Programme 1.1 **Nuclear Power**

Subprogramme 1.1.1 **Integrated Support for Operating Nuclear Facilities**

Project 1.1.1.1 **Engineering support for design, operation, maintenance, and plant life management for safe long term operation**

CRP Title: **Advanced Surveillance, Diagnostics and Prognostics Techniques Used for Health Monitoring of Systems, Structures and Components in NPPs (Additional Activity)**

CRP Code: **I2.10.20**

This CRP will identify and carry out research required in the fields of on-line monitoring, diagnostics, and performance prediction including data acquisition, processing and analysis techniques, integration, overall system operation and maintenance. Emphasis is given to (1) increased SDP needs in existing NPPs arising from power upgrades and license renewals and (2) built-in SDP capabilities in new NPP designs. The technical subject of the CRP was identified by the IAEA Technical Working Group on Nuclear Power Plant Control and Instrumentation (TWG-NPPCI) as an area of high importance.

Subprogramme 1.1.5 **Technology Development for Advanced Reactor Lines**

Project 1.1.5.1 **Technology advances in water cooled reactors for improvements in economics and safety**

CRP Title: **Benchmarking Severe Accident (SA) Modelling for Pressurized Heavy Water Reactors (PHWR) (in cooperation with NSNI) (Activity 14)**

CRP Code: **To be assigned**

This CRP involves benchmarking SA Modelling Codes for PHWRs Work will focus on contrasting the results of various modeling approaches, gaining an understanding of their limitations and how to overcome them, and thereby to increasing confidence in severe accident code predictions.

CRP Title: **Benchmark Analyses of Sodium Natural Convection in the Upper Plenum of the MONJU Reactor Vessel (Activity 15)**

CRP Code: **To be assigned**

This CRP concerns natural convection behaviour of the coolant in the reactor vessel of a sodium cooled fast reactor. The objective of the CRP is to improve the Member States' analytical capabilities in the field of in-vessel sodium thermal hydraulics. This objective is to be achieved through a benchmark exercise focusing on the numerical simulation of the sodium stratification measurements performed (and planned) in the MONJU reactor vessel, and then from a thorough assessment of the calculation versus experiment comparisons.

Project 1.1.5.2 **Technology advances in fast reactors and accelerator driven systems**

CRP Title: **PHENIX End-of-Life Tests and Expertise (Activity 16)**

CRP Code: **To be assigned**

This CRP will focus on end-of-life tests and acquisition of material data before dismantling of a prototype power fast reactor (PHENIX). The CRP's specific objectives are: (1) To improve the Member States' analytical capabilities in the various fields of research and design of sodium cooled fast reactors through data and codes validation; (2) The acquisition of material behaviour data; (3) To support technology and safety demonstration of fast reactors.

Project 1.1.5.4 **Common technologies and issues for small and medium sized reactors (SMRs)**

CRP Title: **Development of Advanced Methodologies for Substantiation of Passive System Performance in Innovative Reactors (Activity 11)**

CRP Code: **To be assigned**

Several research groups around the world are developing new methodologies to assess the performance of passive safety systems by defining and proposing an approach to quantify inherent reliability of a passive safety system or its capability to reach the expected performance for a given set of scenarios. Several designers of innovative reactors of different types (water cooled, sodium cooled, and gas cooled fast reactors) and, specifically, the designers of innovative SMRs, are interested in application of such methodologies to the design optimization and safety analysis of their designs. All methodologies are at a preliminary stage of development and have many important points under-elaborated. Bringing together designers of innovative SMRs and developers of the methodologies mentioned above could help develop advanced methodologies for substantiation of passive system performance, which would enable the progress in risk-informed approaches to design optimization and safety qualification of future SMRs. The specific objectives of this CRP are (i) to reach a consensus on the definitions and to identify common requirements to the methodologies for performance assessment of passive safety systems; (ii) to identify the scope of passive systems and passive processes to be addressed by such methodologies; (iii) to bring together, adjust, merge, modify, and elaborate different approaches and methodologies developed worldwide; (iv) to elaborate a new common approach to the substantiation of passive system performance

Subprogramme 1.1.6 **Support for Non-electric Applications of Nuclear Power**

Project 1.1.6.1 **Support for demonstration of nuclear seawater desalination**

CRP Title: **Advances in Nuclear Desalination Technologies (Activity 8)**

CRP Code: **To be assigned**

This CRP will examine recent advances in nuclear reactors including improved performance, economics, safety & environmental aspects and long term sustainability; advances in the desalination technologies including waste heat utilization, hybrid systems, improved performance and overall economics. The CRP will focus on the development of cost reduction strategies for producing potable water economically from seawater desalination using nuclear energy to meet the future water needs in water scarce areas.

Programme 1.2 **Nuclear Fuel Cycle and Materials Technlogies**

Subprogramme 1.2.4 **Topical Issues of Nuclear Fuels and Fuel Cycles for Advanced and Innovative Reactors**

Project 1.2.4.1 **Supporting nuclear fuels and fuel cycle activities of fast reactors, HTGRs and SMRs with long core life**

CRP Title: **Accelerator Simulation and Theoretical Modelling of Radiation Effects (Activity 13)**

CRP Code: **To be assigned**

The planned CRP on "Accelerator Simulation and Theoretical Modelling of Radiation Effects (SMoRE)" will start in 2008. It is aimed to support a new development and further improvement of core structural materials for higher burn-up applications in LWRs, fast reactors and, by synergy, in the fusion and other nuclear systems. The overall SMoRE objective is to determine, through sharing of information and experience platform in the domain of accelerator-based irradiation and its contribution to the better understanding radiation effects and mechanisms of material damage. Those goals will bridge from micro- to macroscopic behaviour of materials through physical multi-scale modelling validated by specific detailed experiments

Programme 1.4 **Nuclear Science**

Subprogramme 1.4.2 **Research Reactors**

Project 1.4.2.2 **Supporting research reactor modernization and innovation**

CRP Title: **Low Enriched Uranium (LEU) Fuelled, Aqueous, Homogenous Reactor (AHR) Utilisation for the Production of ^{99}Mo and Other Isotopes (Additional Activity)**

CRP Code: **To be assigned**

Demand for ^{99}Mo and other isotopes are increasing. Fulfilling this need is challenged by complex technology and reliance on Highly Enriched Uranium (HEU). Low Enriched Uranium (LEU) fuelled aqueous homogeneous reactors (AHRs) present an attractive alternative. Advantages of AHRs include low temperature, pressure and power operation; smaller, simplified reactor and control systems; large negative temperature coefficients of reactivity; improved process efficiency through target elimination; and less waste generation per unit product. A new Coordinated Research Project could help address remaining challenges by a) completing and sharing research on the further optimization of the fuel base, especially the use of LEU instead of HEU, b) analyzing fission product effects on the process and final products, c) determining long term operational effects including corrosion and d) completing feasibility studies. Results from different organizations and codes will be reviewed and shared so the accuracy and precision of different approaches can be properly evaluated.

Project 1.4.2.2 **Supporting research reactor modernization and innovation**

CRP Title: **Innovative Methods In Research Reactors Analysis (Activity 4)**

CRP Code: **To be assigned**

With the progress in computer technology and numerical methods, the capabilities of computer codes have been substantially enlarged. The recent development of these methods and codes allows for better simulation of the complex processes taking place during the steady state operation and transients of research reactors. Application of these methods and codes may improve the design of research reactors and associated experiments and also their operational and safety performance. Nevertheless, in order to demonstrate the applicability and quality of these innovative analysis tools, it is necessary to carry out coordinated benchmark exercises against good sets of experimental data. An appropriate way to perform these benchmarking activities is within the framework of a new Coordinated Research Project (CRP) on Innovative Methods in Research Reactor Analysis. The objectives of the envisaged CRP will be to: a) transfer know-how in the area of innovative methods in research reactor physics from leading institutes to the other organizations participating in the CRP; b) establish procedures for the qualification of the computational tools for operation and safety analysis of research reactors; and c) apply the available computational codes to different research reactor cases (including design of new research reactors, modifications, and experiments), making detailed comparison of results between different organizations and codes so that the accuracy and precision of the different approaches can be properly evaluated.

