RCA RESEARCH PROJECT THEME

Proposed Title:	Air Quality and Environmental Impact Assessment of Industrial Acitivities in Asian region (Phase 2)
Proposed by:	Dr. Muhayatun Santoso
Proposed Duration:	2021-2023 (3 years)
Proposed Start Date:	January 2021
Brief Summary of Proposed Area of Research:	The research aims to assess the impact of industrial activities on air quality and its surroundings environmental. In Asia, activities such as household solid fuel use, coal-fired power plants, and open burning of agriculture and other wastes are among the most important contributors to outdoor air pollution. The current report from Health Effect Institute (HEI) showed that air pollution is the 5th highest cause of death among all health risks. Therefore, the comprehensive feasibility study is needed to ensure the impact of the industrial activities to the environment.
	Several GPs in the Asia Pacific region involved in the IAEA technical cooperation RAS7029 have carried out research work related to urban areas air quality monitoring. Upon following completion of the project, the RCA Research Project (RP) was initiated by RCARO. RP research activities were expanded and focused on the pollution from industrial activities and the impact to the surrounding environments. In the first cycle (2018-2020), the activities are focused on airborne particulate matters in industrial areas to assess the impact on air quality. The type of industry is focused on coal power plant and metal industries. Most of GPs participating in this RP have these industries and the impact on the air quality can be transported across the borders (transboundary/global pollution). The monitoring parameter is on the characterization of airborne particulate, and preliminary monitoring on soil samples especially on its heavy metal concentrations.
	In the second cycle (2021-2023), the activity will be carried out on the continuation of airborne particulate matter sampling and its analysis, with additional environmental samples to assess the impact of industrial emissions to the surrounding area. The surrounding ecosystem could be waterbody, agricultural field, including residential area. The second phase will be focused on the environmental risk assessment into the surrounding ecosystem. The possibly contamination from air pollution into other ecosystem such as soil, vegetation/crops, and animals (fish, seafood) will be included in the research project. In this way, the propagation of pollutants through the whole food chain can be studied and finally impact on human health can be assessed. Using the chemical composition data and evaluated the spatial distribution of heavy metals in air and soil, its risk to the agro-ecosystem (water, vegetation/crops, animals (fish/seafood)), the pollutant source identification, pollution index and hazard risk quotient to the human health could be estimated. By comprehensive sampling and analysis of samples, the mapping of distribution and status of pollution level in sampling sites could be provided more precisely and the information could be of significant benefit to assess the impact of industrial activities. The research will comprehensively assess the industrial impact on air, soil, water and/or vegetation/crops as well as animals in the surrounding.
	Some important aspects of the future research could include selection and

	optimization of analytical methodologies, selection of adequate sampling sites and sampling strategies, identification of sources of industrial pollution and methods of release of pollutants to environment. The analytical characterization of APM and environmental samples using nuclear analytical techniques can offer important and unique information regarding the concentration level and the distribution of pollutants. The results of the research will be presented at local/international meetings and conferences and published in peer reviewed scientific journals, which will contribute to regional pollutants database for use by stakeholders and government agencies involved in the policy and strategy design for the improvement of the environmental quality.
Area(s) of Compliance with RCA MTS & SP 2021-2023:	Environment (air pollution, soil, water)
Which medium to long term needs and imperatives of the RCA Programme, will be supported by this proposed research proposal and how will it be utilised to provide national and regional outcomes:	This research project will support the medium and long term needs and imperatives of the RCA programme on strengthening promotion and development of nuclear science, technology and applications. Use of nuclear science, technology and applications can address environmental problems (heavy metals contamination in air, water, soil and vegetation/crop as well as fish/seafood as impact from industrial emissions) for sustainable global development. Assessing the impact of industrial activities on air quality and surrounding environment will be a key factor to better understand and monitor environmental challenges, especially due to the increasing numbers of industrial activities in the developing countries. This research will provide information on the dispersion of transboundary pollution from industrial emissions, pollution levels in air, soil, water and vegetation/crops from industrial area, as well as correlation between industrial type (combustion process) with the pollutant emission, to address and minimize the impact to the environment and human health. The mapping distribution of pollutant in soil will enable to provide significant information on pollution level and impact on ecosystem by assessing the level of pollutant in vegetation/crops, animals and evaluating the source identification, pollution index and hazard risk quotient of human health. This important information can be used as a basis for adaptation and/or mitigation strategies for reducing the pollution and minimizing the health impact of pollution.
List the individuaRCA GPs that have been identified through consultations as supporting this proposal and their expected contribution to the research.	RCA GPs that have been confirmed as supporting this proposal: **1. Dr. Perry Davy** P.Davy@gns.cri.nz National Isotope Centre; Institute of Geological and Nuclear Sciences (GNS) P.O. Box 31312, 30 Gracefield Road, LOWER HUTT NEW ZEALAND 2. **Dr. David Damien Cohen** dcz@ansto.gov.au Institute for Environmental Research; Australian Nuclear Science and Technology Organisation (ANSTO) Locked Bag 2001, KIRRAWEE DC, NSW 2232 AUSTRALIA **3. Dr. Muhayatun SANTOSO** hayat@batan.go.id Center for Nuclear Technology of Material and Radiometry; National Nuclear Energy Agency (BATAN) Jl. Tamansari 71 BANDUNG 40132

