

## **New Laboratories for Radiation Dosimetry and Medical Physics at IMROH**

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### **ABSTRACT**

The Institute for Medical Research and Occupational Health (IMROH) is a multidisciplinary scientific institution with more than 70 years of experience in researching the mechanisms of action of various harmful chemical and physical factors and lifestyles on health and the environment. The Institute has a leading role in Croatia in research in the numerous fields that include dosimetry and protection against ionizing radiation, radiobiology, radiocontamination in the environment, as well as human exposure to these contaminants. Institute is at the end of multiyear project: Research and Educational Centre of Environmental Health and Radiation Protection - Reconstruction and Expansion of the IMROH. The purpose of this project is to increase and improve the current IMROH infrastructure and its research equipment, and with the accompanying organizational reform to establish a Research and Education Center for Health and Medical Ecology and Radiation Protection. Building appropriate spacious infrastructure and investing in modern scientific equipment will significantly increase the scientific excellence and visibility of IMROH in the field of existing research. This contribution gives in depth presentation of new laboratories and current capabilities of Radiation Dosimetry and Radiobiology Unit at the Institute. Unit has always played important role in Croatian scientific and professional areas dealing with radiation dosimetry, radiation protection and medical physics. This role will become strengthened with new laboratories that focus on novel technological developments in instrumentation and measurement methods as well as through acquisition of cutting-edge personal dosimetry systems and in-situ dosimetric instrumentation.

**Keywords:** *New Facilities, Instrumentation and methods*

## 1 INTRODUCTION

The Institute for Medical Research and Occupational Health (IMROH) is a multidisciplinary scientific institution with more than 70 years of experience in researching the mechanisms of action of various harmful chemical and physical factors and lifestyles on health and the environment. Institute is at the final phases of the project started in 2017: Research and Educational Centre of Environmental Health and Radiation Protection - Reconstruction and Expansion of the IMROH. In scope of the project Institute is expanded with new building and old building completely renovated. New laboratories are equipped with cutting edge scientific instrumentation which will open new research horizons and help us withhold scientific excellence.



Figure 1: New IMROH building

The Center also envisages the establishment of a "mini technology park" with modular laboratories in which researchers from the Institute in cooperation with visiting scientists could conduct dedicated, ultimately market-oriented, scientific or professional research. This could more often focus scientific research on the needs of industry, and at the same time enable the development of innovative companies with a base in applied research.

Radiation Dosimetry and Radiobiology Unit has always played important role in Croatian scientific and professional areas dealing with radiation dosimetry, radiation protection and medical physics. It operates as major medical imaging quality control and assurance, radiation protection and dosimetry service in Croatia. New laboratories presented in scope of this paper will undoubtedly help us keep professional and research distinction in Croatia and wider region.

## **2 NEW LABORATORIES**

Radiation Dosimetry and Radiobiology Unit will be significantly upgraded and modernized with its new laboratories for X-ray irradiation, dosimetry, electromagnetic radiation (EMR) and general R&D laboratory for development of new technologies.

### **2.1 X-ray irradiation laboratory**

X-ray irradiation laboratory is composed of irradiation room and control and preparation room. Laboratory will house two X-ray units, one continuous 225 kV GE Isovolt Titan E x-ray and secondary 150 kV pulsed X-ray generator XR200. X-rays and accompanying PTW [1] instrumentation

will be setup in traditional reference x-ray irradiation facility layout with 3D calibration bench. We will be able to generate ISO 4037 Narrow Spectrum beam qualities (N40-N200) [2], and diagnostic RQA, RQR and RQT beam qualities as defined in IEC 61267 standard [3]. Beam will be monitored using PTW transmission chamber model 786 for use with calibration benches and readout with PTW UNIDOS Webline [4]. Irradiation room will be equipped with reference environmental data loggers, laser alignment system, radiation monitoring instruments, camera monitoring system, safety systems and several reference ionization chambers.

### **2.2 Dosimetry laboratory**

Unit has for many years used Panasonic thermoluminescent dosimetry system for both personal and area dosimetry. Current system will stay in use but it will be expanded with a modern optically stimulated dosimetry system from Dosimetrics. System will be equipped with semi-automatic reading and erasing modules and irradiator unit.

### **2.3 R&D and EMR laboratory**

R&D and EMR laboratory are planned as multipurpose laboratory for both EMR dosimetry and development of new technologies. It currently includes EMR generator units, field strength analyzers such as Narda SRM 3006, Keysight FieldFox handheld RF and microwave analyzer, Fields at work ExpoM – RF4 exposure meter etc.

Laboratory will now be expanded with Keysight MXR404A mixed signal oscilloscope with 4 GHz bandwidth and 400 Mpts of memory per channel, integrated real time spectrum analyzer, active and passive probes. For development of new detectors there are Keysight B2985B electrometer, bench multimeters, and spectrum of universal nuclear instrumentation such as signal digitizers and logical units. Additionally, laboratory will house signal generators and power supplies from low voltage and high current to high voltage units.

Laboratory will have capacity for small volume PCB assembly with manual pick and place unit, microscope, soldering paste dispenser unit, reflow oven and modern soldering/desoldering station and hot air stations.

### **2.4 Medical physics equipment**

Unit will expand its collection of medical physics phantoms for dosimetry and medical imaging purposes that includes phantom for intraoral radiography assessment, ISO dosimetry calibration phantoms (slab phantom, representing a torso, water pillar phantom, representing arm and leg and acrylic rod phantom, representing a finger), CIRS CT performance phantom (model 610) and tissue equivalent CT dose phantoms etc. We have also acquired additional set of RTI piranha 657 x-ray multimeters

## 2.5 In situ instrumentation

From in situ instrumentation, we would like to emphasize SPIR-Ace with GenieXPort, portable LaBr<sub>3</sub> (Ce) scintillation spectrometer with onboard radionuclide library and data analysis. For low level gamma-ray radiation detection in any environment there is Reuter-Stokes RSDetection ionization chamber. For radon measurement we have chosen the Bertin AlphaGuard, often used as a reference detector. AlphaGUARD simultaneously measures and records ambient temperature, relative humidity and atmospheric pressure with embedded sensors [5]. For a fast radiological survey of a large area, we are developing areal measurement platform based on DJI Matrice 300 drone and scintillation and GM detectors.

## 3 CONCLUSION

Goal of this paper was to present current capabilities and highlights of the new laboratories of Radiation dosimetry and radiobiology unit at IMROH that were equipped in the ReC-IMI project. We have presented new equipment for x-ray irradiation, dosimetry, R&D, medical physics and in measurement instrumentation.

We believe that building appropriate spatial infrastructure and investing in modern scientific equipment will significantly increase the scientific excellence and visibility of IMROH in the field of existing research.

## REFERENCES

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