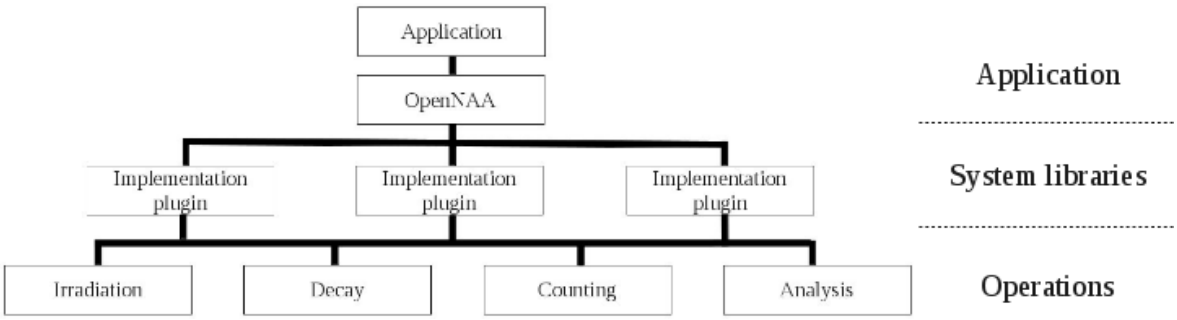
The automation of Neutron Activation Analysis in CRP participant laboratories will require an understanding of the status of the laboratories with regards to their current level of resources and automation.



A questionnaire will be circulated amongst CRP participant laboratories and other NAA labs previously polled, to capture relevant data.

- Task 1: Questionnaire to establish current user workflow. From the data the following will be extracted:
  - Understanding of :
    - Common approaches that currently exist;
    - Common problems that are being experienced;
    - Hardware and software that are in use, including information on capacity within institutions for development.
  - Best practices for different aspects of NAA such as:
    - Sample handling;
    - Irradiation and counting methodologies as they relate to maximizing throughput;
    - QA/QC strategies to improve quality of analytical output;
    - Data management.

- Task 2: Development of low level application programming framework for managing hardware / software and software / software interactions required for NAA in a open manner.



ANNEX VIII. GROUP 3 PRESENTATION ON E-LEARNING TOOLS

Introduction

A key element of the CRP on automation in NAA is to disseminate the output from the project to as wide an audience as possible. Traditionally this activity would have been achieved through the publication of IAEA documents but it is recognised that the reach and penetration of electronic media represent a much more effective platform for the dissemination of information. It is envisaged that videos, interactive documents and webcasts will provide a variety of channels to engage with target audiences in a stimulating environment.

What is E-learning

Videos
- Common platform
- High resolution recording
- Roughly 30 slides in 30 minutes per module
- Some topics may run across more than one module

Web-based documentation
- Tools for analysis
- Frequently asked questions
- Pop-ups

Web-based exams
- Certification

Web-based communications
- Exchange of ideas
- Individual lectures uploaded
- Skyping

Audience

Professional Technicians
Professional Analysts
Professional Development
Undergraduate/Graduate Students
Promotional Activities – how to sell NAA related services to clients

Content

1. What is NAA and Historical Aspects
   - automation of NAA in the future; opportunities & benefits; full LIMS
2. Nuclear Processes
   - web based data bases KAERI, BNL; tools for searching databases and accessing automatically from NAA software
3. Table of Isotopes
   - web based data bases KAERI, BNL; tools for searching databases and accessing automatically from NAA software e.g. http://www.oecd-nea.org/janis/
4. Neutron Sources, Nuclear Reactions, Neutron Fluxes and Neutron Spectra

- Impact of reactor stability (neutron flux, spectrum)during irradiation on automation
- Impact of other utilisation activities on stability
- Automation of irradiation facilities (scheduling, timing, sample delivery, communication with reactor operators, retrieval of irradiation data, online scheduling requests)

5. Gamma Ray Spectrometry
    - automatic sample changer
    - automatic liquid nitrogen filling and possible microphonic and electrical interference with spectrometers
    - training spectra for different material types, with pop-ups
6. NAA Methodologies
    - Relative, k_0 and absolute
    - Sample Preparation and Irradiations
    - electronic saving of weights, sample IDs, irradiation conditions, k_0 parameters, flux monitors
7. Health Physics and Reactor Safety
    - Chemical risks, heating risks, dose risks, radiolysis risks
    - Electronic retrieval of irradiation conditions (time, power, flux etc)
8. Counting Statistics, Uncertainty, Detection Limits
    - automation of overall budget uncertainty
9. Spectrum Analysis
    - Automate transfer of peak area table and all NAA conditions to analysis program
10. QA/QC
    - Laboratory Information Management System (LIMS)
    - Laboratory administration
    - Automated control charts
    - Scheduling
11. Research Applications and Commercialization
    - Batch handling of samples
    - Automation of results allows NAA laboratories to engage effectively in commercialization
    - Examples of successful commercial applications