

RESULTS PROJECT PARTNERSHIP CONTRACT NO. 141/2012

STAGE 1/2012 (02.07.2012-31.12.2012):

1. Documentation of the partners for the project fulfillment:

-Many publications related to the overview problems were consulted, including proposals for an optimum place of the system containing the radon chamber and for the installation mode, types of radon chambers, necessary endowment, measurement intervals, standardization methods, standards used to assure an atmosphere of radon and its daughters appropriate for the standardization.

-At IFIN-HH the international standards in this field were studied, especially the Standard IEC 61577 - Radiation protection instrumentation - Radon and radon decay product measuring instruments, parts I-IV.

-At ICSI Rm. Valcea, the partners studied the construction solutions, materials to be used, dimensions and other technical parameters of the radon chambers built abroad.

-At the University of Bucharest, they studied the standardization procedures and analyzed the influence of the different environmental factors during the measurement, and the evaluation procedures by the computation (especially by Monte Carlo simulation) of the measurement instrument response. A documentation on the latest research in this field was undertaken by the project responsible from the University of Bucharest, Prof. Dr. Octavian Sima, who participated at the „6th International Conference on Radionuclide Metrology – Low Level Radiation Measurement Techniques”, Jeju, Republic of Korea, September 17-21, 2012, and examined with interest the papers presented in the session „Radon”.

-In October 2012, documentation visits were performed abroad: two participants from IFIN-HH went to France, in Saclay, at the „Institut de Radioprotection et de Sûreté Nucléaire” (IRSN) and at the CEA, LNE-Laboratoire National Henri Becquerel (LNHB). One participant from IFIN-HH and another one from ICSI Rm. Valcea made a visit in Italy, Casaccia, at ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti (ENEA-INMRI). During the visits, technical discussions about the standardization systems and their on site examination were organized; proposals of future collaboration in the field were also discussed.

2. The Coordinator IFIN-HH organized the Workshop CARSTEAM-2012, on 15.11.2012, where representatives of all the partners involved in the project participated (13 participants). Following the discussions, a minute was written and signed by the project responsables of the three partners; the document establishes the next stages of the project:

-The radon chamber made in the frame of the project will be designed at IFIN-HH, while its components will be built and tested at ICSI Rm. Vâlcea, according to the Project Plan. The radon chamber will be a metallic tight object, made of stainless steel, cylindrical shaped, having the inner volume of about 1 m³ precisely determined and will be installed in the radon laboratory of the Radionuclide Metrology Laboratory (LMR), i.e. in the room 248, the building of the DRMR Dept. from IFIN-HH.

Considering the possible temperature fluctuations in the room 248, it was agreed to apply a thermal isolation of the future radon chamber, which will have measuring and monitoring

systems for the temperature, atmospheric pressure and relative humidity, in order to characterize the reference radon atmosphere, necessary to standardize the instruments measuring the concentration of radon and its progeny (daughters) in the air. Solutions will be established for an efficient and economic system to control the temperature, atmospheric pressure and relative humidity in the radon chamber, in order to obtain a system with radon test atmosphere (System for Test Atmospheres with Radon, i.e. STAR), according to the international standard IEC 61577-4, ed. 1.0, 2009-02, Radiation Protection Instrumentation – Radon and radon decay product measuring instruments, Part 4: Equipment for the production of reference atmospheres containing radon isotopes and their decay products (STAR).

-The radon chamber will be used at IFIN-HH to standardize instruments that measure the radon gas concentration, in both types of operating modes: static – using radon gas standards in glass vials and dynamic – with radon emitted by the Pylon source from the IFIN-HH/LMR and a reference instrument. The radon chamber will be filled with ordinary atmospheric air or technical air (synthetic) with no impurities (including radon), transferred from pressurized recipients.

-The types of detectors proposed to be standardized in the radon chamber at IFIN-HH are: monitors AlphaGUARD, Pylon, Radon Scout (produced by the company Sarad GmbH), passive monitors (track detectors) type CR-39 and devices based on the thermoluminescence phenomenon (TLD) for the measurement of the radon daughters.

