



# LGC AS A DESIGNATED INSTITUTE

LGC is one of the UK's national measurement laboratories and, since 1988, the Designated Institute (DI) for chemical and bio-measurement. As a DI we form part of the UK National Measurement System (NMS), a collaboration of laboratories funded by the UK Government Department for Business, Energy and Industrial Strategy (BEIS) that provides the core measurement infrastructure for the UK.

LGC delivers world-leading **chemical and bio-measurement science** (metrology), established as one of the top institutes within our scope of designation. As a DI we have two key roles:

- ensuring trust and **confidence** in chemical and bio-measurements in the UK through our state-of-the-art measurement capabilities, as identified by government strategy and industry needs
- addressing measurement challenges of the future to foster **innovation**, promoting productivity and economic growth

LGC supports measurement needs in **healthcare, food and environmental sustainability, national security and energy**. Through improved chemical and bio-measurements we support manufacture and trade, protect consumers and enhance skills development and quality of life.

LGC plays a leading role internationally to develop laboratory best practice and harmonise measurements across the world. Our international position provides further confidence in the UK's science and technology capabilities.



# EXECUTIVE SUMMARY

I am pleased to introduce this inaugural annual review of LGC's Designated Institute (DI) function for chemical and bio-metrology in 2015.

This year has been particularly successful in terms of technology advancement and achievement of our goals. Our internationally-recognised digital PCR capability is being developed into a leading facility for the absolute quantification of DNA and will provide a unique reference measurement service for the benefit of UK. The first traceable laser ablation method for metal mapping in tissues was developed at LGC this year and will support the healthcare industry to validate higher throughput imaging technologies. Furthermore, our efforts to ensure traceability of peptide and protein measurements is maturing and our traceable mass spectrometry method for quantification of a clinical peptide biomarker at low, clinically relevant levels, in real samples is being used to support routine quality assurance schemes.

We continue to provide an important role within the wider metrology community, supporting global consistency and traceability of measurement through our activities under the auspices of the Bureau International des Poids et Mesures (BIPM), the organisation that promotes comparability by, for example, maintaining a coherent international system of units. Within the BIPM we participate in 6 Working Groups (WGs) relating to chemistry and biology under the associated committee (Consultative Committee for the Amount of Substance), maintaining chairs of the Inorganic Analysis and Nucleic Acid WGs, and leading on 5 international comparison studies. This activity supports our reference material portfolio which includes over 150 products straddling multiple industrial markets.

As a DI we are able to provide high quality measurement and calibration services to industry and continue to support analysts in ensuring the validity of their measurement results. Our skills development facility, has recently been awarded Cogent 'Quality assured provider' status for five training courses in metrology related subjects, and continues to attract participants from across industry and internationally.

2015 saw a detailed International Science Review of the UK National Measurement System, of which LGC is a part. This comprised of independent audit of the quality, breadth and impact of our science by internationally acknowledged technical leaders. The details of this audit will be published later in the year and I am pleased that LGC's work has been recognised as being internationally leading across its entire portfolio of activities.

We have also playing an important part in the development of the Department for Business, Energy and Industrial Strategy (BEIS) UK Measurement Strategy which highlights the key requirements for metrology for the next 5 years and beyond. In delivering this strategy we will continue to develop our scientific capability to increase the accuracy and breadth of our work with greater focus on impact through effective and participative cooperation with chemists and biologists across all relevant markets. Additionally, we will place particular emphasis to supporting the innovation sector and to areas of UK / international priority, including diagnostics, precision and regenerative medicine, synthetic biology, and the safety and security of products and supply chains.

We value our ongoing relationships with our partner and collaborator organisations, be they industry, clinical, academic or otherwise and will work ever closer with these to ensure translation of our measurement capability for maximum economic and social benefit.

I would like to thank all those responsible for delivering our work over this year and for their commitment to maintaining the highest quality of science, outputs and impact.

