



# U-SERIES

**RADIOACTIVITY AND  
RADIATION PROTECTION**



# RADIOACTIVITY AND RADIATION PROTECTION

U-Series Srl is a private company active since December 2003 and provides consultancy and services in the field of radioactivity, radiation protection and stable isotopic ratios of hydrogen, oxygen, carbon and nitrogen. The company was founded to pursue scientific research and technological innovation. Nowadays the company operates in the radioactivity field focusing its resources on the radiation protection and on research and development of competitive technological products. U-Series Srl deals with all aspects of radioactivity, not only prevention of risk, analysis and mitigation, but also nationally and internationally scientific research in all areas of radiation protection and radiometry as requested by law or by customers.

U-Series has more than 20 employees, all graduates and many with a PhD, who deal with the management and organization of the company, commercial activity, laboratory activities, research, quality and safety on the work. To date, the company has over 1000 customers in Italy and abroad; U-Series customers are made up almost exclusively of companies, including many multinationals and large companies.

U-Series offers laboratory measurements, field measurements, advice on data interpretation and on radiological risk assessment through Radioprotection Experts (Legislative Decree 101/2020) on all types of sources. The company has its own analysis laboratories and conducts research projects on its own or in collaboration with other organizations and it has received numerous awards from foundations and trade organizations; its activities have often attracted the interest of press and media.



# CERTIFICATIONS

- ▶ ISO 9001:2015 certification issued by Kiwa Cermet Italia for the provision of laboratory services in the field of radioactivity and radiation protection; Certification n. 5977-A of 08/29/2018 expiring on 08/29/2021. Date of first release 08/09/2006).
- ▶ “Suitably equipped” body for Radon measurements and accredited by ARPAV, the Regional Agency for Environmental Protection of Veneto Region.
- ▶ Accreditation as a test laboratory according to ISO 17025:2018 with laboratory number 1711 at ACCREDIA: member of the international networks of accreditation bodies (EA – European co-operation for Accreditation; IAF – International Accreditation Forum; ILAC – International Laboratory Accreditation Cooperation), ACCREDIA is signatory to the corresponding international mutual recognition agreements, thanks to the success of a peer review process. Deadline of accreditation: 07/17/2022 (for further details refer to the website [www.accredia.it](http://www.accredia.it), database section)
- ▶ METAS (Federal Institute of Metrology) certificate for our radon dosimeters valid until 12/31/2021.

The measurements technical quality is constantly controlled by internal procedures in which official national and international reference sources are used. The correctness of the results is also verified by periodic intercomparison exercises.

Since 2003 U-Series Srl has regularly participated in national and international intercomparisons to verify the quality of the measurements carried out. Examples include those organized by the IAEA (International Atomic Energy Agency), HPE (formerly NRPB, Great Britain), BFS (Germany), NIRS (Japan), ENEA and ARPA (Italy), PROCORAD (France).

U-Series is also accredited with HPE in Great Britain for radon measurements.

# SERVICES

- ▶ Workers safety and protection against ionizing radiation.
- ▶ Population safety and protection against ionizing radiation.
- ▶ Risk analysis, evaluation and management concerning physical agents (especially in the use of ionizing radiation in the medical field) for patients, employees and work environment.
- ▶ Consultation on dosimetry and quality assurance, as well as quality control of the technologies installed for image diagnostics.
- ▶ Consultation on problems related to radioprotection in the medical field.
- ▶ Characterization and assessment of radioactive material impacts.
- ▶ Radioactive pollution assessment in the environment.
- ▶ Consultation on international transport and trade of NORM (Naturally Occurring Radioactive Material) and other kind of radioactive material.
- ▶ Consultation on recycling and industrial reuse of waste material containing radioactive isotopes.
- ▶ Controls on ferrous materials collection and processing.
- ▶ Contaminated site remediation.
- ▶ Laboratory analysis in the field of radioactivity.
- ▶ Laboratory analysis of stable isotopes ( $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$ ,  $\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$ ,  $\delta^{32}\text{S}$ ).
- ▶ Refresher and training activities for employees in the various areas of competence.