Subprogramme 1.4.3	**Accelerators and Nuclear Spectrometry for Materials Science and Analytical Applications**
Project 1.4.3.1	**Accelerator techniques for modification and analysis of materials for nuclear technologies**
CRP Title:	**Numerical Modelling and Simulation of Irradiation Effects in Materials (Activity 1)**
CRP Code:	**To be assigned**

It is essential that structural materials of fission and fusion reactors retain functionality of structural and containment components, to maintain the integrity of fuel rods and assemblies and prevent release of radioactivity to the coolant and environment. These materials were originally chosen on the basis of their as-fabricated properties; however there is an inevitable radiation induced evolution of properties and most changes tend to be detrimental. Sharing of information and experience on accelerator irradiation helps meet the goals for understanding radiation effects and the mechanisms of material damage. Information dissemination also improves understanding of the basic physics under operational conditions in fission reactors as well as in other nuclear concepts such as fusion and spallation systems. The research undertaken in this CRP will provide a link from micro- to macroscopic behaviour of materials through modelling validated by specific detailed experiments. These experiments will cover topics such as advancement of theoretical models of the fundamentals of radiation damage, with respect to core structural materials and high dose nuclear applications through comparison and experimental verification of theoretical and computational models; application of advanced characterization techniques down to the atomic level to materials analysis in combination with particle irradiation experiments; and joint experimental studies of existing, prospective and model materials, including round robin testing combined with characterization of selected materials. Specific ion irradiation experiments to understand flux, spectra and ion effects on damage production and property evolution will be used to form empirical correlations between fission reactor irradiation and ion accelerator irradiation at high doses.

Project 1.4.3.2 **Fostering interdisciplinary developments in accelerator applications**

CRP Title: **Interaction of Hydrogen with Materials of Importance to Innovative Hydrogen Cycles (Activity 6)**

CRP Code: **To be assigned**

Hydrogen utilisation can be used as for pollution-free energy production and will therefore play an important role in future power production including innovative nuclear systems. The hydrogen economy consists of many physical and chemical processes linked in an interdependent network that connects production, distribution, storage, and use. Nuclear methods using neutron and particle beams combined with theoretical models as developed in many accelerator laboratories or at research reactors can make a contribution to these efforts if effectively applied to the problem. The coordinated research project on innovative hydrogen fuel cells and hydrogen cycles utilizing accelerators will support research using advanced neutron and accelerator-based techniques for exploitation of hydrogen use. Safe production, transport and storage of hydrogen will be further developed, as a result of a combined scientific and technical approach. A common international effort will help successfully accomplish such objectives in a hydrogen-power technology platform. Research efforts focused in such domains will be extremely beneficial for future progress in hydrogen-energy production, the automotive and renewable energy sector. Future knowledge and understanding of thermodynamic, chemical and mechanical engineering aspects can also be enhanced through such research. Typical examples of such research efforts include validation of material performance, efficiency and safety of competing storage technologies (porous adsorbents, complex hydrides, compressed gaseous and solid-state such as 'conventional' intermetallic hydrides), optimisation of membranes in fuel-cell units or particular safety assessments of such systems.

Programme 2.1 **Food and Agriculture**

Subprogramme 2.1.1 **Sustainable Intensification of Crop Production Systems**

Project 2.1.1.1 **Soil management and conservation for sustainable agriculture and environment**

CRP Title: **Assessing Soil and Farm Management Practices Affecting the Fate of Agrochemicals in Agricultural Ecosystems (Activity 6)**

CRP Code: **To be assigned**

In some parts of the world (Asia and Europe) where land for agricultural production is increasingly limited because of rising urban and industrial development but annual rainfall and its distribution are favorable for intensification of crop production systems, intensive applications of nutrients and agrochemicals may lead to the accumulation of nutrients and agrochemical residues in soils, plant nutritional disorders (toxicities and deficiencies) and subsequently affect downstream water quality through runoff and deep drainage. Agrochemicals can have off-site impacts on the receiving waters such as streams, rivers, lakes and reservoirs. To develop preventive and corrective measures, there is an urgent need to assemble quantitative data on the extent and actual rates of these transformation processes in farmers' fields, their redistribution in the agricultural landscapes and relate them to their economic and agricultural consequences (crop productivity, soil quality, etc.). The main objective of this CRP is to assess the fate of applied agrochemicals and residual effects at the field, farm and landscape scales in intensively cultivated agro-ecosystems using nuclear and related techniques.

CRP Title: **Assessing and Mitigating the Effects of Soil Pollution on Crop Production in Greenhouse and the Use Of Recycled Organic Wastes for Sustainable Vegetable Production. (Activity 7)**

CRP Code: **To be assigned**

The increasing global population and associated urban growth in both developed and developing countries have generated intensive and diversified urban and peri-urban agriculture. Greenhouse production of vegetable and ornamental products with substantial inputs of fertilizers and agrochemicals and recycling of organic wastes may pose enormous strain on soil resilience and soil microbial activity. Support and coordination of research by NARS is required to assess promising management practices in a wide range of environments so that appropriate guidelines for soil, water, chemical fertilizer, organic wastes and other agrochemicals can be developed. Technical direction and support for the adoption of established techniques and guidelines by national research institutes is required to improve soil management and conservation practices on farmers' fields through the formulation and implementation of technical cooperation projects and related human capacity building. This CRP is designed to assess the fate of applied agrochemicals and residual effects at the field, farm and landscape scales in intensively cultivated agro-ecosystems using nuclear and related techniques.

CRP Title: **Sediment Budgets at the Watershed Scale and Sediment-Related Impacts on Downstream Environmental Degradation (Activity 8)**

CRP Code: **To be assigned**

Land degradation such as soil erosion can affect soil quality, crop productivity and downstream water quality. These impacts will need to be investigated at a watershed scale so that appropriate soil conservation measures can be targeted to degraded areas, instead of the 'blanket' corrective approach over the whole watershed. We propose the use of nuclear techniques together with geostatistics and GIS to assess the magnitude of soil erosion-deposition rates taking into account the varying sediment fluxes within the landscape and their relation to geographical conditions. The specific objective of this CRP is to evaluate the impacts of geographical conditions and farm management/land use practices on sediment fluxes at a watershed scale so as to provide an integrated land management strategy for minimizing the sediment related environmental problems.

Project 2.1.1.2 **Technologies and practices for sustainable use and management of water in agriculture**

CRP Title: **Managing Irrigation Water to Enhance Crop Productivity under Water-Limited Conditions Using Nuclear Techniques (Activity 5)**

CRP Code: **D1.20.09**

Currently around 75-80% of worldwide fresh water resource is consumed by irrigated agriculture. This level of consumption by agriculture is not sustainable into the future because of the increasing competition for water from other sectors. Approximately one-third of the population of developing countries live in regions where there is insufficient water to meet the expected needs for agricultural, domestic, industrial and environmental purposes in the year 2025. Thus improving irrigation water management in agriculture is crucial for increased global food security. This will require an increase in crop water productivity and an improvement in water management practices and soil moisture conservation measures at farm and catchments levels. The main objective of this CRP is to enhance farmers' livelihood through the introduction of new irrigation technologies which result in higher crop water productivity at field level (i.e., yield per unit of water applied) and better environmental (land and water) quality.

CRP Title: **On-Farm Water Harvesting and Conservation Measures to Improve Water Productivity under Rain Fed Conditions (Activity 6)**

CRP Code: **To be assigned**

In many parts of the world with arid and semi-arid environments, farming communities are using traditional systems for capturing and using scarce rainfall. In addition there is a number of innovative on-farm water conservation and harvesting technologies such as soil cover, water retention ponds and constructed wetlands. The CRP will apply existing nuclear-based and related techniques to investigate the effects of such water harvesting/conservation techniques on fluxes of water and soil storage, exploring their suitability for different crops, soils, gradients and farming communities, their drawbacks, and their potential for both farmers and the environment. The objective of this CRP is to quantify and develop means to manage soil evaporation losses and increase crop available water within the root zone and investigate the effect of constructed wetlands and ponds on the fluxes of water, nutrients and agrochemicals in rain fed agricultural ecosystems and their subsequent impacts on crop productivity.

Project 2.1.1.3 **Increasing competitiveness and nutritional properties of high yielding crops**

CRP Title: **Better Crops for Better Health - Fighting Hidden Hunger (Micronutrient Malnutrition) (Activity 6)**

CRP Code: **To be assigned**

Consequences of micronutrient deficiencies, i.e. "hidden hunger", include compromised immune functions that increase mortality and the risk of morbidity, impaired cognitive development and growth, reduced reproductive and work capacity, and performance, with obvious implications for human health and economic and social development. Iron, vitamin A and iodine are currently major targets for public health programs to control the deficiency and prevent health-related consequences. Improvement of crops for increased bioavailability of micronutrients, or reduced antinutrients, through induced mutation is a scientifically feasible and cost-effective way to alleviate hidden hunger, i.e. improving nutrition and health in a sustainable way. Applied to locally adapted crops, problems related to producer and consumer acceptance (foreign material) are circumvented, and the need for major nutritional education programs is eliminated. Comprehensive surveillance programs to monitor the impact of biof. The specific objectives of this CRP is to accelerate the improvement of micronutrient bioavailability to crops through the application of induced mutation, biotechnology and molecular techniques for the generation and characterization of induced mutants; to map micronutrient deficiencies in targeted locations in connection to nutritional habits for designing future action plans; and to assess the impact of available bio fortified crops in the absorption and bioavailability of micronutrients in humans.