Derek Craston  
Chief Scientific Officer



## 2015 achievements in numbers

- 29 peer-review publications
- 4 new measurement capability claims
- 8 new reference materials
- 8 ISO standards developed
- 12 CCQM comparison studies, leading 5
- 74 presentations at conferences



# CONFIDENCE IN MEASUREMENT

Thousands of routine measurements are made each day. For governments, society and individuals to have confidence in the decisions based on these results they must have confidence in the measurements themselves.

These measurements vary from clinicians making medical diagnoses, to providing evidence to protect our borders, to safeguarding the quality of our water.

As a Designated Institute we set best practice in chemical and bio-measurements and provide measurement confidence through:

- supporting a global harmonised measurement infrastructure through the production of national and international documentary standards and participation in international inter-laboratory studies with other NMIs/DIs (i.e. CCQM)
- developing and maintaining chemical and biological reference standards for the UK through the provision of reference methods and reference materials
- providing calibration services to support industry



## LGC'S LEADING ROLE WITHIN THE METROLOGY COMMUNITY (CCQM)

We regularly coordinate and participate in international CCQM comparison studies between metrology institutes, and hold a highly respected position within the metrology community. Successful participation in these studies supports our Calibration and Measurement Capabilities (CMCs) claims, with four new claims accepted in 2015.

### New CMC claims

- First methods for GMO analysis for soya, maize and related materials (Bio-003, Bio-004)
- Carbon and lead isotope ratio measurements (Inorg-045, Inorg-047)

In 2015 we successfully participated in 12 studies, leading on 5. Of particular note this year was the LGC-led complex molecular study on cancer biomarker measurements. This study enabled institutes to demonstrate quantification of RNA cancer biomarkers and significantly extends the scope of RNA measurements previously seen at CCQM.

## REFERENCE MATERIALS

We have a portfolio of over 150 materials covering high purity standards, carbon isotope ratios, food, environmental and clinical materials and alcohol standards.

We have accreditation to ISO Guide 34 as a Reference Material Produced and is a founder member of the European Reference Material co-operation established in 2004.



CCQM Meeting April 2015

### New reference materials released

- ERM-AC021a sirolimus, certified for purity
- LGC7244 1 % chicken in sheep meat, characterised for meat species
- LGC7245 5 % chicken in sheep meat, characterised for meat species
- LGC7246 1 % turkey in sheep meat, characterised for meat species
- LGC7247 5 % turkey in sheep meat, characterised for meat species
- LGC7248 1 % beef in sheep meat, characterised for meat species
- LGC7249 5 % beef in sheep meat, characterised for meat species
- LGC7164 crab paste, characterised for elements and proximates

### Replacement materials

- LGC6020 river water, certified for anions
- ERM-CA011c metals in hard drinking water UK, certified for elements

## OUR IMPACT ON STANDARDS

Dr John Warren has been invited on to the ISO REMCO (Reference Material Committee) Ad Hoc working group to contribute to the production of new documents focusing on chemical purity for certified reference materials.

## ISO STANDARDS AND UNDERPINNING MEASUREMENTS

The development, production, and certification of reference materials are underpinned by a number of ISO Guides. These guides, adopted by over 160 countries, ensure that materials, products, processes and services are fit for purpose.

In order to maintain their relevance and ensure their appropriateness, ISO Guides are revised every 5 years. Through our UK representation on the ISO REMCO committee and as chair of the UK Reference Material Working Group, we have taken a leading role in the latest revisions of the reference material guides ISO Guide 34 (General requirements for the competence of reference material producers) and ISO Guide 35 (Reference materials -- General and statistical principles for certification).

Along with revisions, ISO Guide 34 is being converted to an international Standard. We have been instrumental in leading and coordinating the views of UK stakeholders and feeding this into ISO REMCO to inform the international position. This new standard (to be ISO17034), once released, will represent a global consensus for reference material production and will benefit the UK through increased acceptance of our reference materials overseas.

The degree of input into the production and revision of the ISO Guides for reference material production demonstrates the level of impact we have on the best practise in the field, maintaining the position of the UK reference material producers at a global level.