STAGE 2/2013 (01.01.2013-31.12.2013):

1. In the frame of the first activity scheduled in stage 2/2013, the Radon Chamber execution design was done, based on the technical solutions identified by the partners, including the working/documentation/dissemination visits made in Romania and abroad.

At the Horia Hulubei National Institute of Physics and Nuclear Engineering, IFIN-HH (Project Coordinator), Dr. Ing. Leonardo Serbina made the 3D concept model of the project, using the software CAD – Autodesk Inventor, in several variants which were optimized according to: the imposed requirements to a calibration stand for equipments measuring the concentration of Radon and its progeny in air (according to the Standard CEI 61577-Radiation protection instrumentation – Radon and radon decay product measuring instruments), the available place in the radon laboratory, the use of system producing radon gas standard sources and other facilities existing at IFIN-HH, the technical possibilities of the partners and their collaborators. On September 12, 2013, IFIN-HH organised a work meeting with the partners, discussing and establishing practically the technical solutions necessary to build the radon chamber components. Then, during the period September-November 2013, the necessary execution drawings were made and transmitted to the partner ICSI Rm. Valcea, who will build and assemble the radon chamber components during the 3rd stage of the project. In the same time, at IFIN-HH, the sub-components and annexes/accessories of the Radon chamber were defined; also, the equipments necessary to be purchased by IFIN-HH during the 2nd and 3rd stages of the project, were established. Fig. 1 presents a general view of the Radon chamber, according to the execution project.

The National R&D Institute of Cryogenics and Isotopic Technologies – ICSI Rm. Valcea (Partner 1) was strongly involved to define the concept model, including during the work meeting organised by the project coordinator on September 12, 2013, with the participation of Carmen Varlam, project responsible at ICSI, Ionut Faurescu and Dorin Schitea, the project designers and coordinators. Technical solutions were proposed, but some technical limitations of the equipments from ICSI were also outlined.

After receiving the 3D concept model from IFIN-HH, the work proceeded with the evaluation of the financial capabilities of this stage, by defining the list of materials corresponding to the proposed concept model. The necessary materials will be purchased by IFIN-HH and ICSI. The concept model has a total estimated weight of 3993 kg, 2400 mm long, 2000 mm wide and about 1800 mm height. After prioritising the sub-components, with the agreement of the project coordinator, the execution efforts of this stage were concentrated to the inner chamber, where a controlled atmosphere with homogeneous radon concentration must be obtained. So, the execution project of the inner chamber – part of the Radon chamber, was done; it contains 24 execution drawings of the corresponding sub-components, and the purchase of necessary materials started.

Regarding the documentation and dissemination activity, Mrs. Denisa Faurescu, engineer working in the Tritium Laboratory (ICSI), participated during the period 16-21 June 2013 at the international conference “ICRM 2013 – 19th International Conference on Radionuclide Metrology and its Applications”, in Antwerp, Belgium, organised by EC-JRC-IRMM, The Institute for Reference Materials and Measurements, based on the approval (mandate) for travelling abroad on professional interest nr. 6074/13.05.2013. In the poster session of the section Intercomparisons, eng. D. Faurescu presented, together with the colleagues from Slovenia (co-authors), the paper: “Slovenian-Romanian Bilateral Intercomparison on Tritium Samples”, authors: Denis Cindro, Jasmina Kozar-Logar, Carmen Varlam, Denisa Faurescu, Irina Vagner. The paper presents results obtained in the frame of the project of bilateral cooperation no. 532/2012 – “LSC Methods for the determination of H-3 and C-14 in environmental samples (TRICARBENV)” and the project Partnerships nr. 141/2012 – “Realization of a radon chamber - calibration stand for the equipment used in the measurement of radon and daughter products concentration in air (CARSTEAM)”; the paper will be published in the journal Applied Radiation and Isotopes, in 2014.