Project 2.1.1.4 **Integrated technologies to enhance application and efficiency of mutation induction in crop breeding and genetic research**

CRP Title: **DNA Damage, Repair and Mutagenesis in Plants (Activity 8)**

CRP Code: **To be assigned**

Although induced mutations have been widely used in crop breeding and basic research including mutational analysis of important biological systems, the fundamentals that lead to mutations remain largely unknown in plants. Understanding of the biological control of the process of DNA damage, repair and mutagenesis is not only scientifically important, but also vital for manipulation of mutation induction using recently emerging molecular tools. The rapid progress in functional genomics has provided unprecedented opportunities to study the genes and the mechanisms underpinning the response of plant genomes' repair mechanism to physical and chemical mutagens. The overall objective of this CRP is to identify the genes involved in DNA damage repair and mutagenesis response, to decipher their functions in order to develop strategies to increase the frequency, and manipulating the types, of artificially induced mutations in plant genomes, thus to enhance the effectiveness of mutation techniques.

CRP Title: **Development of Integrated Technology Packages for Enhancing the Efficiency of Induced Mutagenesis in Crop Plants (Activity 9)**

CRP Code: **To be assigned**

Induced mutagenesis in plants has over the past 70 years become established as the tool of choice for creating novel alleles of genes for use in crop improvement programmes. Such alleles are usually absent or otherwise hard to exploit from crop germplasm available to plant breeders. This technology has also become important in the elucidation of gene functions while facilitating gene discovery through mutational analysis. A major drawback to its routine application to both crop improvement and genomics studies (forward and reverse genetics strategies, respectively) remains the drudgery of producing, handling and assaying the requisite large populations of mutant stocks, i.e. the relatively low level of efficiency, in terms of quality and quantity, for the production of the induced mutant populations. The main objective of this CRP is development of serialized methodologies providing seamless integration of protocols for facilitating induced mutations by in vitro and molecular techniques and robust easy-to-use (in vivo and in vitro) screening and phenotyping strategies.

Project 2.1.1.5 **Integrated soil-plant approaches to increase crop productivity in harsh environments**

CRP Title: **Approaches to Improvement of Crop Genotypes with High Water and Nutrient Use Efficiency for Water-Scarce Environments (Activity 10)**

CRP Code: **To be assigned**

Most countries in the tropics and subtropics have weather patterns and soil characteristics that constrain crop production over large tracts of land. Thus, a major challenge for making better use of these marginal lands is to select, evaluate and develop crop genotypes that can produce under conditions of high temperatures and low rainfall, or where soils suffer from salinity or acidity or have been “mined” of nutrients. This CRP will address various facets of moisture stress by adapting, testing and applying existing nuclear-based techniques and related methodological options for evaluating crop genotypes with enhanced adaptation to water scarce environments. This CRP is designated to increase crop production in marginal lands through a) identifying and promoting the development of food crop genotypes with enhanced water productivity and high nutrient efficiency and b) developing integrated soil, water and nutrient management practices in low fertility soils and water scarce environments.

CRP Title: **Sustainable Productivity and Quality Enhancement of Mutant Crop Varieties as Affected by Soil Quality (Activity 11)**

CRP Code: **To be assigned**

Orphan/Cinderella/neglected/underutilized crops are a diverse set of crops ranging from cereals such as tef, the millets, grain legumes such as cowpeas, bambara, root and tubers such as yam, and indigenous fruits and vegetables such as quinoa, that tend to be of regional or even local important. These crops however are important to a significant number of the resource poor farmers in developing countries and are critical for food security by providing the needed calories and nutrients. While the majority of minor or orphan crops are nutritious and often adapted to harsh environments, the major constraint to their production are low yields due to cultivation on marginal lands with either poor soil physical or micro-biological properties. The relative importance of these properties on crop productivity and quality needs to be evaluated. Information obtained will be used in the development of mutant crop varieties that can adapt to such environments will be of significant important to poor-resourced farmers. The overall objective of the project is to develop new varieties in orphan crops with high yields and improved quality under low input cultivation in a range of agro-ecologies.

Subprogramme 2.1.3 **Improving Food and Environmental Safety**

Project 2.1.3.1 **Irradiation and agricultural countermeasures for food safety and trade**

CRP Title: **Development of Generic Irradiation Doses for Quarantine Treatments (Activity 4)**

CRP Code: **To be assigned**

This CRP will work on the determination of a single generic (default) dose for the irradiation of all arthropods and specific doses for significant subgroups of Arthropods. The overall objective of the CRP is to produce generic treatment doses for groups of arthropods. Secondary objectives include an examination of the effects of oxygen levels on efficacy, dose rates and tolerances necessary to prevent reproduction while maintaining/enhancing commodity quality and maximum doses commercially required. Research will result in doses rates and levels for the phylum Arthropod and a few subgroups within that phylum as well as specific minimum doses that provide quarantine security against pests in various commodities.

CRP Title: **Use of Irradiation for Shelf Stable Sterile Foods for Immunocompromised Patients and Other Specific Target Groups (Activity 5)**

CRP Code: **To be assigned**

This CRP will aim to increase the variety of foods available for target groups, such as fresh vegetables, fruits and frozen foods and the development of simple as well as complex foods through the use of irradiation, alone or in combination with other food processing technologies (e.g. modified atmosphere packaging (MAP), natural coatings and additives) and flexible packaging materials. The overall objective is to develop a complete set of safe foods for consumption by selected target groups such as immunocompromised patients. The specific objective will be to evaluate (nutritionally, microbiologically and acceptability) the use of irradiation technology alone or in combination with other food technologies to produce a variety of safe foods for the selected target groups.

CRP Title: **Technologies for Monitoring Anthelmintic and Antimicrobial Drug Residues in Foods in Developing Countries (Activity 5)**

CRP Code: **To be assigned**

Concerns over veterinary drug usage and residues related to food safety and the possibility of the development of drug resistant pathogens, especially with regard to antibiotics used in human medicine, as well as an increased interest of developing country governments is the need to meet requirements for international trade. The main objective of this CRP is to develop and validate assays based on the technology developed in another IAEA CRP, in conjunction with the development of confirmatory methods using mass spectrometric techniques, to facilitate the implementation of monitoring programmes for antibiotics and anthelmintics using harmonised protocols in different countries.

Subprogramme 2.1.4 **Sustainable Control of major insect pests**

Project 2.1.4.1 **SIT to control exotic insect plant pests of agriculture and the environment**

CRP Title: **Increasing the Efficiency of SIT for Lepidopteran Pests by Enhanced Quality Control (Activity 17)**

CRP Code: **To be assigned**

Lepidoptera (moths) are among the most important pests of agricultural crops and are considered the most serious potential invasive species. Control of lepidopteran pests is often achieved through the use of broad-spectrum insecticides, which has contributed to the development of resistance in many serious pests, the increase in residues in food, the contamination of the environment, and the destruction of crop pollinators and natural enemies. The Sterile Insect Technique (SIT) and its variation Inherited Sterility (IS) not only offer great potential as components of area-wide integrated pest management strategies in view of the growing demand for sustainable, environment-friendly, efficient, alternative control tactics, but are likewise ideal to deal with small incipient invasive outbreaks. The production and optimal release of highly competitive sterile insects is a prerequisite for success for any programme that integrates the use of sterile or sub-sterile insects. The specific objective of this CRP is to improve the efficiency of the SIT/IS for selected lepidopteran pests through the enhancement of the control, management, and monitoring of the biological quality of the produced insects in the production facilities, during transport and after dispersal in the target areas.

CRP Title: **Development and Evaluation of Improved Strains of Insect Pests for SIT (Activity 19)**

CRP Code: **To be assigned**

The SIT continues to expand its application to new key insect pests and for these candidate species, new strains will need to be developed to ensure the success of the technique. As the SIT is now being used in more and more pest suppression programmes, the economics of the use of sterile insects will play an increasing role in sustainability of the technique. The new strains will substantially increase efficiency, as has been demonstrated with the use of genetic sexing strains in Mediterranean fruit fly SIT programmes. The strains will be developed using both classical and modern biotechnological methods as appropriate. The development of some of these strains, e.g. genetic sexing strains will be essential in order to expand the use of the SIT to some mosquito and other vectors of disease. The suitability of the new strains for use in the SIT will be assessed under a) standard laboratory conditions and b) semi-mass rearing conditions. This CRP is designated to develop and transfer specific strains that increase the efficiency of SIT programmes or enable new SIT programmes to be developed. These strains will include genetic sexing strains, strains refractory to disease transmission, strains carrying a genetic marker to enable them to be distinguished from wild insects, and strains in which the males carry a marker in their sperm.