## WORLD-LEADING DIGITAL PCR CALIBRATION FACILITY

We are leading the development of a novel traceable measurement framework for the quantification of nucleic acids using the highly sensitive technique of digital PCR (dPCR), a method based on single molecule detection and counting that offers a route for higher accuracy quantification. This measurement framework will underpin clinical decisions based on DNA measurements, such as the detection of cancer biomarkers, diagnosis of infectious diseases and the development of personalised therapeutic responses in the future.

“LGC are recognised internationally as being at the leading-edge of applying dPCR techniques to standardise and therefore improve diagnostic laboratory measurements so that we can better diagnose and treat patients”

Prof. Dr. Heinz Zeichhardt, Charité-Universitätsmedizin Berlin

We installed one of the UK's first commercially available dPCR instruments in 2008 and since then have been shaping the measurement landscape to establish traceability to the SI and support regulation in this field, accelerating dPCR's translation from research into real clinical applications. LGC has already established itself as a centre of excellence for dPCR, publishing best practice guides, offering training courses, working with instrument manufacturers, diagnostics and reference material developers and clinical end-users and leading and participating in international comparison studies. The LGC-led guidelines for how dPCR results should ideally be reported in peer-reviewed journals ('dMIQE Guidelines') have been openly endorsed by all major PCR assay manufacturers and cited by 1 in 3 of all peer-reviewed papers since their publication in 2013.

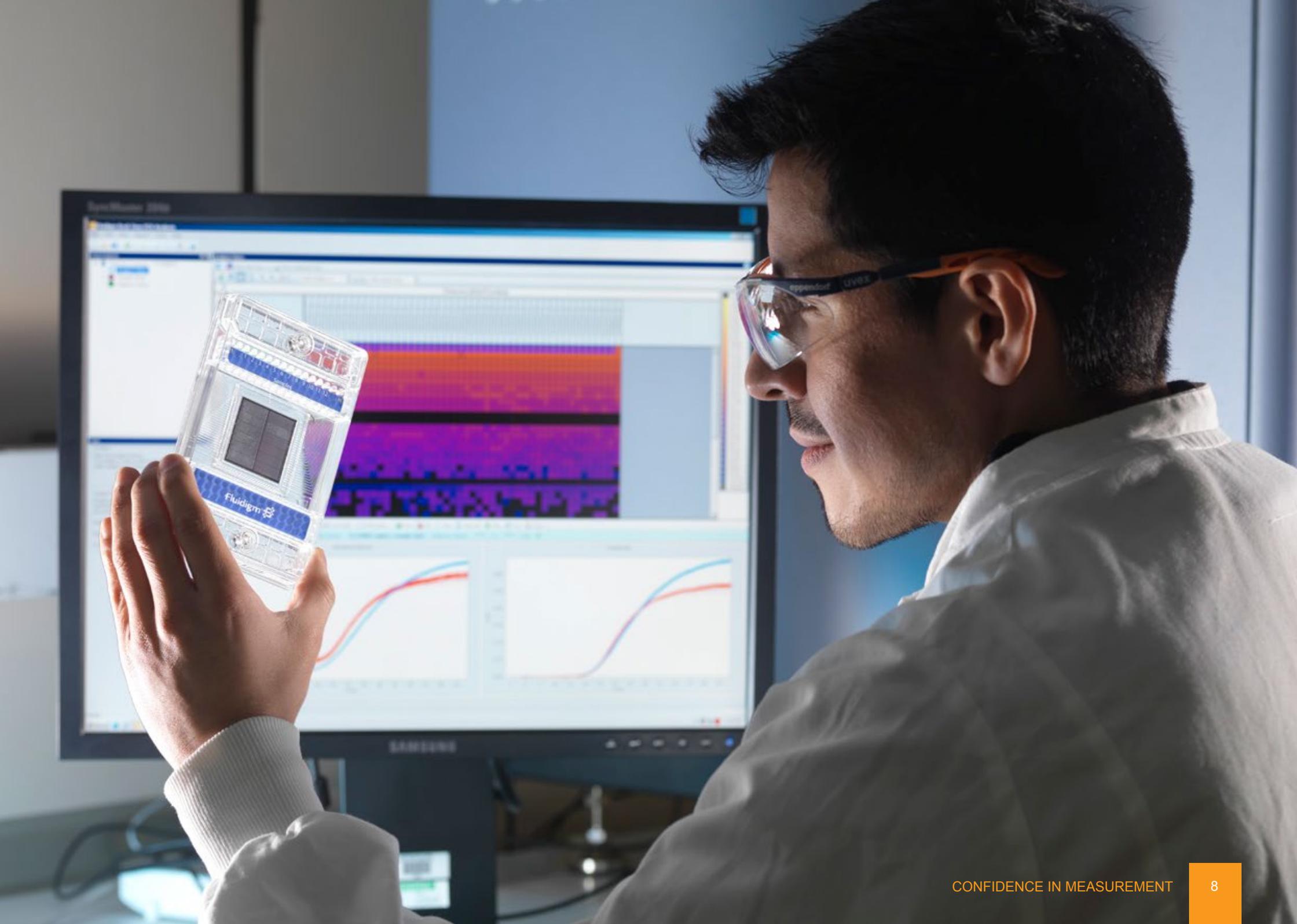
We will open the UK's first measurement facility for DNA measurements using dPCR in 2016. This will be one of few such facilities in the world.