The University of Bucharest (Partner 2), contributed, in the frame of this first activity of stage 2/2013, by developing methods to measure the radon, adapted to the specific conditions from the radon chamber, taking into consideration its use for the calibration of the radon atmosphere, the production of radon standards and the standardization of instruments for radon measurements. During the 2nd stage of the project, in cooperation with colleagues from the Physikalisch-Technische Bundesanstalt (Braunschweig, Germany), the radon distribution in vials containing radium solution was studied, and a calibration method based on gamma-ray spectrometry of the radon daughters was established, by using specific information on their distribution. The paper “Distribution of the ²²²Rn decay products from a ²²⁶Ra solution in a PTB ampoule – implications for calibration”, authors O. Ott, O. Sima and Q. Zhao, was written and presented at the conference “19th International Conference on Radionuclide Metrology and its Applications”, in Antwerp, Belgium, June 17-21, 2013. At the same conference, two other papers having Prof. Dr. Octavian Sima as co-author, were presented: “Improved method for the assessment of ⁶⁰Co and ¹³⁴Cs point sources in samples with non-homogeneous matrix” (authors: R. Suvaila, O. Sima and I. Osvath), respectively “Equivalence of computer codes for calculation of coincidence summing correction factors” (authors: T. Vidmar, M. Capogni, M. Hult, S. Hurtado, J. Kastlander, G. Lutter, M-C. Lépy, J.

Martinkovič, H. Ramebäck, O. Sima, F. Tzika, G. Vidmar). All the three papers will be published in the journal Applied Radiation and Isotopes, in 2014.

2. The second activity accomplished within stage 2/2013 was the purchase of the first materials and equipments needed to build the Radon chamber, by IFIN-HH and ICSI Rm. Valcea (according to the project plan, the University of Bucharest did not participated to this activity).

The stocks (processed materials, raw materials and spare parts) bought are: stainless steel plates of different sizes and thickness, rods for welding stainless steel, electrical cables with multiple plugs, plexiglass plates and birotics (A4 paper and ink printer cartridges). At IFIN-HH, a barometer and a digital thermo-hygrometer were purchased (inventory objects). Other acquisitions at IFIN-HH were two equipments to measure and control the temperature, humidity and pressure, and a pressure reducer for recipients with nitrogen/technical air under pressure to be connected to the radon chamber (capital expenses- endowments). The activity of materials and equipments purchase will be carried on by IFIN-HH and ICSI Rm. Valcea as planned, until the end of the stage 3 of the project, during 2014.

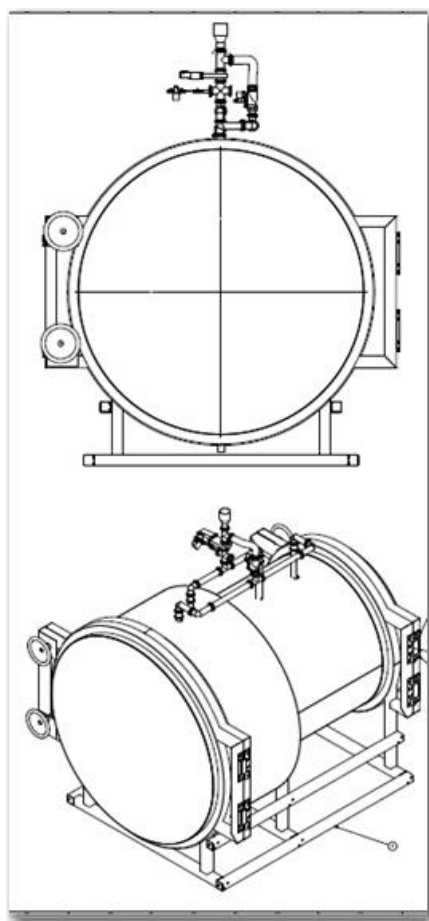


Fig. 1. General view of the Radon chamber (execution design).