Project 2.1.4.3	**Strengthening capacities to use SIT in area-wide control of tsetse and screwworm populations**
CRP Title:	**The Integration of GIS and Tsetse, Screwworm and Blow Fly Population Genetics Data (Activity 16)**
CRP Code:	**To be assigned**

Population genetic information is available for some key insect pests representing indispensable input for efficient planning of area-wide integrated pest management (AW-IPM) programmes, which may rely on a sterile insect technique (SIT) component. In addition, sets of user-friendly geographic information system (GIS) and remote sensing (RS) software and information is available but insufficiently adapted and utilized in the strategy planning and monitoring of area-wide insect pest control programmes. Counterparts face significant difficulties with the spatial analysis of distribution data of pest populations and more specifically, with the identifying and mapping of areas with isolated or confined populations of key livestock pests. The CRP will address this problem. The main concern of this CRP is to improve the planning and monitoring of SIT-based AW-IPM programmes against key livestock pests by refining the sampling and genetic analyses of target pest populations and making use of available GIS and related software for facilitated spatial analysis of population genetic, ecological and other relevant datasets.

Programme 2.2	**Human Health**
Subprogramme 2.2.1	**Nutrition and Infectious Disease Prevention and Control**
Project 2.2.1.1	**Combating the double burden of malnutrition**
CRP Title:	**Management of Severe Malnutrition in Children (Activity 6)**
CRP Code:	**To be assigned**

Lack of access to commercially produced, high quality therapeutic foods in developing countries results in less than optimal management of severely malnourished children. There is an urgent need to evaluate sustainable nutritional interventions, based on locally produced, low cost therapeutic foods, in the management of severely malnourished children, in particular in settings where the prevalence of HIV-infected children is high. The major objective of this CRP is to evaluate the efficacy of locally produced, low cost therapeutic foods in the management of severely malnourished children by monitoring changes in body composition and other indicators of nutritional status.

CRP Title:	**Exposure to Toxic Elements During Infancy (Activity 7)**
CRP Code:	**To be assigned**

Exposure to toxic elements such as arsenic and mercury via contaminated drinking water and food is affecting hundreds of millions of people in developing countries. The transfer of arsenic and mercury from mother to infant via human milk is poorly understood and only limited information is available on the quantities of total element and species of arsenic and mercury ingested by breastfed infants. As infants are especially vulnerable to the negative health effects of exposure to toxic elements due to rapid growth and development, more information is clearly needed in this age group. The major objective of this CRP is to estimate exposure of arsenic and mercury in breastfed infants in areas where maternal exposure to arsenic and/or mercury is high. Exposure will be estimated by a combination of analyses of total element and species of arsenic and/or mercury in human milk samples and stable isotope techniques to measure intake of human milk in breastfed infants.

Project 2.2.1.3	**Nuclear techniques in the prevention and control of HIV/AIDS and other infectious diseases**
CRP Title:	**Nutrition and Malaria, TB and Other Infectious Diseases in Infants and Children (Activity 6)**
CRP Code:	**To be assigned**

Infectious diseases and under nutrition often overlap in young children. The relationship between undernutrition and morbidity is complex as illness often results in under nutrition and under nutrition increases susceptibility to disease. Children living in resource poor settings are thus often caught in a vicious cycle. This CRP is designated to evaluate the effect of improved nutritional status on incidence and severity of infectious diseases in children under 5 years of age.

Project 2.2.2.3	**Nuclear medicine in non-communicable and communicable diseases including quality assurance of clinical practice**
CRP Title:	**Use of Sentinel Lymphnode Detection in Breast, Melanoma and Head & Neck Cancers (Activity 5)**
CRP Code:	**To be assigned**

Sentinel lymph-node detection and biopsy is one of the fastest growing techniques in Nuclear Medicine because of its impact on the management of women with early stage breast cancer. Improving cancer patient management in developing Member States is the main objective of this CRP through the formation of multi-disciplinary teams, their quality management, and introduction of novel and cheaper radiopharmaceuticals.

Project 2.2.2.4	**Cost-Effective radiopharmaceuticals: Clinical applications**
CRP Title:	**Clinical Use of PET Tracer Generators and PET/CT in Early Differential Diagnosis of Lung Cancer (Activity 3)**
CRP Code:	**To be assigned**

Generator technologies have revolutionized Nuclear medicine practices. Instant availability of suitable PET radioisotope with ultra short half-life from a generator could once again have considerable impact on the growth of Nuclear medicine. The new Ge/Ga68 generator has that potential however its true value in main stream clinical practice has still to be established. Lung cancer is the second commonest cancer and leading cause of death in the world. The early differential diagnosis in terms of lung cancer is a great challenge especially in emerging countries where smoking is rampant and where lung bound infections e.g. TB is much higher than reported on Europe or North America. Peptides are highly specific and can be radiolabeled with gallium-68 which could aid differential diagnosis. Recent reports suggest 88% survival rate over 10 years in stage 1 or 2 as compared to less than 5% with stage IV lung cancer; therefore early diagnosis, accurate staging and treatment is critical for lung cancer. The use of PET/CT can provide accurate early diagnosis; staging and treatment follow-up. However, there is need for a large multi-centre investigation to establish true merits of PET/CT and generator based technologies. This CRP is designated to evaluate and address these clinical challenges.

CRP Title: **Treatment of Patients with Metastatic Bone Pain with Lu-177 Labelled Compounds (Activity 4)**

CRP Code: **E1.30.33**

This CRP comprises a multi-phase clinical investigation. Phase-I began in June 2007. Phase-II of this CRP will be opened next year by including additional centres. The objective of this CRP is to investigate the safety and clinical effectiveness of the radiopharmaceutical Lu-177 EDTMP on relieving pain caused by bone metastasis from prostate cancer, a common cancer in men. The relevance for Member States will be the availability of a much less expensive but still effective radiopharmaceutical for bone pain palliation in metastatic cancer conditions.

Subprogramme 2.2.3 **Radiation Oncology and Cancer Treatment**

Project 2.2.3.1 **Palliative cancer management using radiotherapy**

CRP Title: **Short Course Versus Standard Course Radiotherapy, in Elderly and/or Fragile Patients with Glioblastoma Multiforme (GBM) (Activity 5)**

CRP Code: **To be assigned**

Glioblastoma mutiforme (GBM) is a type of brain tumour with the poorest prognosis. When diagnosed it usually is beyond curative treatment due to invasive spread to surrounding brain tissue. Treatment with surgery is rarely complete; radiotherapy and chemotherapy are used alone or in combination. Although the effectiveness of radiotherapy on survival has been demonstrated in several clinical trials, the prognosis for GBM patients remains poor. At diagnosis, the elderly and/or fragile patients have the poorest prognosis. Altering the fractionation schedule using a short course may be an option for helping these patients to shorten the length of hospital stay and treatment time and to improve the quality of life for these patients. A randomized trial is being considered, to evaluate the question of optimized dose/fractionation and treatment time in elderly/frail patients with GBM. The CRP will be considered and possibly developed upon recommendations from an international expert group meeting.

CRP Title: **Resource-Sparing Palliative Treatment for Advanced Squamous Esophageal Cancer: Comparison of Two Brachytherapy/Radiotherapy Regimens (Activity 6)**

CRP Code: **To be assigned**

Liver cancer is the third common cause of cancer death in low and middle income countries and commonly present especially in Asia and Africa, among people in productive age as well as children. Main aetiological factors are hepatitis infection, aflatoxins and alcohol consumption. The incidence is increasing in high income countries. Radiotherapy is used for palliation but the tolerance of liver towards radiation is limited. Different fractionation schedules need to be evaluated within a context of a clinical study to develop treatment guidelines for palliation in liver cancer using resource sparing radiotherapy regiments. This specific objective will be to assess the effects of radiotherapy in liver cancer on quality of life, response and survival.

