Project Proposals for the RCA Programme 2020/2021
2nd Round Project Concept Template

Part 1: Information Sheet

Project proposals for the RCA Programme 2020/2021 are to be prepared using the attached template. Completed templates will be reviewed by the RCA PAC at the Meeting in Vienna being held 28 January to 2 February 2018.

- **PLEASE NOTE THAT ALL PROSPECTIVE CONCEPTS REQUIRE INFORMATION THAT IS LODGED ON THE RCARO WEBSITE (access is only required to the RCA information not the whole Members Only site).**
- **YOU WILL HAVE TO APPLY FOR A PASSWORD AND ACCESS CODE TO ENABLE ACCESS TO THIS INFORMATION.**
- **PLEASE GET ENDORSEMENT FROM YOUR NATIONAL REPRESENTATIVE FOR THIS ACCESS.**

The 2nd Round Concept Proposals will be evaluated against the response to the feedback you have received from RCA PAC on your 1st Round Concept Proposals as well as the criteria listed below:

- **Is its aims and objectives in line with priorities set out the RCA Medium Term Strategy for 2018/2023?**

  Yes

- **Identify which elements of the MTS are being complied with.**

  It is complied with the strategy direction 2&3 and C.2.1 priorities in Food and Agriculture

- **Why it should be a regional project.**

  The food security is a critical issue in the RCA region

- **The essential role of the nuclear technology in the project.**

  EB facility can process a large amount of food to ensure the food security in the context of climate change

- **Does the proposal identify links to previous projects in this area of technology?**

  Yes

- **Does the proposal overlap or duplicate current or previous RCA projects?**

  No

- **Is a convincing case made to justify further projects in this area?**

  No

- **Is there a strong TCDC component to exploit the benefits from the earlier projects?**

  Yes

- **Is there a readily available baseline against which to measure the effectiveness of the project?**
  Yes

- **If the proposal is essentially an extension of previous projects in this area that have been implemented for more than 2 TC Cycles, does the proposal include arrangements for the transfer of project leadership to others?**

- Yes, the proposal do not overlap previous RCA project. But it is an important extension of the project RAS 5/071, which has been done for 1 TC cycle.

In addition to the above, please address the following specific questions:

Was this concept identified at the 46th RCA GCM as requiring merger with other similar concepts?	**NO**
If "YES" – was this concept prepared as a result of consultation with the other proposers?	**NO**
If "NO" - why was this not undertaken?	

(Please note that it is important to address all the dot points in the Concept Template.)

Your National Representative will be reviewing the concept document to ensure that it has been prepared in compliance with the RCA special requirements.

(Please be aware that, if your concept design does not take account of the special requirements for the RCA programme, it will be rejected.)

Part 2: Concept Template

Title: Promote food irradiation using machines (EB or X-ray) for food security in the context of climate change

Compliance with the RCA Medium Term Strategy for 2018/2023:

Nowadays, food irradiation has been proved as the friendly technology and recommended as an effective processing method for not only controlling food-borne diseases, but also reducing post-harvest loss of foods and agricultural products by the World Health Organization (WHO), Food and Agriculture Organization (FAO) and International Atomic Energy Agency (IAEA). This technology has been approved by more and more developing countries, even as an obligatory quarantine measure for imported fruits and fresh vegetables at the United State, Australia and Chile. It was fully aware that the technology is needed for RCA region where food borne diseases and post harvest losses of foods are increasing due to climate change. Then, RCA has identified and recommended the sustainable use of available resources to increase agricultural production, productivity and quality of food commodities; strengthen mitigation and adaptation to climate change; and facilitate the global trade in food through the applications of nuclear science and technology as its strategic priorities for the period of 2018-2023.

In the past, RCA have launched 7 projects related to food irradiation to enhance its applications for socio-economic growth of the developing countries in region, and most of government parties (GP) have received the necessary support to improve their capacities in practice for food irradiation. At present, almost of existing facilities in the region are gamma irradiators using ^{60}Co radionuclides, which can only produced by China, India, Japan and Korea. So the potential risks related to nuclear safety and processing cost are ever increasing. Recently, irradiation machines (high energy electron beam EB up to 10 MeV and 5.0-7.5 MeV X-ray) have been developed for radiation processing. These machines are high speed, economic and efficient in food irradiation. In addition, they can be used without any concern about radioactivity that helps increase the customer acceptance of irradiated food. Therefore, some commercial machines have been developed at China, Vietnam, Korea for food irradiation. Some other countries intended to get the technology and EB facility replacing for gamma irradiator due to difficulty in management and storage of the radioactive wastes. The cooperation among Government Parties expected as an effective way to promote the application of food irradiation using EB for not only improving the quality of food commodities, enhancing the global trading of irradiated foods, but also addressing the climate change impacts as recognised in the last project of RAS/5/071. Therefore, the proposed project will contribute to the economic growth of member states and region in coming years.