### OUR IMPACT ON NUCLEIC ACID STANDARDS

An LGC Best Practice Guide on nucleic acid measurement, and Publicly Available Specification authored by LGC have been agreed to be used as drafts for the new ISO standards of the Technical Committee Biotechnology: 'Quality considerations for targeted nucleic acid quantification methods' (ISO/PWI 20395) demonstrating the value LGC's work has in this area.

The new dPCR measurement facility will not only enable LGC to assign accurate values to reference materials produced in-house but will support developers of molecular diagnostic kits and reference materials in developing high accuracy products for the benefit of patients, underpinning a global industry expected to be worth over \$500m by 2019.





# MEASUREMENT FOR INNOVATION

Through our Designated Institute role we support innovation within measurement science.

We sit in the middle of the technology readiness levels (4-7), bridging the gap between fundamental research and operational use of technology in industry. We provide novel measurement solutions to ensure translation from proof of concept to application in industry.

As identified by the 2015 Measurement Survey, 30 % of innovations would have failed without measurement support.

**30%** of innovations would have failed without measurement support

Measurement support enables businesses...



...to make improvements more quickly

**72%** **AGREE**

...to reduce the risk associated with development

**75%** **AGREE**

...to make improvements more effectively

**79%** **AGREE**

NPL 2015 Measurement Survey

## NANO MATERIALS: SIZE DOES MATTER

Nanomaterials, materials containing particles between 1 nanometre (one billionth of a metre) and 100 nanometres in size, are increasingly being used in everyday life, present in over 1300 commercial products, from the medicines we take to the food that we eat. It is becoming increasingly important to be able to characterise nanomaterials within biological systems

and understand their behaviour and potential impact on human health and the environment.

LGC coordinated an EU-funded consortium of National Measurement Institutes, academics and industrial partners to address this challenge (project known as NanoChOp) and support EU regulation and policy development. The project focused on the development of metrologically validated methods to characterise nanomaterials, understand

how they interact with biological systems and produce candidate reference materials for quality control.

New and improved metrology capabilities, such as advanced separation and mass spectrometry methods (FFF-ICP-MS), have been developed at LGC and a new Publicly Available Specification for nanotechnologies (PAS189) was a direct result of this project.

These methods have been used to improve current commercial technologies and will support this multi-billion pound industry with quality control and risk assessment of existing products and ultimately protect human health by ensuring the production of safe nanomaterial products in the future.