CRP Title: **Concurrent Radiochemotherapy Versus Concurrent Radiochemotherapy Followed by a Consolidation Chemotherapy in Locally Advanced Non-Small Cell Lung Cancer (Activity 7)**

CRP Code: **E3.30.29**

Clinical trials have well established the use of concurrent radio chemotherapy and now this should be considered the standard of care for locally-advanced NSCLC patients with good performance status. However, the role of consolidation chemotherapy and/or biological therapy following concurrent radio chemotherapy remains unclear. This randomized clinical trial compares concurrent chemo radiotherapy followed by either chemo therapy/biological therapy consolidation treatment or no further therapy, to evaluate the feasibility of consolidation chemo therapy/biological therapy. The specific objective of this CRP is to assess the benefits of additional chemotherapy/biological therapy in local control, disease-free survival, distant-metastases-free survival and overall survival, compared to conventional radio chemotherapy, by means of a multicentre/multinational clinical trial and to evaluate the tolerability and the toxicity of the consolidation chemotherapy/biological therapy following the concurrent radio chemotherapy schedule.

Project 2.2.3.2 **Curative cancer management Using radiotherapy**

CRP Title: **Altered Fractionation and Radio-Sensitisation in Head-and-Neck Cancer Radiotherapy (Activity 8)**

CRP Code: **To be assigned**

Cancers of the head and neck region are extremely common in low and middle-income countries and radiotherapy plays a key role in their treatment. The current CRP is aimed at improving the outcome and quality of life while sparing scare teletherapy resources. This CRP is designated to test the relative effectiveness of an accelerated radiotherapy regimen of 6 fractions/week compared with the same regimen plus the radiosensitiser Nimorazole. The accelerated regimen was shown in a previous IAEA CRP to be superior to 5 fractions/week for local control in advanced head-and-neck cancer. The radiosensitiser has been shown in one clinical trial to improve local tumour control, and its use is now standard treatment for head-and-neck cancer patients in Denmark receiving radiotherapy.

CRP Title: **Resource-Sparing Curative Treatment for Colorectal Cancer (Activity 12)**

CRP Code: **To be assigned**

Preoperative radiotherapy has gained wide acceptance in the treatment of rectal carcinoma because of tumour shrinkage, increased radiosensitivity and decreased toxicity. However there is no uniform consensus for the selection of preoperative fractionation schedules. A multicentre/ multinational randomized clinical trial that compares preoperative hypofractionated radiotherapy followed by chemotherapy or preoperative conventional radiochemotherapy is needed to address to this question. The main objective of this CRP is to compare two different fractionation modalities in terms of local control, disease-free and overall survival rates for patients with resectable T3-4 low-grade rectal cancer.

Project 2.2.3.3 **Advanced techniques for cancer radiotherapy**

CRP Title: **Improving Outcomes in Radiotherapy Using Novel Biotechnologies: Modification of Tissue Reactions and the Use of Stem-Cell Therapeutics (Activity 7)**

CRP Code: **To be assigned**

The dose delivered to cancer patients is limited mainly by the small risk of severe tissue reactions (morbidity). There are various new growth factors, such as KGF (Keratinocyte Growth Factor) which is being investigated to reduce mucosal and epithelial reactions, and new compounds such as essential fatty acids, angiotensin II blockers, and statins that modulate the response of the vasculature which is partly responsible for late tissue reactions. In addition, stem cell transplants may help tissue recovery. The use of blood stem cells to restore haemopoiesis in bone marrow in irradiated patients receiving transplants is well established. There is research ongoing to try and replicate this strategy for epithelial tissues in skin, gut and testis. Also oligodendrocyte cultures are being investigated regarding their potential to heal irradiated spinal cords. The reduction in morbidity risk, by using these new agents or stem cells, may also allow higher radiation doses to be delivered. The specific objective of this CRP is to use molecules which reduce early tissue reactions or late vascular injury in irradiated tissues, including the use of stem cells or their progeny, in laboratory studies and in clinical trials.

Project 2.2.3.4 **Therapeutic applications of unsealed radioactive sources in the management of benign and malignant diseases**

CRP Title: **131-I for Treating Benign Thyroid Disorders Applying Imaging Equipment Input and Standardized Protocols (Activity 3)**

CRP Code: **To be assigned**

The implementation of oral administration of 131-I as Sodium Iodide (NaI) solution is an established approach for the effective treatment of thyroid diseases leading to hyperthyroidism (excess production and release of thyroid hormone). Most common pathologies of the thyroid gland that can cause hyperthyroidism include multi-nodular or mono-nodular toxic adenomas and Graves's disease, an autoimmune condition resulting in the production of agonist auto-antibodies directed against the "Thyroid Stimulating Hormone-Receptor" (TSH-R). In countries with iodine deficiency, supplementation of food salt with Iodine has lead to an increase in the incidence of hyperthyroidism either caused by the high prevalence of multi-nodular goiter or by the induction of increased incidence of autoimmune disease as reported in Europe and observed in African and east European Member States. The aim of this CRP is to create a standardized approach for effectively treating this condition by making use of the available nuclear medicine imaging equipment for pre-therapeutic dose estimations.

Subprogramme 2.2.4 **Quality Assurance and Metrology in Radiation Medicine**

Project 2.2.4.1 **Quality audits in dosimetry for radiation medicine**

CRP Title: **Development of Quality Audits for Radiotherapy Dosimetry for Complex Treatment Techniques (Activity 7)**

CRP Code: **To be assigned**

The external audit is a crucial element of any quality assurance (QA) programme for clinical dosimetry. So far the procedures for national TLD networks involved beam calibration checks and measurements in non-reference conditions for rectangular fields. As the next step, new procedures will be developed that will address more complex irradiation techniques used for treatment of cancer patients, such as conformal radiotherapy that uses irregular radiation fields conforming to the tumour geometry. National audit networks will incorporate in their programmes procedures for checking hospital dosimetry for these techniques. The main objective of this CRP is to develop TLD-based dosimetry audit procedures for national external audit groups for dose measurements for complex techniques used in radiotherapy.

Project 2.2.4.3	**Quality assurance and guidelines for medical physics in the optimization of clinical radiation imaging**
CRP Title:	**Development of Quantitative Nuclear Medicine Imaging for Optimised Patient Specific Dosimetry (Activity 12)**
CRP Code:	**To be assigned**

Nuclear Medicine instruments have the potential to provide quantitative information and its distribution with time, i.e. biokinetics. This information provides the basis for internal dosimetry and is needed to properly optimize the use of any radiopharmaceutical. Patient-specific dosimetry is often a legal obligation when administering radiopharmaceuticals for therapy. There are, however, no harmonized protocols or guidelines for acquiring quantitative information from Nuclear Medicine instruments. Nor are there documents that address the possibilities and limitations of these instruments for quantitative information. This CRP aims at addressing this gap. The specific objective is to develop and test guidelines for accurate quantitation using Nuclear Medicine instruments such as gamma-probes, gamma-cameras and PET scanners. The CRP will also investigate to what extent combined scanners (PET/CT and SPECT/CT) can provide enhanced quantitative accuracy.

Project 2.2.4.4	**Quality assurance and Medical Physics Development in Radiotherapy and Therapeutic Nuclear Medicine**
CRP Title:	**Doctoral CRP on Quality Assurance of the Physical Aspects of Advanced Technology in Radiotherapy (Activity 12)**
CRP Code:	**E2.40.15**

To safety and effectively implement new radiotherapy treatment modalities, highly skilled medical physicists are needed to develop and implement the dedicated Quality Assurance programme. These professionals are in short supply, especially in developing countries. Of these professionals, medical physicists provide the technical and scientific backbone for the use of ionizing radiation in medicine. By pairing a host institution from a developing country with an agreement institution from a developed country in a doctoral program, the CRP would have a positive impact on medical physics service, teaching and research in the developing world. Thus, the objective of this project is to enhance the capability of Member States to implement advanced radiotherapy treatments with curative intent, by training a number of medical physicists at the Ph.D. level with research and clinical capability.

Programme 2.3 **Water Resources**

Subprogramme 2.3.2 **Isotope Methods for the Improved Understanding of the Water Cycle**

Project 2.3.2.1 **Isotope methods for the assessment of groundwater sustainability**

CRP Title: **Evaluation of Isotope and Geochemical Methods (based on Vadose Zone and Aquifer Sampling) for Estimating Groundwater Recharge (Activity 3)**

CRP Code: **To be assigned**

Evaluation of groundwater recharge and its mechanism, remain the most critical information for assessment of groundwater resource and its sustainability. A number of hydrological studies based on isotope geochemical tracers have been carried out to estimate recharge rates by studying the movement of soil moisture in the vadose zone or by estimating ages of shallow groundwater. However, the linkage between the two approaches to validate the applied methodologies has not been attempted so far. This CRP focuses on tracers and groundwater age indicators to evaluate soil moisture movement and shallow groundwater dating to improve estimates of groundwater recharge. Both chemical and isotope tracers will be used in selected sites to obtain a deeper insight and better estimates of groundwater recharge.