Overall Objective:

To promote the application of food irradiation using EB facility for ensuring food security, and harmonizing the regional strategy in coping with climate change impacts.

The project is aiming to:

- Disseminate and share the knowledge and practical experiences related to food irradiation using EB facility among Government Parties.
- Improve the application of EB technology to provide the irradiated foods for the customers, and increase their awareness and acceptance for food irradiation.
- Harmonize the regional strategy in coping with the climate change impacts.

Proposed Participating Government Parties:

Australia, Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Pakistan, Philippine, Korea, Sri Lanka, Thailand and Vietnam.

Technical Cooperation among Developing Countries (TCDC) Project Component:

- *Outline the TCDC strategies to be used in the project to enhance regional cooperation:*

Currently, climate change includes global warming, changing in precipitation causing negative impacts for the crop production in the region. According to the latest report of German watch, the most vulnerable countries to climate change are located in the South East Asia. The long-term Climate Risk Index (CRI) of Myanmar, Philippine, Bangladesh, Vietnam and Thailand are 2, 5, 6, 8 and 10 respectively. Climate change caused the increase in post-harvest losses, proliferation of insects, and even emergence of new pest diseases, threatening the sustainable development in agriculture. The climate change not only reduces the agriculture production but also affects to the quality of food, and consequently, it requires more critical way to preserve what has been produced.

Food irradiation is a food processing method to control the insects, spoilage bacteria, pathogen, parasites and fungi existing in the food, and it is very useful to reduce post-harvest losses and improve the quality of food hygiene and food safety. At present, more than 60 countries have approved the technique for treating at least one kind of food. Beside facilities using cobalt-60 (^{60}Co) as the source of ionizing radiation, irradiation machines provide an alternative technology using electricity to generate ionizing radiation and avoids the problems related to radioisotopes including procurement, transport, storage, disposal and safeguard. However, the processing with EB facility is more effective for the individual units of food products than larger packaging units due to its limited penetration.

In recent years, some research projects using EB processing for food irradiation and quarantine treatment have been done by Vietnam Atomic Energy Institute (VINATOM). In Vietnam, about thousand tons of food are irradiated with 10 MeV EB at Vinagama, together with the larger amount processed by linear accelerator at Sonson, a private company. Therefore, VINATOM will provide the training courses related to food irradiation using EB with aiming to develop and promote cooperation decree, which facilitate to regional trading of irradiated food within ASEAN for food security in the context of climate change. With about 50 EB in operation and more than 10 new facilities will be installed in the region (mainly in China and Korea), these resource countries can transfer the facility to least developed countries (LDC) like Myanmar and Cambodia through technology transfer project. And the advanced GP will also provide expertise and technology for LDC through RTCs or EMs under the project.

- *Will the project design feature partnering arrangements between those advanced and those less advanced in the technology?*

From 2014, Hanoi Irradiation Center, Vietnam Atomic Energy Institute (VINATOM) and The Advanced Radiation Technology Institute, Korea Atomic Energy Research Institute (KAERI) have signed MOA for technical cooperation on radiation technology. Under this MOA, the scientists and managers from both parties are trying to promote the cooperation in food irradiation and other radiation applications using irradiation machine. In the RCA region, Malaysia and Philippine have already installed their EB facilities, then they can receive the technology and training from the advanced GPs as addition output of the project. Moreover, the project will design cooperation arrangements between those advanced and less advanced GPs like Cambodia and Myanmar through technology transfer.

