

UK Research  
and Innovation



# **Report of the UK-Republic of Korea Civil Nuclear Collaboration Workshop**

4-5 July 2018, Bailbrook House Hotel, Bath

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## Glossary

EPSRC	Engineering and Physical Sciences Research Council
MSIP	Ministry of Science, ICT and Future Planning (of Republic of Korea)
NRF	National Research Foundation (of Republic of Korea)
PI	Principal Investigator
PDRA	Postdoctoral Research Assistant
ROK	Republic of Korea
UKRI	UK Research and Innovation

## Summary

EPSRC held a bilateral UK-Republic of Korea (ROK) workshop in July to: a) review projects from Phase 1 of the UK-Korea Civil Nuclear Collaboration Programme, and b) scope phase 2 of the collaboration, as well as help shaping the future of the collaboration.

Based on the outcomes of this workshop, EPSRC will work closely with the NRF to define the research areas covered by the next round of this collaboration. EPSRC will be inviting proposals towards the end of 2018.

## Background

EPSRC's [Nuclear Fission Portfolio](#) is a multidisciplinary and highly collaborative portfolio of research and training, which addresses challenges in waste management, decommissioning, regulation, existing operations, new build, geological waste disposal and public acceptability.

EPSRC, in line with [UKRI priorities](#), recognises the importance of excellent international collaboration to maintain and further enhance the UK research. We work proactively with partners in various countries to set targeted joint funding initiatives to address global challenges. Along these lines, it is one of the aspirations of the Nuclear Fission Portfolio at EPSRC to continuously engage with international partners to exchange and build knowledge.

The UK-ROK collaboration in civil nuclear research was initiated in 2014. A bilateral workshop was held in March 2014 in Oxford and negotiations following the event culminated with the [UK-ROK Civil Nuclear Research Programme](#) (phase 1) call. [Five projects](#) were funded in this call, with EPSRC providing funding for UK-component proposals and MSIP funding Korea-based component proposals.

Negotiations with the NRF for a second round of the collaborative project started in November 2017. It was agreed to hold an event to bring together the UK and ROK delegations to share best practice and scope the next call. EPSRC led the organisation of the bilateral workshop at the beginning of July (more details in next section).

EPSRC is expecting to open a call for proposal towards the end of 2018. The thematic areas covered by this call will be set based on the outcomes from the UK-ROK workshop reported in this document, upon negotiation with the NRF.

## Event Organisation

The workshop was held at Bailbrook House Hotel on 4-5 July 2018. The event aimed to review collaborative UK-ROK projects previously awarded, as well as to scope future UK-ROK managed activities, in particular the UK-ROK Civil Nuclear Collaboration Phase 2, which is expected to be delivered in Q1 2019.

EPSRC invited PIs from grants awarded in the previous phase of the collaboration, and sought [expressions of interest](#) from the wider community to attend the workshop. Applicants were selected on the basis of their career stage, previous participation in the programme, expectations from and potential contributions to the workshop. A total 14 delegates attended the event to represent the UK nuclear research community. NRF coordinated the ROK delegation, and a total 13 delegates attended.

The agenda for the event can be seen on table 1. The two presentation sessions ('opening session' and 'review of finishing projects') covered the current status of the nuclear R&D in the UK and ROK, followed by presentations delivered by PIs of Phase 1 grants that highlighted the successes and challenges faced by the projects. Two facilitated sessions were held; the first one explored best practice in international collaborations, as well as challenges and opportunities for UK and ROK to pursue further; the second one was aimed at defining areas of interest for the future phase 2 and beyond.

Table 1: Agenda of the bilateral UK-ROK workshop held in Bailbrook House, Bath, on 4-5 July 2019

<b>4 July</b>		
<b>10:00-10:30</b>	<b>Arrival (refreshments available)</b>	
<b>10:30-12:30</b>	<b>Opening session - state of the art</b>	
15 min	EPSRC and the Energy Theme	Dr James Fleming
15 min	Nuclear research landscape in the UK	Dr Victoria Mico
15 min	Nuclear R&D in ROK	Dr Hongjune Park
15 min	Decommissioning Activities Performed by Korea Industry	Dr Kiwhan Chung
15 min	An overview of civil nuclear energy status and research in the UK	Prof Neil Hyatt
15 min	Overview of decommissioning technology research in KAERI	Dr Seonbyeong Kim
15 min	Discussion	
<b>12:30-13:30</b>	<b>Working lunch</b>	
<b>13:30-15:30</b>	<b>Review of finishing projects</b>	
20 min	Advanced Radioactive Waste Treatment using Nanostructured Hybrid Composites (NaSHC)	Prof Harry Eccles
20 min	Developing novel materials and engineering strategies to recover Cs and Sr from the environment	Dr David Harbottle & Dr Jaewoo Lee
20 min	Advanced Waste Treatment using Nanostructured Hybrid Composites	Prof Laurence Harwood
20 min	Advanced Waste Management Strategies for Technetium and Iodine in the Nuclear Fuel Cycle	Prof Neil Hyatt
20 min	Extraction of radionuclides by functionalised silica coated magnetic nanoparticles and their subsequent vitrification.	Dr Mark Ogden/Prof Laurence Harwood
20 min	Robotic systems for retrieval of contaminated material from hazardous zones	Prof Rustam Stolkin R & Prof Jaehee Kim
<b>15:30-16:00</b>	<b>Coffee break</b>	
<b>16:00-17:30</b>	<b>Facilitated session – Best practice, opportunities and challenges</b>	
<b>17:30</b>	<b>Close</b>	
<b>5 July</b>		
<b>9:30-11:00</b>	<b>Facilitated session - Scope of next call</b>	
<b>11:00-11:30</b>	<b>Coffee break</b>	
<b>11:30-12:15</b>	<b>Final discussion and close</b>	
<b>12:30-13:30</b>	<b>Lunch</b>	