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What benefits of Nuclear Science and Technology are being demonstrated through this research?	The research project will be mainly focused on the application of nuclear analytical technology in environmental samples characterization. No other technique can compete with nuclear analytical technology to provide information on the elemental composition of environmental samples such as airborne particulate matters, soils, foods and others, with high sensitivity and fast analysis times. All of the GPs participating in this RP have an access to the nuclear facilities and they will either use XRF, which is becoming increasingly popular amongst Member States due to its relative low cost or the well-established ion beam analysis – IBA techniques (such as PIXE and PIGE). A minority of the GPs may also use NAA for analysing samples. IBA, XRF and NAA allow analysis of minute samples less than one milligram without complex chemical preparation. This technique allows for rapid, simultaneous detection of elements with a large dynamic range (mg/kg to µg/kg). Compared to other methods such as inductively coupled plasma atomic emission spectrometry (ICPAES), inductively coupled plasma mass spectrometry (ICPMS) which need sample dissolution or digestion process, the NATs are fast, non-destructive with simple sample preparation makes these methods suitable and ideal choice for the characterization of environmental samples such as APM and others. The RCARO support is important in the program to facilitate, coordinate, strenghten the networking between GPs and synergizing each other to solve the environmental problem especially due to industrial activities in the national and regional scale. Progress needs to be rigorously assessed at review meetings to help to achieve objectives, milestones and outputs.
How does the research have the potential for development into an RCA technical cooperation project?	GPs participating in this RP have experiences in previous research work that had been carried out in RAS7023, RAS7029 and RCA RP (first phase) which focused on the characterization of airborne particulate matter in urban and industrial area using nuclear analytical techniques and identification of source apportionment. They have appropriate facilities, skilled and competent personnels which can significantly support the achievement of this project. The long interaction of NPCs with each other made a good collaboration, team work, partnerships and support to each other which made this research project feasible and promising mutual growth beyond borders. The expected results of the research project including optimized analytical methodologies, adequate sampling protocols,

	strategies and understanding of mechanism of release and propagation of pollutants through different environmental media can be used in the future TC projects related to comprehensive and systematic characterization of environmental pollution in Asia and Pacific Region and elsewhere.These modalities make this RP potential for development into an RCA technical cooperation project.
How does this proposal have the potential for improving the utilisation of established national research organisations / institutes, increasing regional research networks and resources and adding value to future inputs to that particular area of research?	In this RP, the focus research area is based on the common problem faced by most of the GPs due to the impact of industrial activities and the need for strategies/action plan to solve this problem. Therefore, this project will increase all GPs involvement with the mutual needs, sharing expertise, facilities use, and more over strengthening the regional research networks and collaborations.
	Accordingly, the success of this project will significantly improve the capability and competency of human resources in applying nuclear analytical techniques in environmental problems and improving analytical methodology which will contribute for adding value to future inputs.
	This RP could be potential in expanding the use of regional facilities such as IBA, synchrotron facilities in Asian countries i.e. India, Thailand or Japan. It will also have an added value to improve the human capability through expert mission from other GPs in environmental study in the assessment of the elemental distribution of industrial pollutant in the local environment.