- *If so, list those expected partnerships.*

1. VINATOM, where a high energy EB of 10 MeV was installed and radiation scientists and food irradiation specialists are working.
2. Vietnam plant protection department (NPP)
3. Vietnam Standards and Quality Institute
4. The advanced Radiation Technology Institute, KAERI, a party can support technology and facilities for the LDC.
5. Sichuan Institute of Atomic Energy (SIAE), China, a party can promote regional development of food irradiation

Analysis of gaps / problems / needs as applied to the RCA region:

Outline the major gaps / problems/specific needs to be addressed by the project (~ 300 words):

Under pressure to supply enough food and agriculture products for the rapidly growing population, the crop production has become more intensive in its use of land and water resources, so its impacts on natural eco-systems becomes more and more apparent. The abuse of agro-chemicals without sufficient knowledge and consideration of the cost to human health and ecosystem function has exaggerated negative impacts of climate change which may significantly alter regional and national development strategies. Therefore, more friendly methods such as food irradiation can be applied for sustainable development in agriculture. This has proved as an effective and friendly way to control the foodborne diseases, harmful insects and pests, restrict post-harvest losses, extend the shelf-life of foods and has been approved by most countries in the RCA region. It is predicted that there will be a significant demand for large quantities and variety of radiation facilities for food irradiation in the near future because this technology can replace for the chemical treatments like fumigation.

At present, most countries in the region approved the regulations related to food irradiation, and the irradiated foods have commercialized in some developing countries such as China, India, Vietnam and Thailand. However, the technology is under-developed (Korea, Malaysia, Sri Lanka), even limited (Japan) due to the public concerns about radioactive affects. EB facilities do not require any radionuclide, then customer acceptance for the foods processed by the machine may increase. Thus, large amount of irradiated foods can be produced with EB as safety rations timely provided for the victims in natural disasters or other climate change event.

Review the resource documentation and list any past RCA projects that have addressed similar problems/needs in this area of technology.

Food irradiation has been recognized as an environmentally friendly technology of food processing where certain types of food are exposed to a source of ionizing radiation (gamma rays from ^{60}Co or electrons from EB accelerator, and X-rays from electrons with incident energy below 5 MeV). With the positive effects in sprouting inhibition of bulbs and tubers, maturation delay of fresh fruits, disinfestation of insects and pests, killing all pathogens and parasites for food hygiene, decontamination and self-life extension for food commodities, the RCA have launched 7 projects to improve the applications of food irradiation technology for ensuring food safety and food security as well as promote socio-economic growth in the region. With awareness of the technology role in addressing the climate change impacts on food security, last project **RAS/5/071**, "Strengthening Adaptive Climate Change Strategies for Food Security through the Use of Food Irradiation" was approved by IAEA/RCA for implementation during 2014-17. Under the project, government parties have tried to harmonize the regional strategy for adaption and mitigation the impacts. The advantages and wholesome of food irradiation were also recognized by climate change communities and policy makers. However, those projects only focused on gamma irradiators using Co-60 radionuclides, which required more and more cost related to nuclear safety. In contrary, irradiation machines can be easily produced, installed and operated at even less developed countries or islands in the region. Differ from the previous projects, this project will provide new approaches to promote the use of EB facility for food irradiation to ensure food security as regional strategy in dealing with climate change.

What are the major additional capabilities/skills in this area of technology that will be provided through this project (~ 200 words).

With high speed of radiation treatment, EB can process large amount of food during short time, so that GPs can focus on what they can irradiate now, but not only mention about what they might irradiate in the future as previous projects. The availability of irradiated foods provide more choices for customers and help them gain better understanding of technology for their acceptance for food irradiation. Under this project, VINATOM and other partnerships will provide the expertise and skills in practices for dosimetry in EB facility for radiation processing. Standard operation procedures for some kind of food such as fresh fruit, and preparation of emergency rations for food security may also be provided through this project.

Requirements for participation:

- *Indicate the minimum requirements that the counterpart institutions in Government Parties would need to meet in order to participate in this project.*

Government parties should have institutions for research and development of radiation technology and approved for at least a regulation related to food irradiation. The counterpart institutions (food manufacturers, facilities, nuclear research institutes) in GP should have sufficient capacity and suitable resources. The project also requires a project team include researchers, specialists and managers in the fields of food irradiation, EB accelerator and climate change.

The counterparts should be equipped at least one multi-purpose radiation source for R&D activities in radiation technology, and planned to install new EB facility for food irradiation in coming years. There is a working group on the field of dosimetry and nuclear safety in the counterpart institute.