## Outputs from Best practice session

The first facilitated session built on from the reflections laid out by the PIs of the UK-ROK projects awarded in the previous phase. This session was aimed at exploring best practice for international collaborative research projects. Attendees were asked to provide their views in the following areas: opportunities, in the context of the UK-ROK civil nuclear collaboration programme; best practice, to explore what practices had already been implemented by the research groups; challenges, to identify the barriers for international collaboration and highlight the needs of the community and what the funding agencies could do to help. The following table summarises the comments made during this session:

Table 2: Outputs from the 'best practice' facilitated session

Opportunities	Best Practice	Challenges
Training and development: exchange of students and PDRAs		Public perception and cultural perspectives: competitiveness with renewables, geological disposal, new build
Nuclear wastes: characterisation, repacking, volume reduction, access to real waste	Internal communication: sharing ideas and results	
Increased engagement: industry, national labs, with larger UK projects (i.e. Nuclear Consortia)	External communication: Joint publications, project websites,	Intellectual property and non-disclosure agreements
Shared capability: identify common research goals/challenges, shared testing facilities, idea export and solution deployment, information sharing, jointly taking fundamental research up along the TRL scale	Management: agreements for facility sharing, shared projects, multidisciplinary ensuring that partners have complimentary expertise, planning of the projects beyond the lifetime of the grant	Maintain level of engagements from both partners
		Funding, coordinating funding bodies from different countries
Radionuclides: evaluation, on-site analysis, treatment	Networking with other projects, joint workshops or conferences	Recruitment, retention and contract extension for PhDs and PDRAs
New build, including public perception and awareness	Student engagement	Cybersecurity, big data, standardisation

## Outputs from the scoping session

The second facilitated session was aimed at determining the thematic areas for the second call. Delegates were asked to provide their views on research areas of relevance for the UK, and for the UK-ROK collaboration, towards the phase 2 of the programme. It was highlighted

the need for the three areas to be connected, as well as the relevance of autonomous systems technologies particularly to waste management.

- **Waste:** including characterisation of legacy waste and radionuclides, cost and volume reduction, classification, separation, packaging and C-14 management. Many of these tasks have the potential to be handled remotely, such as scanning of waste containers. Attendees discussed the need to reduce contaminated metal and concrete, and also of implementing/developing/improving recycling techniques for contaminated materials, as well as pyro-processing. Delegates commented on high level waste stabilisation and treatment, understanding its behaviour when in storage and exploring options for long-term disposal.

Other areas mentioned by the delegates include: tritium separation and characterisation, decontamination and treatment of effluents, treatment of high  $\alpha$ -wastes from re-processing, standardisation of chemical separation techniques, alternative fuel cycles, cost reduction in molten-salt separation/extraction/clean-up, end of life assessments and the potential for nanotechnology to aid these tasks.

- **Decontamination and environmental assessment.** The following areas were raised: treatment of soils and water, including assessment and monitoring, immobilisation, separation restoration, re-use, modelling long-term decay; *in-situ* radiation, specifically for tritium, level monitoring and analysis; assessment for disposal facility; assessment of nuclear safety systems, cybersecurity, big data, J-value, interpretation of data on human and environmental effect; public acceptability.
- **Robotics:** including remote and underwater radiation assessment, decommissioning/decontamination (scrabbling, laser ablation, pressure washing, size reduction, cutting, packaging), spatial monitoring and 3D mapping, object and contaminant recognition, autonomous problem-solving and reconfiguration, modular construction, initial response to accidents, cybersecurity and safety verification for AI systems and development of human-controlled designs. As mentioned above, delegates stressed the opportunities for remote monitoring and maintenance in waste storage facilities.

Potential areas for future UK-ROK collaboration were identified, safety (accident tolerant fuels, transport of nuclear material and public acceptance of nuclear power) and materials science (fabrication, extending materials operating life, long-term behaviour of aging materials for both fusion and fission applications).

## Further comments

Delegates stressed the importance of effective networking between projects awarded under the same call, and more generally, between projects working in similar areas. This can contribute to avoid duplication of the research, but also to build strong relationships and jointly explore new areas. Delegates recognised that organising large research projects (i.e. for

the Nuclear Consortia - TRANSCEND) often results in a growing, more cohesive community, eager to form new collaborations. Some ideas put forward to achieve a more coherent UK – ROK collaboration included: international workshop for all grant holders during the duration of the grants, launch event, moving from smaller, fragmented projects to consortia-like organisation to better coordinate the programme.

## Next steps

EPSRC and NRF will work closely in the next few months to define the areas covered by the next UK-ROK Civil Nuclear Research programme. These discussions will be based on the outcomes of the workshop as laid out in this document. EPSRC and NRF are expecting to launch a joint call to be delivered in Q1 2019, for which EPSRC expects to invite proposal submission towards the end of 2018.

<b>Name</b>	<b>Date</b>	<b>Version</b>	<b>Change</b>
Victoria Mico	17/07/2018	1	Created Document