Programme 2.4 **Environment**

Subprogramme 2.4.1 **Marine Environment and Radiological Assessment (MERA)**

Project 2.4.1.2 **Diagnosing contaminant sources and fates using nuclear and isotopic techniques**

CRP Title: **Development of Validated Methods for the Speciation of Selected Forms of 'Hg', 'As' and 'Sn' in Marine Samples (Activity 5)**

CRP Code: **To be assigned**

The exact toxic or beneficial effects of an element in the biosphere are dependent on the physical-chemical form (or forms) of that element within the compartment studied. For instance methyl mercury compounds are more toxic than inorganic forms; inorganic tin is less toxic than butylated forms (which may induce alterations in the DNA of certain marine organisms); inorganic arsenic is much more toxic than the 'As' bearing species arsenobetaine, which is the predominat form of the element found in fish tissues. Knowledge of speciation is therefore imperative for decision making related to safety including certain trade issues (e.g. importation of fish for human consumption). Reference materials provide a vital tool for method validation studies and in assuring the validity of analytical data. Currently, very few materials exist that are characterised for species content in marine samples. The main objective of this CRP is developing validated speciation methodologies for 'As', 'Hg' and 'Sn' species, for a basket of analytical techniques (available to MS laboratories).

Project 2.4.4.1 **Laboratory quality management activities and metrology**

CRP Title: **Benchmarking Calibration for Low-Level Gamma Spectrometric Measurements of Environmental Samples (Activity 3)**

CRP Code: **To be assigned**

The increased interest in measuring low levels of radionuclides in the environment has resulted in the emergence of large-volume low-background hyperpure germanium (HPGe) gamma-ray detectors, multi-detector arrays for various types of coincidence counting, ultra-low-level passive shielding, active anti-cosmic and anti-Compton shielding and underground laboratories. The calibration of such spectrometric systems is a complex task relying on a combination of experimental and modelling approaches. An accurate determination of detection efficiency and related uncertainties is essential to improve the estimation of the combined measurement uncertainty. This CRP is designated to co-ordinate development of validated calibration methods relying on combined experimental and modelling approaches and to establish traceability of results through comprehensive quantification of measurement uncertainties associated with low-level gamma spectrometric analyses of environmental samples.

Project 2.4.5.2	**Ecotoxicology**
CRP Title:	**Environmental Impact of Radioactive Particles on Man and Non-Human Species (Activity 2)**
CRP Code:	**To be assigned**

The research carried out under a previous CRP on radiochemical, chemical and physical characterization of radioactive particles in the environment recognized the importance of radioactive particles released into the environment from a wide range of different nuclear sources, with respect to environmental impact and risk assessments. These studies have highlighted common problems related to analytical measurements and sample homogeneity, incomplete dissolution of samples, and potential differences in the transport, solubility and dosimetric properties of particle associated radionuclides compared with those existing as atoms, molecules, ions or complexes. Furthermore, there are no valid reference materials for the analysis of radioactive particles. As a consequence, there has been a lack of knowledge and a high degree of uncertainty about the short- and long-term ecological and health impacts of particle associated radionuclides. Thus, for particle contaminated areas, the overall uncertainties in environmental impact and risk assessments will be unacceptably high, if the particle distributions, particle characteristics and factors influencing weathering rates are not taken into account. This new CRP will focus on biological and health effects induced by radioactive particles to improve environmental impact and risk assessments for ecosystems contaminated with radioactive particles.

Programme 2.5	**Radioisotope Production and Radiation Technology**
Subprogramme 2.5.1	**Development of Radioisotope Products for Medical and Industrial Applications**
Project 2.5.1.1	**Fostering the development of emerging radioisotopes and generators for medical and industrial applications**
CRP Title:	**Development of Production Methods (using Cyclotrons) for Emerging Radioisotopes and Generator Based Positron Emitters for Medical and Research Applications (Activity 7)**
CRP Code:	**To be assigned**

Interest in establishing medium and low energy cyclotrons for radioisotope production and development of radiolabelled products for clinical nuclear medicine is growing including in many developing countries. It is often the case that the cyclotrons dedicated for production of PET radioisotopes have adequate excess beam time available, which could be used to produce other radioisotopes, either for clinical or for research purposes. There are several radioisotopes of potential utility which could be made on medium or low energy cyclotrons, e.g. Cu-64, Y-86, Br-75, Br-76, I-124, and Tc-94m. In addition, for centres which do not have cyclotrons, the availability of PET radionuclide generators would facilitate the use of PET imaging. Two PET generator systems, namely Ge-68/Ga-68 and Sr-82/Rb-82, are currently re-emerging, the former due to the importance of Ga-68 products for PET tumour imaging and the latter for myocardial PET imaging. There is a need to strengthen the procedures for production of the emerging radioisotopes, as well as, the parent radionuclide for the generators in medium and low energy cyclotrons, the chemistry for the separation of the products and technology for the preparation of the generator systems, in order to ensure that these tracers could conform to the quality requirements for medical use. The major objective of this CRP is to develop production methods for emerging radioisotopes such as Cu-64, Tc-94m and I-124 (using medium and low energy cyclotrons) and preparation of radionuclide generator systems for PET studies (Ge-68/Ga-68 and Sr-82/Rb-82), including development of radiochemical processes for separation of the radionuclides from irradiated targets, development of technology for the production of radionuclide generator systems and development of appropriate QA/QC techniques for the PET radiotracers.

Project 2.5.1.2	**Development, production and quality control of emerging diagnostic radiopharmaceuticals**
CRP Title:	**Development of F-18 Labelled Radiopharmaceuticals other than FDG, (such as F-DOPA, Fluorothymidine, Flourothyrosine) (Activity 3)**
CRP Code:	**To be assigned**

Positron emission tomography studies using [F-18] FDG is widely used in oncology, neurology and cardiology. Despite several notable developments, none of the other F-18 radiopharmaceuticals has come to the large clinical arena and greater efforts are needed to bring them as widely used clinical products. Some of the F-18 based radiopharmaceuticals such as fluorodopa, fluorothymidine, fluorotyrosine etc. are finding utility as PET tracers in imaging disorders of the brain as well as different type of cancers. There is a need to develop the chemistry, automated synthesis; and QA/QC procedures for the above Flourine-18 based radiopharmaceuticals in order to enhance their wider use. This CRP has been designed to work on the development of the chemistry, technology for automated synthesis; and QA/QC of F-18 based radiopharmaceuticals such as fluorodopa, fluorothymidine, fluorotyrosine etc.

CRP Title:	**Development of Radiopharmaceuticals Suitable for Sentinel Node Scintigraphy for Breast and Neck and Head Tumour (Activity 4)**
CRP Code:	**To be assigned**

Auxiliary lymph node dissection represents an important staging procedure in the surgical treatment of breast cancer. There is a lack of reliable clinical, imaging or laboratory methods to define nodal status, the most reliable predictor of disease outcome. Lymphoscintigraphy using radiolabelled particulates is one of the most successful methods for identification of sentinel lymph nodes and consequent surgical intervention. The transport of the particulates into lymphatic vessels depends on particle size and surface characteristics. Tc-99m based particulate tracers with a size of about 20-100 nm demonstrate reliable transport from the interstitium to initial lymph vessels and eventually results in lymph node uptake. There is a need to develop cost effective radiopharmaceuticals for lymphoscintigraphy to help in the management of breast; and head and neck cancer. This CRP will focus on the development of radiopharmaceuticals and cost effective cold kits for the formulation of Tc-99m based nanoparticulates for sentinel lymphnode scintigraphy studies.

CRP Title: **Development of Specific Radiopharmaceuticals Applicable for Imaging Movement Disorder and Cancer (Activity 5)**

CRP Code: **To be assigned**

Neuroimaging using PET and SPECT radiopharmaceuticals is used for the diagnosis and management of Parkinson's disease and other neurodegenerative disorders. The involvement of the dopaminergic receptor system in numerous brain disorders such as schizophrenia, Parkinson's disease and other movement disorders has prompted an intense research in the development of both SPECT and PET based tracers for imaging neuroreceptors. Most of these agents are based on cocaine congeners. While some of these compounds have found routine application for the examination of Parkinson's disease, some others have found application as surrogate markers in the development of novel drugs for use in the therapy of brain disorders. Over the years, many attempts have been made to develop SPECT based neuroreceptor imaging radiopharmaceuticals; and Ioflupane (DatSCAN) and Tc-99m-TRODAT have shown promise as useful imaging agents. There is a need to develop radiopharmaceuticals for neuroimaging that can be cost effective. The main objective of this CRP is developing radiopharmaceuticals for imaging neurodegenerative disorders and cancer.