### OUR IMPACT ON NANOTECHNOLOGY

With our expertise in nanoparticle measurements, LGC has been working closely with instrument manufacturers developing the latest nanoparticle detection technologies with Malvern Technologies Ltd to improve the state-of-the-art:

“LGC have provided expert application support to aid the development of our nanoparticle tracking technology. Their forward thinking approach has made them willing candidates for beta testing new concepts and providing valuable feedback which has helped shape parts of our technology.”

Phil Vincent, Development Scientist, Malvern Instruments Ltd



## FAILURE TO DIAGNOSE: MEASURING BIOMARKERS FOR CHRONIC HEART FAILURE

We are helping to improve the accuracy of early diagnosis of chronic heart failure by developing reference methods for the biomarker brain natriuretic peptides (BNP). This will ensure more precise prognoses and hence more effective patient care, ultimately reducing the need for frequent re-admissions to hospital, saving the NHS millions each year.

Measurements for these markers are not trivial as the relevant clinical cut-off levels are very low (less than 1 part per billion, a teaspoon in an Olympic size swimming pool) and the samples are highly complex. Current routine methods are not traceable and the use of assays from different manufacturers can lead to highly variable results. We have developed a novel SI-traceable method for BNP using mass spectrometry. Working with the UK national external quality assessment

scheme (NEQAS) for analysis of cardiac markers, we have used this method to assign an independent traceable value to the NEQAS samples and are comparing the reference results with traditional assays (ELISA) used in hospital laboratories.



## SECURING UK BORDERS

We have provided UK national security stakeholders with an improved understanding of technologies used to detect drugs, explosives, and chemical weapons.

Counter-terrorism and drug identification technologies must be continuously improved and developed in order to minimise the risk of terrorist and criminal groups finding a way of circumventing them. We investigated the measurement challenges associated with the novel transportable mass spectrometry technologies that can be used at a crime scene or in an airport to tackle drug crime and counter-terrorism activities.

Further improving measurement accuracy of current equipment and ensuring appropriate adoption of novel technologies will improve the detection of explosives and chemical weapons at UK borders and safeguard the UK from further terrorist attacks protecting property and infrastructure, avoiding disruption for businesses and travel, and improving confidence in public safety.

### OUR IMPACT ON SECURITY

Based on our expertise in support of the national security sector, LGC is coordinating an international inter-laboratory comparison study on ambient ionisation involving 19 laboratories from industry and academia. This technology is used in devices used for screening drugs and explosives at border points and the study will evaluate the performance of a range of platforms across a number of sample types of different chemistries.



“LGC’s considerable knowledge of analytical instrumentation coupled with the high quality of their work gives us greater confidence in our deployment of IMS technology for drug detection on the person, on vehicles, and on currency notes. This confidence is essential for the integrity of evidence for intelligence and forensic purposes.”

A collaborator from the Home Office Centre for Applied Science & Technology

“LGC are world-leaders, and unique in the UK, in applying much-needed measurement rigour to dPCR practices. LGC leads the way on dPCR measurement standardisation, which is essential for quality assurance of new diagnostic tests, and therefore improved understanding and earlier detection of antimicrobial resistance.”

Prof. Tim McHugh, Professor of Medical Microbiology & Director, UCL Centre for Clinical Microbiology

## INFECTIOUS DISEASE DIAGNOSIS

Infectious diseases are responsible for 20 % of human deaths globally. Accurate rapid methods for diagnosis and monitoring transmission and drug resistance are vital to protect public health. We have evaluated the capability of new molecular methods to address this challenge.

We have been working in collaboration with the University College

## OUR IMPACT ON HEALTHCARE TECHNOLOGY

LGC led a European-funded project to develop novel measurement procedures and validate frameworks to support current and emerging molecular approaches for rapid diagnosis, surveillance and monitoring of infectious disease ('Infect-Met'). As result of the expertise developed within this project, LGC was able to provide additional high quality quantitative data to a microbiology-biotechnology company on the amount of TB in their ready-to-use *in vitro* diagnostic kits for TB diagnosis to improve measurement confidence.