- *Indicate the status of expected participating Government Parties as "Resource" or "Recipient".*

Vietnam, Korea and China, where EB facilities have been operated for food irradiation are expected as "Resource" and Australia, Bangladesh, Cambodia, Indonesia, Malaysia, Myanmar, Philippine, Sri Lanka and Thailand are "Recipient".

Stakeholder analysis and partnerships:

Briefly describe who are expected to be the principal beneficiaries of this project and any role that will be defined for them in the project.

The project is targeting to manufacturers/processers of food products and agricultural commodities, radiation technology facilities and institutes in the region as principal beneficiaries. The technology will increase the availability of irradiated foods for customer choice and facilitate the regional and international trading of food, reduce post-harvest loss and control foodborne disease for food safety and security. Therefore, the customers, traders and climate change communities also are beneficiaries.

Have any extra budgetary funding possibilities, sponsors and partners been identified?

Yes, several manufacturers are tried to invest and apply these friendly technology. For example, Complex Beam Ltd., Russia is negotiating to install an irradiation machine at Hanoi Irradiation Center, Vietnam for sharing the benefits.

Have they been involved at this concept stage?

Yes, some manufacturers. For example, Agricare Vietnam has learnt that the fresh fruits are always packaged in small cartoon boxes, suitable for EB processing. And they are ready to apply the radiation quarantine treatment using EB facility.

Role of nuclear technology:

- *Indicate the essential nuclear technique that is planned be used in this project.*

Food irradiation in which food or other agricultural products are exposed to ionizing radiation, has been proved as alternative technology for the use of chemical and heat treatment in food preservation. This technology has increasingly approved by many countries and regions due to its essential contribution to reduce post harvest loss, controll the foodborne disease, and ensure the food safety and quality. Up to now, three radiation sources are approved for food irradiation: ^{60}Co radionuclides, electron generated by EB accelerator at maximum energy of 10 MeV, and X-rays produced by a machine at a maximum energy up to 7.5 MeV. In EB, the accelerated electrons collides with a material, ionizing and excitation occur due to the interaction between the material and the beam and chemical reaction occurs consequentially to kill insects, bacteria and fungi existing on food.

- *Outline why it is suitable for addressing the problems/needs in question.*

Together with increasing in demand for foods and other agricultural products providing to the growing population, the increase of post-harvest loss of crop production by climate change in the region are threatening our food security. From last project, food irradiation has been considered as an effective and potential way to address climate change for food security. However, low processing speed and high cost of gamma irradiator somewhat limited food irradiation applications in practice. High energy EB can process at high speed, especially for the foods which required low radiation dose as radiation quarantine and radiation pasteurization. Moreover, the EB facility can be easily installed at port for facilitating to the regional and international trading of food. It is also expected that the use of machine sources rather than radionuclides may improve the customer's acceptance for food irradiation.

- *Is this the only available technique?*

No, food irradiation is not only available technique to ensure food security in the context of climate change. However, it is the only technique that can process the pre-packaging food products in large-scale. The technology can applied to treat huge volumes in relative short time.

- *Does it have a comparative advantage over non-nuclear techniques?*

Many methods have been developed to address the climate change impacts for ensuring food safety and food security in recent years. While food irradiation can process large amount of foods within relative short time, non-nuclear techniques usually required labor and time. In particular, high processing speed of EB can timely provide safe food for ensuring food security in the disasters caused by climate change. Up to now, most food processing techniques required heat or chemical, which may contaminate the products, whereas radiation is physical process that can apply to packaging food without any significant change in irradiated food. Therefore, food irradiation technique is safe and friendly. Moreover, the technology can process food in industrial scale with saving energy, so that its processing cost is much cheaper than other non-nuclear techniques, even it requires high initial investment.

Duration of the project:

- *Indicate the number of years estimated to be required to complete the project.*

4 years (The project will be conducted for the 2020-2023 period)

First year: Harmonize the regional strategy to address climate change by the technology

Second and third years: Improve the practices for dosimetry, standard operation procedure of food

Last year: Promote the technology application for food security in the region.

Part 3: National Representative Endorsement for Project Concept

I have endorsed the proposer to have access to the RCARO web page for the resource documentation necessary to complete the attached concept document.

This 2nd Round Concept meets the RCA project requirements and I endorse it as a priority for the RCA Programme 2020/2021.

Signed:

PhD. Nguyen Hao Quang

National RCA Representative of Vietnam

Date: **12 January 2018**