



May 2017

## ReNuAL+: Equipment Requirements

*This list consists of equipment being sought within the €3.0 million equipment budget for ReNuAL+. All items are urgently needed by the laboratories, and they will be sought until either the items on the list or the equipment budget is exhausted. The list indicates the intended use of each item, and required technical specifications for all items are provided in the appendix to this list. Interested donors are requested to note that only contributions that directly correspond to or otherwise support the procurement of items on this list will be reflected as contributions to ReNuAL+.*

### Animal Production and Health Laboratory

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#### **High power X-ray irradiator for biological research**

Required for irradiated vaccine development programs of APHL. The x-ray (or e-beam platform) irradiator is specifically required for R&D activities on irradiated vaccines against exotic and transboundary animal diseases.

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#### **Flow cytometer**

To study characteristics of cells in order to develop new irradiated vaccines, to evaluate current livestock vaccines and study host-pathogen interactions that will aid in developing diagnostics. Characteristics include cell morphologies, cell phenotypes and cellular functions. Flow cytometers are also used to assay biomarkers in a multiplexed manner.

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#### **Next Generation Sequencer**

Used to increase the sequencing efficiency more than 100,000 times, greatly reduce the cost per genome, and enable quick response towards disease management during outbreaks. NGS technology offers a wide range of applications and will also be beneficial to genetic characterization of indigenous livestock genomes of indigenous species for meat and milk production, disease resistance, etc.

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#### **High throughput single nucleotide polymorphism (SNP) genotyping system**

Required to screen and detect novel genetic variants in indigenous livestock of various Member States. This platform will be cost-effective for multiplex SNP genotyping and can help in generating high quality genotype data for genetic association as well as animal health studies. Has the advantage of being integrated with robotic liquid handling system to improve the precision and speed of the experiments.

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### Dosimetry Laboratory

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#### **Gamma beam protection level irradiator (Cs-137 and Co-60)**

Used in radiation protection level calibration of different types of dosimeters (Dosimetry Laboratory provision of calibration services to Member States).

## Food and Environmental Protection Laboratory

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### **Ultra performance liquid chromatograph (UPLC) high resolution QToF (Quadrupole Time of Flight) mass spectrometer**

For food authenticity method development using untargeted metabolomics, selection and identification of biomarkers for food commodity characterisation (for authenticity and traceability), and untargeted testing for mixed and unknown chemical food contaminants.

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### **Liquid chromatograph-Orbitrap mass spectrometer**

Food contaminant analysis, authenticity marker identification.

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### **Pyrolysis Elemental Analyser interface for isotope ratio mass spectrometer (IRMS)**

Research and method development of traceability/authenticity of food products through stable isotope measurements.

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### **Ultra high performance liquid chromatograph (UPLC) - triple quadrupole mass spectrometer**

Used for a variety of purposes, including the detection in foods of chemical contaminants such as mycotoxins, pesticide residues and residues of antibiotics and other pharmaceuticals used in the production of food animals using the isotope dilution format, with the use of stable isotope-labelled molecules.

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### **Biological oxidizer**

Research and development with radiolabelled pesticides/compounds.

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### **High performance/Ultra high performance liquid chromatograph (HPLC)**

Research and development of cost-effective, transferrable methods for food traceability/authenticity.

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### **Nuclear magnetic resonance spectrometer (NMR)**

For site-specific natural isotope fractionation (SNIF); fingerprinting, structural elucidation.

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### **Raman/Infra-red spectroscopy**

Research and development of cost-effective, transferrable methods for food traceability/authenticity.

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## Insect Pest Control Laboratory

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### **Cryopreservation Equipment**

A technology where insect eggs are preserved by cooling to very low temperatures and can be revived at a later time.

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### **X-Ray Tubes Replacement (4)**

The crucial piece of the x-ray machine used for irradiation work, actually emitting the x-rays.

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### **Insect incubators (7)**

Used to maintain insects at very specific temperatures and humidity conditions. Often used to assess the impact of climatic conditions on the performance and fitness of insects.