London's (UCL) Centre for Clinical Microbiology to improve the detection of drug-resistant forms of tuberculosis (TB). We assessed the performance of commercial DNA extraction kits and developed novel sequencing approaches to detect drug resistant forms. Our input helped standardise UCL's sample processing protocols in a clinical evaluation of whole genome sequencing of TB directly from saliva samples.

The work done by LGC on improving methods both for diagnosis of TB and monitoring drug resistance supports the 2015 Public Health England initiative to wipe out tuberculosis in the UK.



## OUR IMPACT ON PERSONALISED MEDICINE

LGC's expertise in digital PCR has been crucial in developing a personalised approach to chronic myeloid leukaemia treatment. In collaboration with Imperial College London, a novel DNA-based dPCR assay that detects minimal residual disease levels in leukaemia patients previously thought to be in remission has been developed. Adoption of this approach in the clinic would ultimately ensure that appropriate treatment for these patients continues, preventing costly relapses.

## IMPROVING DISPOSAL OF NUCLEAR WASTE

To support the UK in conforming to EU legislation surrounding the disposal of nuclear waste, we have been working in collaboration with NPL to develop novel approaches for monitoring long-lived radioactive elements that persist in the environment for thousands, if not millions, of years. Current radiochemical technologies do not have the necessary sensitivity and accuracy to measure the levels of these long-lived radionuclides.

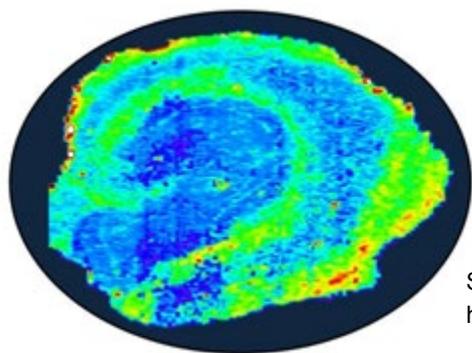
Zirconium-93 (Zr-93), one of seven long-lived products of uranium-fuelled reactors, is expected to be the second most abundant radionuclide in the environment within 1000 years. Building on expertise in inorganic mass spectrometry analysis (ICP-QQQ-MS), we have developed novel methods for the analysis of Zr-93 in environmental samples such as soil and groundwater. These methods achieve sensitivities 100,000 times lower than current radiochemical techniques and require minutes rather than weeks to analyse.

The work done at LGC allows long-lived radionuclides to be quantified accurately, cheaply and quickly and will be instrumental in improving environmental monitoring of active and decommissioned nuclear sites to protect the public and the environment not and into the future.



“LGC’s real value is that they bridge the gap between research and translation to real-world applications where patients’ lives can be improved. Their internationally-recognised measurement skill provides the quantitative, traceable, measurement we need so that our findings can be used to develop treatments and/or tests via the pharmaceutical and biomedical engineering industries. I am not aware of any other institutions in the UK offering this skill and emphasis on measurement in this field.”

Dr Joanna Collingwood, Associate Professor, University of Warwick



Showing Fe in human brain tissue

## METAL IMAGING FOR DISEASE DIAGNOSTICS AND THERAPEUTICS

Metals can be used both for disease diagnosis, such as monitoring the build-up of metals in patients with neurodegenerative diseases, and for disease therapy, for example in the case of platinum-based cancer therapies. To accurately follow the location of metal build-up within cells and tissues or monitor the behaviour of drug therapies, novel bio-imaging techniques such as laser ablation combined with mass spectrometry (LA-ICP-MS) are required.

We are developing novel traceable methods to determine total metal concentrations in diseased versus normal tissues and identify the spatial distribution



of clinically relevant metals and metal-species to support brain and cancer research.

We have been working with leading expert collaborators to develop the first potential reference method for iron in brain tissue, associated with the progression of Alzheimer’s disease, a disease that affects around 850,000 in the UK. The work performed will ultimately provide validation for routinely used non-traceable techniques such as MRI and PET scans. The capability being developed at LGC will also

enable the biodistribution of multiple clinically relevant species to be accurately measured in a consistent and comparable manner. This will allow for earlier disease diagnosis, leading to quicker administration of drugs to slow disease progression and an overall improvement in patient care.