# COMPANY ACTIVITIES

**1.** Appointment of radiation protection expert with regard to the possession and use of radiological equipment and particle accelerators. The provided service allows us to respond to all the obligations set out in the Italian Legislative Decree 101/2020, including checks of individual dosimeter readings, compilation and updating of individual dosimeter cards, management of the distribution and collection of individual and environmental dosimeters; risk assessment; communication documents to the Construction Manager; periodic radioprotection checks and drafting of the related report; preparation of documents for the prior communication of practices, for the authorization and for the renewal of the aforementioned authorizations; checks for the recording of radioactive sources and checks on the procedures for the removal of radioactive waste; support in the preparation of the administrative documentation for radiation protection (authorization updates, detention communication, etc.).



**2.** Appointment of radiation protection expert with regard to the possession and use of radioactive materials falling under the prior notification of practice and authorization regime; especially for import, production, trade, possession and use of radioactive material located at the company's sites: analysis of existing documentation, integration with any missing or incomplete documents, periodic inspection for physical surveillance with preparation of the related documentation, periodic reports for supervisory bodies, wet sampling (smear tests) on the external surfaces of the sources, subsequent analysis in the laboratory by means of liquid scintillation or spectrometry range and issue of radiological non-contamination certificates; computerized management of sources: creation of an IT module for the management of sources (internal operations register) between the various sites and towards external suppliers and customers; identification and training of people who can carry out non-contamination samples on the sources; training and information of people who, for any reason, can come into contact with or manage radioactive sources, and drafting of operating procedures; drafting of the information note for placing on the market, together with the Prevention and Protection Service (PPS) and the competent corporate functions; participation in periodic meetings pursuant to art. 35 of Legislative Decree 81/08; support to PPS for the correct shipment and reception of sources; support to the PPS for relations with customers, suppliers and supervisory bodies; support to the PPS for the preparation of the Risk Assessment Document and the Single Document for the Evaluation of Interference Risks, as far as it is concerned.

**3.** Appointment of radiation protection expert for interventions in case of work activities carried out in contaminated areas or in case of orphan sources discovery (interventions in Italy, USA, Japan, Cyprus, Bosnia). In particular: carrying out measurements in air, taking and analyzing organic and inorganic samples for estimating environmental contamination and the inhalation and ingestion dose; laboratory analysis; drafting of technical reports. Assessment of radiological safety conditions in areas of Japan near Koriyama (Fukushima Prefecture) and Utsunomiya (Tochigi Prefecture). In particular: environmental monitoring for the evaluation of released radioactivity; dose measurements; analysis of soil, water, food and urine samples.

**4.** Appointment of radiation protection expert in the presence of natural and NORM sources, both in work activities and in specific interventions, in Italy and abroad. In particular, interventions at oil sites in Italy and Cyprus: dosimetric mapping, evaluation of the effective dose for workers, definition of protective measures, radioactivity measures in alpha, beta and gamma spectrometry.



**5.** Design of the radon measurement campaign by the radiation protection expert; supply and analysis of passive nuclear trace detectors with test reports releasing by the U-Series internal laboratory – quality certified and accredited by numerous Italian and foreign bodies; preparation of technical reports by the radiation protection expert; dose assessments; design, execution and verification of remedial actions; management of relations with the supervisory bodies and with the Construction Manager, planning and provision of training; drafting and updating of the Risk Assessment Document and of the Single Document for the Evaluation of Interference Risks; legal advice on the interpretation of the law.

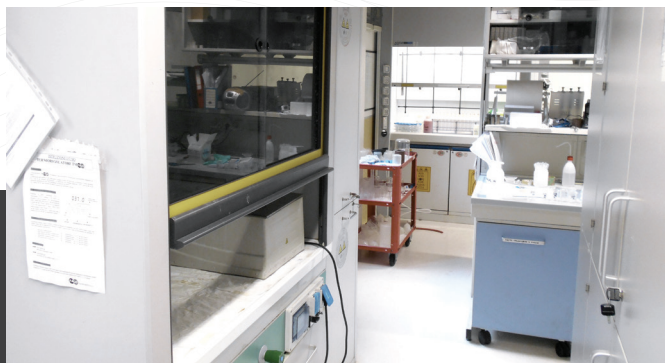
**6.** Neutron sources, e.g.  $^{252}\text{Cf}$ , DD and DT: risk assessments, preparation of authorizations, relations with OOVVs, design of barriers, dose assessments, design of safety devices, drafting of procedures, MCNP calculations (license to use the program in the name of U- Series Srl).