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### **Bioclimatic chamber for specific experiments on fruit fly rearing (2)**

An incubator for the preparation of the biological materials used for specific experiments on fruit fly rearing.

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### **Tsetse production unit 4**

A device used for the semi-automatic keeping/maintenance of tsetse flies.

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### **Food mixer with pumps to automatically dispense the diet into the trays**

A ribbon blending mixer machine used to prepare diet for fruit flies.

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### **Ultra-centrifuge**

A device that can spin at a very high speed to sediment very small particles such as viruses and protein components.

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## Nuclear Science and Instrumentation Laboratory

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### **Transportable large area 2D fast-scanning micro-XRF spectrometer**

To incorporate capabilities for fast large-area 2D elemental analysis and imaging at sub-millimetre scale of medium to large size objects. Allows the inspection of easel paintings, electronic circuits and other samples where elemental distribution is of concern.

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### **Upgrade of the Scanning Electron Microscope (SEM) and Energy Dispersive X-Ray Spectrometer (EDS)**

Used in environmental monitoring related studies. The upgrade will be used to control electronics for improved imaging capabilities and the upgrade of the scan generator. Offers the possibility of obtaining crystallographic information from the analysed samples. In house analytical services and to Member States upon request will be also provided.

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### **Caesium Iodide (CsI) array detector assembly**

Research and development (R&D) in the development of CsI scintillator arrays opens new possibilities for cost effective improved medical imaging devices.

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### **Upgrade of the existing Scanning 2D and 3D Micro-X-Ray Fluorescence (micro-XRF) spectrometer**

R&D and advanced training. Will reduce maintenance cost for the X-ray tube (water cooling, power consumption) and improve the analytical performance of the spectrometer (spatial resolution, throughput readout) with a new generation polycapillary x-ray optics.

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### **Development of improved efficiency portable XRF spectrometer**

Improved efficiency to respond to the needs of in-situ analysis of low atomic number elements.

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### **Neutron Deuterium Deuterium (DD) Generator**

For field production of in-situ radioisotope tracers and neutron imaging applications for industrial applications and cultural heritage.

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### **Laser Systems for Matter Analysis**

Analysis for air particulate matter and laser-induced breakdown spectroscopy (LIBS) for food security.

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## Plant Breeding and Genetics Laboratory

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### **Modular greenhouse (300 m<sup>2</sup>)**

Environmental control glasshouse compartments for research and training related to tropical and temperate crops. Radio-sensitivity testing, mutant trait screening, research on mutant lines and populations and for training.

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### **Modular netted screenhouse (150 m<sup>2</sup>)**

Growth of protected plants in field conditions.

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### **Equipment for genotyping**

Mutation detection: R&D and training, including freezers, lyophilisers, centrifuges, automated DNA extraction, high-throughput DNA analysis, proteomics equipment.

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### **Growth Chamber**

For growth of small and large numbers of plants under complete environmental control; for off-season propagation of mutant and doubled haploid plants.

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### **Pathogen testing facility**

Dedicated and separate facility for plant disease trials, including containment incubators.

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## Soil and Water Management and Crop Nutrition Laboratory

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### **Modular greenhouse (80 m<sup>2</sup>)**

Climate controlled (18-28°C) glasshouse to study and enhance soil-water-plant synergies in the context of climate-smart agriculture (for tropical and temperate crops).

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### **Gas chromatography combustion isotope ratio mass spectrometry (GC-c-IRMS)**

Analysis of specific organic compounds (e.g. fatty acids) to identify hot spots of land degradation.

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### **Accelerated solvent extractor with autosampler for extracting organic compounds**

Preparation of soil samples for analysis in GC-c-IRMS described above.

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### **Broad energy gamma detector**

For measuring radionuclides for soil erosion assessment and nuclear emergency response in food and agriculture.

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### **Automatic CO<sub>2</sub> flux measurement system**

For automatic in-situ CO<sub>2</sub> measurements (including accessories, such as 16 automatic gas chambers).

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### **Hyperspectral camera system (+ accessories) for air-borne soil property screening through unmanned aerial vehicles (UAVs)**

Hyperspectral remote sensing is a technology with many applications. It is capable of identifying unique spectral signatures of vegetation types, soil minerals, rock formations, and water quality. Systems are now available for integration within UAVs.

