

An Overview about Incorporation Monitors

Tab. 1: Assembly and design of incorporation monitors, the techniques of **shielding** as well as the **geometries** and the specific position of the detectors

Assembly and Design →	Bed	Chair (Variation)	Arc	Vertical (standing)	Body (moving)
Shielding					
Stationary:	labyrinth shielding	labyrinth shielding	labyrinth shielding		
	room shielding with door	room shielding with door	room shielding with door		
	cylindrical 4π -shielding				
Stationary/ Mobile	shadow shielding	shadow-shielding		shadow-shielding	
	local detector shielding	local detector shielding		local detector shielding	
Portable					no or indiv.
Detector Position					
<i>homogeneously distributed nuclides</i>					
WBC:	stretcher-, line-scanning bed-, spec. spatial- and X/Y- profile-geometry		arc, central symmetric geometry	vertical line-scanning or fixed geometry	vertical line-scanning
PBC:		trunk, stomach geometry			
<i>in-homogeneously distributed nuclides</i>					
Lung	chest: left and/or right lung	chest: left and/or right lung			
Lymph node	upper part of the body	upper part of the body			upper part of the body
Liver	liver	liver			
Skeleton	head, knee, hand, back	head, knee, hand, back			
Thyroid	neck	neck			

Tab. 2: Available **types of monitors** for *in vivo* measurements for direct evidence of radionuclides in individuals mostly using HPGe, NaI(Tl), and Scintillators

I. For Whole Body Measurements:
• Single - Detector Versions
1. chair geometry
2. arc geometry
3. bed or stretcher geometry (stationary or line-scanning version)
• Multi - Detector Versions
1. stationary stretcher geometry (mostly 4 - 8, up to 54 detectors)
2. stationary arc geometry (mostly 2, up to 4 detectors)
3. line scanning stretcher geometry (mostly 2, up to 4 detectors)
II. For Individual Organ or Partial Body Measurements:
• Low - Energy Counters
1. organ counter
- lung counter (mostly 1 - 4, up to 8 detectors)
- liver counter (mostly 1, up to 2 detectors)
2. bones (skeleton) monitors
- head counter (mostly 1, up to 6 detectors)
- knee and hand counter
• Thyroid Monitors
1. direct positionable I-131, I-125 and Tc-99m monitors
2. scanning fluorescence monitors (diagnosis)
• Wound Monitors
- direct positionable, individual versions
III. For Whole Body Profile Measurements:
• X-Y Scanning Profile Monitors
- mostly 2 detectors (below and above)
IV. For β and β/γ Measurements:
• Whole Body Monitors and Partial Monitors
1. β counter
2. Bremsstrahlung counter
3. β/γ and Bremsstrahlung counter
V. Dosimetry Monitors for Radiation Protection:
• Monitors for directly internal Dosimetry
- mostly several counting detectors, individual positioned
• Door Monitoring
- mostly several counting detectors, individual positioned

Tab. 3: Physical aspects of radionuclides and type of radiation as well as the available types of detectors for incorporation monitors.

γ-Radiation: 150 keV - 3 MeV	γ-Radiation: 20 keV - 200 keV X-rays: 1 keV - 150 keV (1 keV - 60 keV)	β-Emitter (Bremsstrahlung) E_{\max}): > 1MeV (500 keV - 1 MeV) ((< 500 keV))
<u>Nuclides, Isotopes</u>		
Anthropogenic:		
Cs-137/134, Co-60, Sr-85, ... I-131/130/124/126 Ag-110m, Sb-125, ...	Am-241, Pu-Isotope, ... I-125/129 Ce-144, ...	Sr/Y-90, Sr-89, ... I-129 Ru/Rh-106, Ce/Pr-144, P-32,..
Natural Primordial and Daughters		
Ra-226, U-235, Ra-224 Bi/Pb-212/214,Ac-228, Tl-208	Ra-226, U-235, (Ra-224) Pb-210, Th-234, Th-231 U-238, Th-232,	Bi-212/214,Ac-228,Tl-208 Bi-210, Pa-234m, (Pb-212/214,) ((Th-234,Ra-228,Pb-210))
K-40		K-40 ((Rb-87, In-115, Re-187))
Natural Cosmogenic:		
Be-7		(Be-10), ((H-3, C-14))
<u>Detectors</u>		
Semiconductor Detectors:		
HPGe: coaxial p-type and n-type rel. Eff.: 10% - 170 %	HPGe: coaxial n-type HPGe: semi-coaxial HPGe/Si(Li): planar (arrays)	HPGe: semi-coaxial HPGe/Si(Li): planar
	Si(Li): planar (cooled) Si: planar (room temp.) p-type and n-type diodes, strips,	Si(Li): planar (cooled) Si: planar (room temp.) p-type and n-type diodes, strips,
Scintillation Detectors:		
NaI(Tl): 1“ bis ca. 8“	NaI(Tl): thin layer	NaI(Tl): thin layer
BGO, CsI, CaF ₂ , BaF ₂ , ...	Phoswich: NaI/CsI,	Phoswich: NaI/CsI, CaF ₂ (Eu)/NaI(Tl), plastic/NaI(Tl), ...
plastic scintillators	plastic scintillators	plastic scintillators
Proportional Counter:		
		proportional counter