**7.** Training, information and training in the field of radioprotection and radioactivity measures: preparation of didactic documentation, delivery of classroom and remote courses, field training for sampling or measurement, laboratory training.



# LABORATORIRES AND EQUIPMENT

U-Series has about 400 square meters of offices and laboratories equipped to conduct determinations of numerous radioactive isotopes and stable isotopic ratios on a large number of matrices. Concerning Business continuity, the company is equipped with 2 independent laboratories sited in Bologna (Italy) in two separate buildings (in via Ferrarese 131 and in via Gobetti 52/2): this ensures that there is no interruption of service. From an IT perspective, all data are saved and duplicated by scheduled backups.

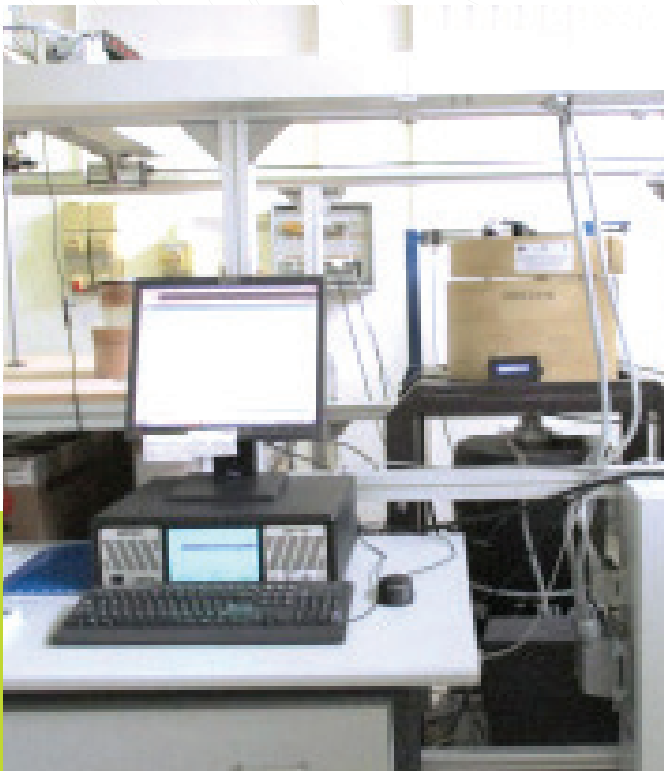


U-SERIES LABORATORIES



**Gamma and X spectrometry with Hyperpure Germanium (HPGe) detectors**, with detection energy range 5–2000 keV and possibility of portable dewar for in situ analysis. With this technique, the gamma-emitting isotopes of both natural and artificial origin are normally measured. The samples are suitably treated by mechanical means (shredding, sieving, pressing, etc.) except in cases where there is no possibility of treatment. In this case, it is possible to proceed with the analysis of the sample “as is”. The most commonly analysed matrices include water, soils and sediments, rocks and soils, building material, food, biological samples and structural materials of plants and installations according to the appropriate reference standards (for example: UNI 11665: 2017). The gamma analysis can be preceded by a radiochemical treatment of the sample to allow better Detection Limits where necessary.

GAMMA SPECTROMETERS | C PROFILE: 3KEV – 2MEV, EFFICIENCY 66%



GAMMA SPECTROMETERS | P-TYPE: 50KEV – 2MEV, EFFICIENCY 50%



**Alpha and beta spectrometry with LSC.** With this technique some emitting alpha and beta isotopes in various matrices are normally measured. For example, total alpha and beta, inorganic tritium and OBT, Radon,  $^{210}\text{Pb}$ ,  $^{89}\text{Sr}$  and  $^{90}\text{Sr}$ ,  $^{14}\text{C}$ ,  $^{63}\text{Ni}$ ,  $^{35}\text{S}$ ,  $^{99}\text{Tc}$  in various matrices are measured. Thanks to the availability of a fully equipped laboratory with hoods, stoves, muffles, freeze dryers, specific furnaces for  $^3\text{H}$  and  $^{14}\text{C}$ , virtually all matrices can be treated before radiochemical procedures.