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## Terrestrial Environment Laboratory

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### **Inductively coupled plasma optical emission duo spectrometer (ICP-OES)**

For chemical characterization of reference materials to provide full determination in a single analysis.

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### **Infrared laser systems for stable isotopes in CO<sub>2</sub> and CH<sub>4</sub>**

For analysis of stable isotopic composition of CO<sub>2</sub> and CH<sub>4</sub>; to characterize new CO<sub>2</sub> and CH<sub>4</sub> reference materials foreseen for calibration of equipment in laboratories worldwide.

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### **Stable Isotope Ratio Mass Spectrometer (IRMS) dual inlets, continuous flow (CF)**

Used for sample preparation methods where produced combustion gases are transported by continuous helium carrier flux into the mass spectrometer.

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### **Carbonate system for IRMS**

Used for reference material preparation.

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### **Triple Quadrupole Inductively-Coupled Plasma Mass Spectrometry (QQQ-ICP MS) - formerly Laser-ablation-ICP-MS**

Adds advanced interference removal capabilities for use of reaction cells (additional quadrupole filters) for trace element analysis and therefore improves analytical sensitivity, otherwise achievable only by much more expensive instrumentation.

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### **Infrared laser systems for stable isotopes in H<sub>2</sub>O**

For analysis of H<sub>2</sub>O samples (mainly to monitor IAEA water stable isotope reference materials); to characterize new liquid H<sub>2</sub>O and vapour reference materials foreseen for future production.

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### **Gas handling system and vacuum equipment**

Used for gas mixing, vacuum pumps; gas supplies in the lab.

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## Appendix: ReNuAL Plus Project: Equipment Requirements

### Animal Production and Health Laboratory

- **High power X-ray irradiator for biological research:** Benchtop X-ray irradiator, dose rate up to 70 Gy/min, electrically operated specimen holder, operate on standard A/C outlet, no extra shield requirement.
- **Flow cytometer:** Laser based system for cell analysis & biomarker detection; include 3 excitation lasers with 10 colour spectra, capable to detect submicron particles.
- **Next Generation Sequencer:** Massively parallel sequencing platform for mammalian genome & transcriptome with high coverage and sequence output (10GB - 1TB), read length (250bp - 10,000 bp).
- **High throughput single nucleotide polymorphism (SNP) genotyping system:** Dynamic array based system for SNP genotyping, integrated fluidic circuits that automatically combines reactions and perform endpoint measurements.

### Dosimetry Laboratory

- **Gamma beam protection level irradiator (Cs-137 and Co-60):** comprised of a gamma beam radiation protection level irradiator, safety items and ancillary instruments. Includes a Cs-137 and a Co-60 radioactive source for radiation protection level calibration. Operated through a remote control panel that shall allow computer driven operation and should have connection to various safety interlocks.

### Food and Environmental Protection Laboratory

- **Ultra performance liquid chromatograph (UPLC) high resolution quadrupole time of flight (QToF) mass spectrometer (MS):** Ultra high performance LC coupled to QToF MS, exact-mass, ion-mobility or equivalent, mass range (up to 16.000).
- **Liquid chromatograph (LC) Orbitrap mass spectrometer (MS):** Ultra high performance liquid chromatograph (LC) coupled to Orbitrap mass spectrometer (MS), exact-mass, mass resolution at least 40,000.
- **Pyrolysis Elemental Analyser interface for isotope ratio mass spectrometry (IRMS):** High precision analysis of non-exchangeable hydrogen isotopes. Research and method development of traceability and authenticity of food products through stable isotope measurements.
- **Ultra high performance liquid chromatograph (UPLC)-triple quadrupole mass spectrometer:** Ultra high performance gradient LC, triple-quadrupole MS, simultaneous positive & negative acquisition, electrospray interface, DART interface.
- **Biological oxidiser:** Suitable for combustion of food and soil sample material for liquid scintillation counting.
- **High Performance/Ultra High Performance Liquid Chromatograph (HPLC):** Ultra-performance gradient HPLC system, diode-array detector (DAD) and fluorimetric detectors, data station, C18 column, precolumn, degasser, temperature controlled column compartment.
- **Nuclear magnetic resonance (NMR) spectrometer:** Benchtop NMR instrument, for site specific natural isotope fractionation (SNIF); fingerprinting, structural elucidation.
- **Raman/Infra-red spectroscopy:** Bench top and hand held Raman, fourier transform infrared spectroscopy (FTIR) and near infrared spectroscopy (NIR) instruments for research.