Project 2.5.1.3 **Cost-effective radiopharmaceuticals: development (complementary project to Human Health project 2.2.2.4)**

CRP Title: **Development of Therapeutic Radiopharmaceuticals based on Re-188 and Y-90 for Radionuclide Therapy (Activity 4)**

CRP Code: **To be assigned**

Radionuclide therapy (RNT) has emerged as an important modality of nuclear medicine for cancer management. The use of short-lived radioisotopes has several advantages in radionuclide therapy such as higher rate of dose delivery and shorter duration of hospital stay. Among the radioisotopes used for therapy, Re-188 and Y-90 can be made available from radionuclide generator systems. IAEA has an ongoing CRP on the development of the radionuclide generators for the above radioisotopes. There is a need to develop cost effective radiopharmaceuticals using different carrier molecules such as peptides, antibodies etc. labelled with Re-188 or Y-90 for the management of cancer. The specific objective of this CRP is to develop of cost effective radiopharmaceuticals using Y-90 or Re-188 derived from radionuclide generators for targeted therapy; and collect preclinical data for their subsequent clinical application.

Project 2.5.2.1 **Support to improve industrial process management using radioisotope and radiation techniques**

CRP Title: **Evaluation and Validation of Radioisotope Generator Based Radiotracers for Application in Industrial Investigation and Field Conditions (Activity 4)**

CRP Code: **To be assigned**

Poor availability of radiotracers in developing countries limits the area of radiotracer applications and puts serious constraint on routine service to industry. Many urgent applications are not being carried out and radiotracer technology is greatly under-utilized in developing countries simply because of this problem. For further development of tracer technology and expansion of radiotracer applications in industry and environment, it is vitally important to improve the availability of appropriate tracers for various types of tracing operations. The objective of the CRP is to identify and validate (a) industrial tracers from suitable radioisotope generators and (b) radiotracers for harsh conditions in industry and environment.

CRP Title: **Development of Digital Radiography Techniques for Industrial Applications (Activity 5)**

CRP Code: **To be assigned**

New digital radiographic techniques being developed are replacing classical film radiography techniques in non destructive testing (NDT). The use of X-ray film carries with it a number of limitations, including the cost and shelf life of film and chemicals, availability of darkrooms with processing tanks near the inspection site, delay between the exposure and the viewing of results, apart from environmental concerns due to chemical discharges. Replacing film-based inspection processes with detector-based digital systems is enormously advantageous. On-going development on digital X-ray detectors could enhance dramatically the digital image resolution. In many cases, X-ray imaging systems can now meet and exceed the resolution provided by X-ray film. Detector-based digital radiography is now being applied to a broad range of X-ray applications including inspection of pipeline welds, castings, electronics assemblies, wheels, bridges and many other industrial uses. A large number of developing MS have operational NDT laboratories, where film radiography testing was already established in routine inspection. There is a need to foster change to on-line digital radiography techniques for in service inspection, plant life assessment and quality control. This CRP will focus on testing and validation of simple digital radiography techniques, in particular on optimisation of detector-source configuration, on data processing and on evaluation of accuracy, spatial resolution and contrast. The specific objective of this CRP is to prepare protocols on optimisation of detector-source configuration and procedures for use of simple affordable digital radiographs for online NDT inspection, adaptable by developing MS; to compare the performance of various digital systems and formulate standards for quality control and accreditation; to draft training manuals.

CRP Title: **Radiometric Methods for Measuring and Modeling Multiphase Systems Towards Process Management (Activity 6)**

CRP Code: **To be assigned**

Multiphase systems are indispensable in many modern industrial and environmental processes, and their optimisation is important in ensuring enhanced performance, economic viability and environmental acceptability. The fluid-dynamical properties and process parameters of such systems are necessary to be measured to facilitate process control and optimisation. Radioisotope techniques offer, in many cases, the only means of performing such measurements. The radiotracers and sealed source techniques to the study of simple industrial systems is generally well known and the techniques have been adopted by many developing countries. However, the techniques for the investigation of multiphase flow systems are less understood, and in need of further development to ensure their transfer to developing countries. This CRP is designated to identify and validate radiometric methods for optimization of processes in industrial and environmental multiphase systems.

Project 2.5.2.2 **Radiation technology for advanced materials development**

CRP Title: **Potential Applications of Radiation Processed Nanomaterials in Health Care and Industry (Activity 3)**

CRP Code: **To be assigned**

Nano-technology has recently received enormous scientific attention due to the known benefits to advanced material development for potential applications in industry and healthcare. The use of radiation processing techniques to enhance the commercial value of materials is well practiced in many Member States. In recent years there is a wide spread interest in development of nano-structured materials using X-rays, e-beams and ion beams. There is scope for better exploitation and innovative areas require more co-operations amongst research institutions in developed and developing Member States. This CRP will concentrate on study of mechanisms of interaction of radiation on single particle or clusters in solutions or solid materials, development of the methods for radiation enhanced nano-composites synthesis and evaluation of physico-chemical properties of the resultant materials. The major concern of this CRP will be to evaluate the role of radiation processing in the development and testing of nano-materials and enhance the capability in the Member States in the application of radiation processed nano-materials.

CRP Title: **Radiation Processing of Natural Polymers for Development of Finished Products for Health Care, Agriculture and Environmental Applications (Activity 4)**

CRP Code: **To be assigned**

The success of radiation technology for processing of synthetic polymers can be attributed to two reasons namely, their ease of processability in various shapes and sizes, and secondly, most of these polymers undergo crosslinking reaction upon exposure to radiation. On the other hand, naturally occurring polymers were difficult to process and degraded when exposed to high energy radiation. Thus, the area of radiation processing of natural polymers largely remained unexplored and industrial applications have been difficult to achieve. In recent years, natural polymers are being looked again with renewed interest because of their unique characteristics like inherent biocompatibility, biodegradability and easy availability. Traditionally, the commercial exploitation of natural polymers like carrageenans, alginates or starch etc. has been based, to a large extent, on the empirical knowledge. But now, the applications of natural polymers are being sought in knowledge-demanding areas such as pharmacy and biotechnology which is acting as a locomotive for further scientific research in their structure-function relationship. Some regions are especially rich in respect to wide variety of indigenous natural polymers, such as chitin/chitosan, carrageenans and alginates. This CRP is designated to enhance the research on going in the nuclear centres located in the Member States in the field of application radiation processed natural polymers. New marketable advanced materials (eg.using concept of nanomaterials) especially new health care and medical products will be developed in the frame of the project. The technology transfer from RCA region to other regions of the world, especially Latin America and Africa is expected, through active participation of the scientists from these regions.

CRP Title: **Radiation Induced Grafting of Polymers for Selective Separation Purposes and Adsorption of Materials (Activity 5)**

CRP Code: **To be assigned**

Radiation-induced graft polymerization has now gained much more acceptance for the manufacturing of advanced polymeric materials by modifying the surfaces of commercially available commodity polymers. Grafting is based on the generation of active ionic or radical sites on various polymers by the action of ionizing radiation followed by graft polymerization of a selected monomer. A large concentration of free radicals is produced in the irradiated material without the use of chemical initiators. These radicals undergo reaction with a monomer of choice to produce macromolecular chains that are covalently bound to the irradiated specimen. Polymer surface grafting offers versatile means for providing existing polymers with new functionalities such as, hydrophilic, adhesion, biocompatibility, conductivity, anti-fogging, anti-fouling, and lubrication. While different techniques have been commercially practiced using thermal-chemical systems, electron beam irradiation can be used to eliminate concerns over the sensitivity of reaction catalysts to temperature. The CRP will focus on the development and evaluation of techniques on radiation-induced grafting of polymeric membranes, polymeric adsorbents and polymers for medicine and biotechnology for the applications in areas such as recovery of metal ions from seawater and aqueous wastes, chemically resistant self-cleaning filtration membranes and implants for bone replacement applications. The specific objective of this CRP is to foster the role of the radiation in development and testing of grafted materials in three main directions: polymeric membranes, polymers for medicine and biotechnology, and polymeric adsorbents, and enhance the capability of the Member States in these applications.