**Alpha spectrometry with silicon detectors.** With this technique, after radiochemical treatment of the samples, we measure the isotopes of Pu, U, Th, in addition to  $^{241}\text{Am}$ ,  $^{226}\text{Ra}$ ,  $^{210}\text{Po}$  and others in various matrices.

**Nuclear traces with optical microscopy.** With this technique  $^{222}\text{Rn}$  measurements are mainly performed using CR-39 type detectors. Radon is also measured with electrets and silicon electronic instrumentation, with sampling times from 5 minutes to 1 hour.

ALPHA SPECTROMETER (PACKARD TRI-CARB 1600)



BETA SPECTROMETER (QUANTULUS 1220 PERKIN ELMER)



BETA SPECTROMETER (QUANTULUS 1220 PERKIN ELMER)





### **Electrolytic enrichment of tritium used in combination with beta spectrometry.**

This technique allows to enrich the tritium contained in aqueous matrices to improve the analytical sensitivity. Tritium is a tracer widely used at an environmental level to monitor the hydrogeological cycle of meteoric, surface and underground waters and identify any anthropogenic contaminations.

**Furnace for tritium and radiocarbon determination used in combination with beta spectrometry.** The furnace is used for the extraction of  $^3\text{H}$  and  $^{14}\text{C}$  by oxidative combustion from a wide range of materials: environmental (atmospheric particulate filters, soil and sediment, water), waste (industrial waste, waste water, percolate), biological samples (feces, urine), foods (milk, oils, vegetables).

**Isotopic mass spectrometry.** The current configuration of the instrument allows you to analyze solid material (e.g. animal and vegetable tissues, soil, sediment, food, processing residues of various origins, etc.) and liquid (water and aqueous solutions). The sample is converted into carbon monoxide ( $\text{CO}$ ) and hydrogen ( $\text{H}_2$ ) by pyrolysis (conversion at high temperature in the absence of oxygen) for the analysis of stable isotopes of oxygen ( $^{18}\text{O}/^{16}\text{O}$ ) and hydrogen ( $^2\text{H}/^1\text{H}$ ). For the analysis of stable isotopes of carbon ( $^{13}\text{C}/^{12}\text{C}$ ), nitrogen ( $^{15}\text{N}/^{14}\text{N}$ ) and sulfur ( $^{34}\text{S}/^{32}\text{S}$ ), on the other hand, the sample is converted by combustion into carbon dioxide ( $\text{CO}_2$ ), molecular nitrogen ( $\text{N}_2$ ) and sulfur dioxide ( $\text{SO}_2$ ). The gases thus formed are separated by means of a chromatographic column and injected continuously in an isotopic mass spectrometer.

CATALYTIC PYROLYZER-2 TRIO



THE IRMS INSTRUMENT

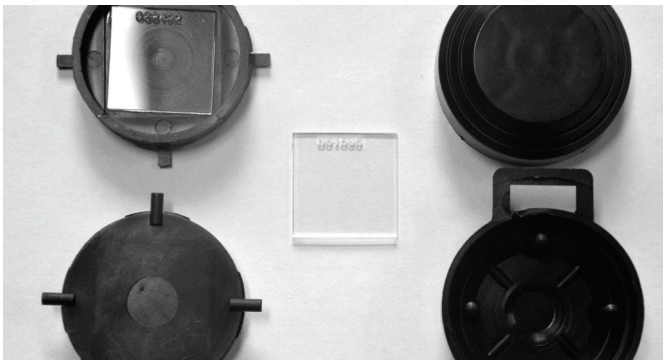


DISTILLATION AND TRITIUM ENRICHMENT SYSTEM



We currently use this instrumentation mainly to make analyzes of  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  in water and  $\delta^{13}\text{C}$  of total carbon in water. In parallel, we are developing a method for determining the geographical origin of food that is based on the natural and foreseeable variability of stable isotopes linked to the geographical and climatic conditions of the production areas. The technique is very powerful and can also be applied to other fields such as the origin of explosives, drugs and pollutants; the migration of animals (for example in wildlife protection programs) and the movement of human beings (for example to support investigative activities linked to unknown victims); the identification of some types of food fraud (for example the use of sugar to increase the alcohol content of wine); the anthropic or natural origin of different types of substances (for example methane).