## OUR IMPACT ON TECHNOLOGY

LGC has worked closely with Postnova Analytics Ltd on their new field flow fractionation instrument to evaluate a new fluorescence detection module. Due to the collaboration and significant input from LGC scientists, this German company have recently opened a UK headquarters in Bishops Cleeve, Herefordshire.

## CELL MANUFACTURING

Cell therapies have significant potential and the UK is a world leader in the field of regenerative medicine, a market expected to be worth over £1.2bn by 2020. To support regulation and safeguard the millions of pounds being spent on research in to cell therapies we have developed a novel, rapid approach to determine the quality, viability and identity of cell therapy products.

This method uses flow cytometry to fingerprint cell lines quickly and effectively using markers common to a large range of human cell types. This novel approach is highly sensitive and amenable to quantitative analysis and standardisation and has the potential to perform an important role as a quality control tool for cell therapy products.



## OUR FUTURE IMPACT ON HEALTH

LGC has won approximately €1.35m in the latest round of European measurement science funding to address the grand challenge of 'metrology for health'.

Working collaboratively with the top European NMIs, these projects will address some of the most challenging measurement issues facing diagnosis and management of neurodegenerative diseases and the detection, monitoring and evaluation of antimicrobial resistance.

- "Innovative measurements for improved diagnosis and management of neurodegenerative disease" (LGC is project coordinator)
- "Novel materials and methods for the detection, traceable monitoring and evaluation of antimicrobial resistance" (LGC is project coordinator)
- "Role of metals and metal containing bio molecules in neurodegenerative diseases, such as Alzheimer's disease" (LGC is leading a work package)

The European Metrology Programme for Innovation and Research (EMPIR) is the main programme for European research on measurement science and is funded by the European Commission.

# PEOPLE

Dr Philip Dunn was elected Chair of the Forensic Isotope Ratio Mass Spectrometry Network for the next three years, recognising LGC's expertise and reputation for isotope ratio measurements.

LGC's position as a world-leading DI is recognised through two Chairs at CCQM Working Groups. Dr Mike Sargent is Chair of the Inorganic Analysis Working Group (IAWG), which celebrated its 15th anniversary in 2015. Dr Helen Parkes is Chair of the newly formed Nucleic Acids Working Group (NAWG), continuing LGC's leadership position in bio-metrology.

Dr Steve Ellison is one of the two UK National Representatives for Eurachem, responsible for maintaining the system for the international traceability of chemical measurements and promoting best practice in analytical measurement.

Dr Jim Huggett is a Managing Editor and Dr Carole Foy an Editor for Biomolecular Detection and Quantification, an open-access journal that focuses on the application of qualitative and quantitative molecular methodologies to all areas of clinical and life sciences, championing molecular study design and measurement.

Kate Groves, a part-time PhD student at the University of Leeds, supervised by Professor Alison Ashcroft, was awarded the Best Student Talk for 2015 by the LBMSDG, a group sponsored by the British Mass Spectrometry Society and the RSC Separation Science Group.

Chris Hopley has been invited to be a committee member of the British Mass Spectrometry Society (BMSS) committee and onto the organising committee for the BMSS Special Interest Group for ambient ionisation.

Dr Heidi Goenaga-Infante, one of the top 10 % cited authors in the RSC analytical portfolio of journals, is an Editorial Board member of the RSC Journal of Analytical Atomic Spectrometry (JAAS). JAAS is the central journal for publishing innovative research on fundamentals, instrumentation, and methods in the determination, speciation and isotopic analysis of (trace) elements within all fields of application.

# KNOWLEDGE TRANSFER & DISSEMINATION

## TRAINING FOR THE FUTURE

We have been delivering analytical quality training programmes to customers worldwide for 18 years. Our courses focus on providing analysts with the tools to ensure the validity of their measurement results.