### Insect Pest Control Laboratory

- **Cryopreservation equipment:** One chemical hood, one bacteriological cabinet, one transmitted light dissection microscope, two liquid nitrogen containers, one pressurized liquid nitrogen container, one 4-liters Dewar, five cool containers, five Liquid Nitrogen-Cooled Mortar, three Robot (Cryobot IV) components.
- **X-Ray Tubes Replacement (4):** Radsources RS 2400 X-ray machine tubes.
- **Insect incubators:** Three incubators, temperature range: -10-50°C, 20-95% RH, light: 100-1000 lux.

- **Insect incubators:** Four incubators, temperature range: -10-50°C, 20-95% RH, light: 100-1000 lux.
- **Bioclimatic chamber for specific experiments on fruit fly rearing (2):** Two bioclimatic chambers, temp. range: -10-50°C, 20-95% RH, light: 100-1000 lux.
- **TPU 4:** Custom made feeding and holding units for tsetse flies.
- **Food mixer with pumps to automatically dispense the diet into the trays (2):** Model BULL 160 INOX CE, container volume: 160l, stainless steel, motor 6 kW, 400 v, dimensions (1200 x 920 x 2200 mm), weight 800 kg.
- **Ultra-centrifuge:** centrifuge capable of providing a speed of 60,00- 90,00 rpm and adapted with different fixed and swing rotors.

#### Nuclear Science and Instrumentation Laboratory

- **Transportable large area 2D fast-scanning micro-X-Ray Fluorescence (micro-XRF) spectrometer:** Moveable spectrometer excluding detection head (tray span 60x60 cm), 2 x (50w) X-ray tubes (Rh, Cr) with collim (0.1 to 0.5 mm), digital MCA & control unit for measuring 'on the fly' mode.
- **Upgrade of the Scanning Electron Microscope (SEM) and Energy Dispersive X-Ray Spectrometer (EDS):** Service to Upgrade control system for SEM model Phillips XL30: operation and advanced data processing (SEM, EDS, WDS); installation of Electron Backscatter Diffraction system.
- **Caesium Iodide (CsI) array detector assembly:** CsI scintillation crystals <3x3" in size with integrated or separate detector components including front and back end electronics, power supplies, support frame, data acquisition and analysis software.
- **Upgrade of the existing Scanning 2D and 3D Micro-XRF spectrometer:** Air cooled micro-focus X-ray tube (50-100 W), Polycapillary X-ray lens (15-20 µm focus); PolyCapillary Conical Collimator (PCCC) 20-30 µm focus end electronics, power supplies, support frame, data acquisition and analysis software.
- **Development of improved efficiency portable XRF spectrometer:** Multisegment (silicon drift detector (SDD) with anodes surrounding a central hole, miniature x-ray tube, integrated digital signal processing (DSP) and microcomputer for operation and spectrum interpretation.
- **Neutron Deuterium Deuterium (DD) Generator:** Compact, portable for field use, >2.5MeV neutrons, >1x10E8 n/s, 5kHz pulsing rate or continuous use, neutron rise and fall time <5us, minimum pluse with 10us, remote operated, <30kg, dia <200mm, length <1000mm.
- **Laser Systems for Matter Analysis:** Air particulate Matter complementary technique, LIBS for food security.