SEVERAL INSTRUMENTS FOR RADIOACTIVITY MEASUREMENTS





**The portable instrumentation** available consists of contamination meters for alpha and beta radiation, ionization chambers for dose intensity measurements, NaI and HPGe detectors with multi-channel analyzers for gamma spectrometry in the field, detectors for continuous radon, thoron and PAEC measurements, electret detectors for radon measurements, high volume dust samplers.

The company has the necessary skills for hard to measure radionuclides determination so, if requested, it is therefore able to set up specific measurement lines.

The company has a long experience of geochronological measures, with particular attention to techniques related to the U-Th and  $^{14}\text{C}$  disequilibrium. This fact determined a particular attention in the definition of procedures and in the precise quantification and reduction of the minimum detectable activity and measurement uncertainties, even on matrices particularly complex and with isotopes of difficult determination (e.g. U, Th and Pa in organic matrices).





# QUALITY POLICY

In order to satisfy market demand and extend its business alliances, U-Series focuses its resources on proficiencies improvement.

The board, aware of the growing necessity of market demand in terms of client service quality, establish client satisfaction as primary objective of its quality policy. For this reason, the board is committed:

- ▶ to guarantee good professional practice and tests quality defining operative procedures that technicians and collaborators should follow in each step of the employment requested by the client, taking part in inter-laboratory comparisons, effecting internal quality control, supporting personnel educational growth
- ▶ to guarantee a services quality standard feasible even with a continuous collaboration with its own clients
- ▶ to define and pursue impartial and measurable quality objectives e.g. client satisfaction, results efficiency and efficacy enhancement and continuous improvement
- ▶ to get personnel involved into the quality management system promoting internal training on the quality system in order to familiarize themselves with the quality documentation and implement the policies and procedures in their work; verifying that the personnel employ established policies and procedures; sensitising personnel on the importance of the maintenance of the quality management system
- ▶ to guarantee and maintain every resource necessary to ensure the achievement of each pre-set objectives and the accomplishment of the requirements established by ISO 9001:2015 and ISO 17025:2018 expected by Italian accreditation authority and sector cogent requirement
- ▶ to guarantee the commitment to comply a continuous enhancement of the effectiveness of quality management system
- ▶ to maintain secrecy commitment for all the information acquired.

# RELEVANT EXPERIENCE

- ▶ **Radioactivity measurements in soil, sediments, water:** evaluation of the effective dose to the workers of some companies engaged in drilling operations in the so-called phosphogypsum lagoon in a former fertilizer plant. The operations are carried out offshore and onshore in the fenced area outside the phosphogypsum lagoon and the dose evaluations take into account the real nature of the operations and the reading of the personal dosimeters.
- ▶ **Radioactivity measurements in soil, sediments, biological matrix; dose assessment:** radiological risk assessment after the Fukushima accident for the workers through dose mapping and sampling of environmental and biota samples.
- ▶ **Radioactivity measurements in environmental matrix like particulate matter, water:** periodic monitoring of air, particulate and groundwater matrices to measure the present radionuclide concentrations and thus evaluate the radiological risk associated with the areas.
- ▶ **Radioactivity measurements in the soil and radioprotection consultancy:** evaluation of the effective dose to the workers engaged in landfill plant operations. The operations are carried out offshore and onshore in the fenced area outside the landfill and the dose evaluations take into account the real nature of the operations and the reading of the personal dosimeters. Radioactivity measurements and radon mapping have been conducted on collected soil cores samples.
- ▶ **Radioactivity measurements in caves during astronauts training:** continuous monitoring of the radon activity has been hourly recorded by active electronic devices placed in the caves. The radon pattern has been also mapped in the main karst system with passive detectors. In order to assess the exposure dose to trainers and trainees, a specific procedure has been adopted by the participants in order to have a periodic control of the inhaled dose and to ensure not to surpass the limits for non-exposed workers.



**U-SERIES SRL**

**VIA FERRARESE, 131 - 40128 BOLOGNA**

**TEL. 051 6312418 - FAX. 051 368645**

**INFO@U-SERIES.COM**

**WWW.U-SERIES.COM**