

## TRAINING ON SOFTWARE FOR SHIELDING AND ORGAN DOSE CALCULATIONS IN THE X-RAY DIAGNOSTIC

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### SUMMARY

The purpose of radiation shielding is to limit radiation exposures to employees and members of the public, to an acceptable level and to ensure the doses to the patients and to their organs as low as possible without reducing the benefit of the necessary diagnostic examination. Medical exposure is the only category in which large reductions in average dose are possible, and it is therefore highly desirable to reduce applications of medical radiation.

The determination of the thickness of primary and secondary barriers is based on National Council on Radiation Protection and Measurements recommendations. In particular, reports n. 49 (NCRP 49, 1976) and n. 147 (NCRP Report 147, 2004) are the standard guideline for shielding of radiographic rooms and the report ICRP n. 34 (ICRP34 1982) defines the protection patient procedures.

The main features of these recommendations have been implemented in an homemade software based on JAVA language. The intent is to realize a tools to be used in radio protection training.

### PROGRAM

The program allows to import a planimetry image over which draw walls, doors, windows, apertures and sources. Once all the information are given a real time computation in the mouse position is performed and the recommended materials thickness are shown to be compared against the thickness of the various material actually crossed by the beam. Some intermediate results are also shown as represented as following:

#### NCRP 49:

Material computed: concrete, lead

Intermediate results: transmission for primary and secondary radiation, working load

#### NCRP 147:

Material computed: cement, lead, gypsum, steel

Intermediate results: transmission for primary and secondary radiation and the physical parameters defined in the protocol for each material

The screenshot displays the software interface with several windows:

- Project:** Design parameters including Wall, Door, Window, Aperture, Panel, Source, and Delete options. It also shows material selection (concrete) and thickness (cm).
- Shieldings - file:** A planimetry image of a radiology room with a mouse cursor pointing to a measurement point.
- Results:** Calculation results for NCRP 147, showing transmission for primary and secondary radiation, working load, and recommended material thicknesses for concrete and lead.

Category	Material	Thickness [cm]	Thickness [mm]
TRADITIONAL: primary radiation	concrete	4.523	[cm]
	lead	0.578	[mm]
TRADITIONAL: secondary scattered radiation	concrete	< 0.001	[cm]
	lead	< 0.001	[mm]
TRADITIONAL: secondary leakage radiation	concrete	< 0.001	[cm]
	lead	< 0.001	[mm]
NCRP147: primary radiation	cement	< 0.001 [cm]Fit; < 0.001 [cm]Graph	(alpha: 0.039 [mm-1]; beta: 0.144 [mm-1]; gamma: 0.423; Xpre: 72.0 [mm])
	lead	< 0.001 [mm]Fit; < 0.001 [mm]Graph	(alpha: 2.651 [mm-1]; beta: 16.56 [mm-1]; gamma: 0.585; Xpre: 0.85 [mm])
NCRP147: secondary radiation	cement	< 0.001 [cm]Fit; < 0.001 [cm]Graph	(alpha: 0.039 [mm-1]; beta: 0.146 [mm-1]; gamma: 0.448)
	gypsum	< 0.001 [cm]Fit; < 0.001 [cm]Graph	(alpha: 2.513 [mm-1]; beta: 17.34 [mm-1]; gamma: 0.499)

### CONCLUSIONS

A homemade software has been developed to compute the shielding barriers to radiography rooms according to NCRP 47 and 147 recommendations.

The software gives also the intermediate results facilitating the radio protection training.

Actually the preliminary results of the program are in agreement with the expected values.

A new feature will be the possibility to evaluate the organ dose to the patient according to ICRP 34.