**In 2015 we delivered  
31 courses in  
12 countries  
385 delegates from  
83 organisations**

Our extensive programme of courses is delivered from our headquarters in Teddington or at customer sites customised, to meet your specific training requirements.

### Topics covered include:

**Method validation** – Learn how to demonstrate your test method is fit for purpose

**Evaluating measurement uncertainty** – The principles and practice of estimating measurement uncertainty in your laboratories

**Statistics for analysts** – Getting the most from data generated in your laboratory

**Designing effective experiments** – How to plan, execute and analyse your experiments efficiently

**Understanding ISO/IEC 17025 technical requirements for analytical laboratories** –

**Using proficiency testing in the analytical laboratory** – realising the maximum benefit from your participation in proficiency testing schemes

**Reference material production** – Planning effective reference material characterisation studies to meet the requirements of ISO Guide 34.

Our courses consistently receive excellent feedback from delegates such that we have a high level of repeat customers. Over 97% of delegates who completed a course feedback questionnaire in 2015 stated that the training met or exceeded their expectations.

Details of all our training programmes are available at [www.lgcgroup.com/training](http://www.lgcgroup.com/training).

## OUR IMPACT ON TRAINING & SKILLS

LGC is a member of the Steering Group for the Metrology Apprenticeship Trailblazer. The Trailblazer programme, overseen by BEIS, aims for employer-led groups to develop apprenticeship standards relevant to their sectors. As a member of the Steering Group, we will help to ensure that the standards meet the requirements of employers.

## SELECTED PUBLICATIONS

In 2015 LGC experts published 29 scientific papers in peer reviewed journals, demonstrating the quality and credibility of our science. Here are a selection of our publications:

Alikian M et al. NGS-assisted DNA-based digital PCR for a personalised approach to the detection and quantification of residual disease in CML patients. *J Mol Diagn* (2016)18(2)176-89. *Selected for press release and inclusion in JMD2016 Continuing Medical Education program*

Bartczak D, Vincent P, Goenaga-Infante H. Determination of Size- and Number-Based Concentration of Silica Nanoparticles in a Complex Biological Matrix by Online Techniques. *Anal Chem* (2015)87(11)5482-5.

Devonshire AS et al. Highly reproducible absolute quantification of Mycobacterium tuberculosis complex by digital PCR. *Anal Chem*. 2015 87(7):3706-13. *Listed in Nature Index*

Dunn PJH, Malinovsky D, Goenaga-Infante H. Calibration strategies for the determination of stable carbon absolute isotope ratios in a glycine candidate reference material by elemental analyser-isotope ratio mass spectrometry. *Anal Bioanal Chem* (2015) 407(3)869-882.

Huggett JF, Cowen S, Foy CA. Considerations for digital PCR as an accurate molecular diagnostic tool. *Clin Chem* (2015) 61(1)79-88.

Huggett JF et al. qPCR, dPCR, NGS – A journey. *Biomol Detect Quantif* (2015) 3:A1-A5. *Top ten cited BDQ article*

Hawley JM et al. Candidate reference measurement procedure for the quantification of total serum cortisol with LC-MS/MS. *Clin Chem* (2015) 62(1)262-9.

Taylor et al. Atomic spectrometry update: review of advances in the analysis of clinical and biological materials, foods and beverages. *J Anal At Spectrom* (2014)29:386-426. *Most accessed JAAS article 2015.*

Whale AS et al. Detection of rare drug resistance mutations by digital PCR in a human influenza A virus model system and clinical samples. *J Clin Microbiol* (2015) *Advance article*

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## ACCESS OUR EXPERTS:

### **Do you have a measurement-related question?**

Our National Measurement System Helpdesk ([nmshelp@lgcgroup.com](mailto:nmshelp@lgcgroup.com)) provides organisations with access to our experts in a range of analytical, chemical and biological measurement technologies and related topics such as analytical quality assurance, method validation, measurement uncertainty, reference materials and proficiency testing.

Advice is normally provided free of charge, but occasionally it may be necessary to charge fees to cover the costs of dealing with more complex enquiries.

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