#### Plant Breeding and Genetics Laboratory

- **Modular greenhouse (300 m<sup>2</sup>):** Four compartments; temperature 15-30°C ±5°C; lighting 300 µEm-2s-1 (photosynthetic quality); adjustable day length (12-20 h); automated watering; automated humidity (50-80%); modular design.
- **Modular netted screenhouse (150 m<sup>2</sup>):** Unheated and unlit with screen net barrier to keep out pests (birds and rodents); water supply.
- **Equipment for genotyping:** Centrifuge: 6L maximum capacity, 82,000xg high performance; lyophiliser: 1.5L, -50°C, cfc-free suitable for plant tissues; DNA: high sensitivity DNA sizing and quantification, 96-well, barcode, automated.
- **Growth Chamber:** 1650 mm maximum growth height, 3.7 m<sup>2</sup> growth area, two shelves, controlled light intensity and temperature.
- **Pathogen testing facility:** Filtered air, double door system, controlled conditions for 500 plants

#### Soil and Water Management and Crop Nutrition Laboratory

- **Modular greenhouse (80 m<sup>2</sup>):** Compartmentalised, with environmental controls; temperature control (18-28°C ±5°C); lighting 300 μEm-2s-1, photosynthetic quality, adjustable day length (12-20 hours); automated watering and humidity (50-80%).
- **Gas chromatography combustion isotope ratio mass spectrometry (GC-c-IRMS):** For measurement of C-13 and N-15 stable isotope signatures of specific organic compounds (e.g. fatty acids); the system consists of a gas chromatograph (GC) with an autosampler for liquid and headspace injection, an oxidation/combustion-system and an open-split system connected to the Isotope Ratio Mass Spectrometer.
- **Accelerated solvent extractor with autosampler for extracting organic compounds:** Temperature up to 200°C and pressure up to 10 MPa during extraction; reduction of extraction time and solvent consumption; Rotavapor for evaporation of solvents. For preparation of soil samples for analysis in GC-c-IRMS (ASE - 200 extraction system and rotavap).
- **Broad energy gamma detector:** Broad Energy Ge (BEGe) Detector to covers the Energy range from 3 keV to 3 MeV, combines the spectral advantages of Low Energy and Coaxial HPGe detectors.
- **Automatic CO<sub>2</sub> flux measurement system:** Field deployable, suitable for long-term measurements of CO<sub>2</sub> concentrations up to 20 000 ppm, including accessories, such as 16 automatic gas chambers, a multiplexer, and data analysis software.
- **Hyperspectral camera system (+ accessories) for air-borne for soil property screening through unmanned aerial vehicles (UAVs):** 3.2 Mpixel, multi-spectral R-G-NIR System for Unmanned Aircraft, light-weight camera with software.

#### Terrestrial Environment Laboratory

- **Inductively coupled plasma optical emission duo spectrometer (ICP-OES):** High sensitivity and high precision ICP-OES with dual view option for environmental samples (high-concentration dynamics).
- **Infrared laser systems for stable isotopes in CO<sub>2</sub> and CH<sub>4</sub>:** Laser systems for either pure CO<sub>2</sub> and CH<sub>4</sub> gas samples, respectively for ambient concentration levels of CO<sub>2</sub> or CH<sub>4</sub> in atmospheric air with dynamic concentration range of 10.
- **Stable isotope ratio mass spectrometer (IRMS); dual inlets, CF:** Stable isotope ratio mass spectrometer with EA and Pyrolysis system for continuous flow applications, especially for long-term quality monitoring of stable isotope reference materials.
- **Carbonate system for IRMS:** Acid treatment of carbonate samples for quantitative stable isotope analysis of generated CO<sub>2</sub> via isotope ratio mass spectrometry.
- **Triple Quadrupole Inductively-Coupled Plasma Mass Spectrometry (QQQ-ICP MS) - was Laser-ablation-ICP-MS:** High sensitivity and high precision ICP-MS system for environmental samples coupled with laser ablation system for analysis of grain sized samples for homogeneity studies on reference materials.
- **Infrared laser systems for stable isotopes in H<sub>2</sub>O:** Routine water infrared water analyzer for homogeneity tests of prepared samples of water reference materials.
- **Gas handling system and vacuum equipment:** Equipment for gas mixing, vacuum pumps; gas supplies in the lab.