Project 2.5.2.3 **Remediation of pollutants using radiation technology**

CRP Title: **Radiation Processing for Remediation of Organic Pollutants in Solid and Aqueous Environment (Activity 5)**

CRP Code: **To be assigned**

Municipal and industrial activities lead to environmental degradation and the destruction of non-biodegradable organic compounds and the removal of biological contamination of sludge and aqueous effluents are important for environmental preservation. Industrial effluents, which carry chemical compounds, heavy metals, organic pollutants, (most often petrochemicals, pesticides, dyes and some pollutants synthesized in situ, as for example, chloro organic compounds), provokes a contamination of surface and groundwater, resulting the risk of infection and adverse health effects. The development and implementation of alternative technologies for the clean-up of industrial wastewater containing organic compounds is critical for the sustainability of many countries. Another problem to be addressed is the treatment of sewage sludge, or bio solids, from wastewater treatment plants which can be utilized for land application because it is a rich source of many micronutrients and a valuable source of fixed nitrogen thus making it a valuable fertilizer. However, the presence of pathogenic micro organisms and organic compounds from industrial wastewater has been a source of concern in agricultural applications. Radiation technology can play an important role in tackling this problem, by degrading and destroying organic and biological contaminants and offering solutions to achieve sustainability. The same approach can be used for soil remediation with high contamination of organic compounds from industrial and agricultural activities which present a serious public health risk. The CRP will focus on the evaluation of the effect of radiation on organic pollutants in solid and aqueous environment and address the related analytical and remediation techniques where are applicable. The main objective of this CRP is to study the radiation degradation of organic compounds, mainly of industrial origin and in solids and aqueous environments, to assess and establish the potential applications of radiation processing in preserving the environment.

Project 2.5.2.4	**Strengthening capabilities for detection of explosives and illicit materials and for compositional analysis.**
CRP Title:	**Applications of Nuclear Analytical Techniques Using Transportable Neutron Sources (Activity 3)**
CRP Code:	**To be assigned**

Analytical techniques in-situ are appropriate for investigations of geochemistry of rocks, minerals and ores, detection of components of metals and alloys, detection and control of nuclear material content, ecological monitoring of environment, control of agriculture production, and detection of poison and other toxic substances without container disassembly. Applications of Neutron Activation Analysis in Geological Sciences to determine trace impurities in gem stones (diamonds), trace element analysis of minerals to obtain element partitioning, or trace multi-element analysis of bulk rocks will be enhanced by utilization of transportable sources and a combination of analytical techniques. The overall objective of this CRP is to improve non-destructive examination in-situ of specific material, by the utilisation of cold neutrons as analytical probes for prompt-gamma activation analysis and neutron depth profiling as well as neutrons in instrumental and radiochemical neutron activation analysis.

CRP Title:	**Large Sample Neutron Activation Analysis in Low Flux Reactors (Activity 4)**
CRP Code:	**To be assigned**

In order to carry out neutron activation analysis, samples have to be irradiated in a neutron source, such as a research reactor. The amount of activity produced is, among other parameters, related to the source strength, e.g. the neutron flux rate. Research reactors in developing countries are generally not of the high flux type but rather limited in source strength, such as miniature RRs, or for economy in use of fuel being operated at only partial nominal power. To compensate for low flux of neutrons, sensitivity in analysis can be gained by increasing the amount of sample to be exposed for irradiation. In regular NAA samples range from a few mg to 200-300 mg only. Users of low flux reactors could irradiate samples of up to several 100 g to compensate for reduced neutron intensity. The objective of the CRP is to introduce NAA users in developing countries to the possibilities of large sample NAA in order to help them to improve sensitivity and expand the range of possible applications of this nuclear analytical technique. Large sample irradiation can also be applied e.g. in analysis of archaeological samples that are too precious to be broken into pieces, or in cases where material cannot be easily homogenized such as house hold and industrial waste, or highly refractory materials. The routines to obtain reliable results will be developed and tested by the participants.

Programme 3.1 **Incident and Emergency Preparedness and Response**

Subprogramme 3.2.3 **Development and use of Advanced Safety Assessment: methods and Applications**

Project 3.2.3.3 **Fostering technical developments and trends in safety analyses**

CRP Title: **Development of Advanced Methodologies for Substantiation of Passive System Performance in Innovative SMRs (Activity 4)**

CRP Code: **To be assigned**

Several research groups around the world are developing new methodologies to assess the performance of passive safety systems by defining and proposing an approach to quantify inherent reliability of a passive safety system or its capability to reach the expected performance for a given set of scenarios. Designers of innovative reactors of different types are interested in application of such methodologies to the design optimization and safety analysis of their designs. All methodologies are at a preliminary stage of development and have many important points under-elaborated. The specific objectives this CRP are (i) to reach a consensus on the definitions and to identify common requirements to the methodologies for performance assessment of passive safety systems; (ii) to identify the scope of passive systems and passive processes to be addressed by such methodologies; (iii) to bring together, adjust, merge, modify, and elaborate different approaches and methodologies developed worldwide; (iv) to elaborate a new common approach to the substantiation of passive system performance.

CRP Title: **Safety and Security Aspects of Fusion (Activity 6)**

CRP Code: **To be assigned**

There is an increased demand to assess the balance between technologic outputs and safety requirements aiming at satisfying the licensing requests for ITER. Efforts in this direction started to develop during the ITER design phases, and the Host factor has now been included in it. However, this work represents just the beginning of a more challenging process; the establishing of the safety basis for the licensing of a DEMO fusion power plant. The objective of this CRP is to examine in an integrated way all safety aspects anticipated to be relevant to ITER, and to the first power plant prototype expected to become operational by the middle of the century, leading to the first generation of economically viable power plants with attractive safety and environmental features.

Project 3.2.6.1 **Enhancing the safety of research reactors**

CRP Title: **Benchmark on Neutronics and Thermalhydraulic Computational Methods and Tools for Safety (Activity 1)**

CRP Code: **To be assigned**

The recent development of innovative computational methods and tools allows for better simulation of the complex processes taking place during the transients in research reactor. The conclusions obtained from the completed CRP on the "Safety Significance of Postulated Initiating Events for Different Research Reactors Types and Assessment of the Analytical Tools" emphasized the need of benchmarks against experimental data to demonstrate the quality of these computational methods and tools, through a formal qualification process, before judgement on the validity of their application to the safety analysis of research reactors. These experimental data can be also used to improve the design and, therefore, the safety performance of research reactors. The main objectives of this CRP are to a) establish procedures for the qualification of the neutronics and thermalhydraulic computational codes for the safety analysis of research reactors; b) to define the accuracy of the available neutronics and thermalhydraulic computational tools and to check the validity of their application to the safety analysis of research reactors; c) to transfer know-how in the area of innovative methods for research reactor safety analysis from leading institutes to the other participating organizations; d) to evaluate the user effects on the results predicted by different computer codes; and e) to apply the available computational tools to different cases of research reactors, including design of new research reactors, modifications and new experiments with major safety significance.

Programme 3.4	**Management of Radioactive Waste**
Subprogramme 3.4.2	**Management and Disposal of all Types of Radioactive Waste**
Project 3.4.2.4	**Strengthening capabilities for the disposal of radioactive waste**
CRP Title:	**Development of the Specifications for Demonstration Tests in an Underground Facility on Engineered Clay Based Barriers for Use in the Geological Disposal of Radioactive Wastes (Activity 11)**
CRP Code:	**To be assigned**

Many of the Member States with advanced programmes for the deep geological disposal of HL Radioactive and Fuel Wastes propose to isolate the waste-containers from the surrounding rock masses with engineered barriers made of highly compacted, swelling, bentonite/smectite- clay-based materials. The expected performance of these materials at elevated repository temperatures and under the varying hydraulic, chemical, thermal and mechanical potentials that will exist spatially and temporally as a repository is closed and thereafter is not without speculation. Accordingly, this gives rise to uncertainties in the predictions of repository performance and, thus, the evaluation of long-term safety. Under this CRP it is proposed to back analyze the output from the major experiments that have already been undertaken and recommend the foci for further international experimentation. The back analyses should be completed by parties who were not members of the original experiment teams although these individuals/organizations should be invited to guide and provide a critique of the conclusions drawn through the CRP. The specific objective of the CRP will be to deliver the following:- identification of the major findings and lessons learned from the past experiments; recommendations for future experiments; preliminary designs for the suggested experiments that of higher priority; general training and technology transfer; development of increased common understanding between participating Member States.

Subprogramme 3.4.4	**Decommissioning of Installations and Remediation of Sites**
Project 3.4.4.3	**Facilitating the transfer of sustainable technologies for decommissioning of facilities**
CRP Title:	**Planning, Management and Organizational Aspects in Decommissioning of Nuclear Facilities (Activity 11)**
CRP Code:	**To be assigned**

The overall objective of the CRP is to promote R&D activities, as well as the exchange of information and transfer of knowledge on planning, organization and management aspects of decommissioning, in order to pave the way to its smooth planning and implementation. This should be achieved through a better understanding of the decision-making process in comparison and selection of decommissioning options and planning, organizational and management issues affecting the entire decommissioning process.