Operation manual for work with radioisotopes in the laboratories of I. category on IOCB ASCR.

1. Unsealed sources of ionizing radiation handled on IOCB ASCR are classified as **simple sources**.

2. The **Radiation protection officer** (RPO) for IOCB is **Tomas Elbert Ph.D.**, head of Laboratory of radioisotopes (Lab. 206 building "A" SW-wing, II. floor, extension 395, GSM +420 739 00 22 26). RPO is charged by director to communicate with SUJB (Czech State Agency for Nuclear Safety) in all matters concerning the radiation protection. RPO is responsible for application of Czech legislation in the matters of radiation protection on IOCB. The new experiments (new experimental arrangement, new radioisotope never used before etc.) must be authorized by RPO. RPO is authorized to stop any experiments with radioisotopes in the case of non-compliance.

3. **Qualified experts** charged by director to systematically supervise the radiation protection measures on IOCB are
Aleš Marek Ph.D., Lab. 206 building "A" SW-wing, II. floor, extension 395 , 456, 269
Aleš Zábrabský Ph.D. , Office C.4.13, extension 232

4. Qualified experts give consultations in the field of radiation protection and supervise the compliance of radioisotope handling with regulations.
They specially control
- record keeping of consumption of activity (see par. 7)
- use of regulation personal protective equipment (see par. 8)
- keeping of laboratory monitoring records (see par. 16)

5. The heads of work groups are responsible for compliance of the operations with the radiation protection regulations.

6. Every new worker supposed to work with radioisotopes must pass the training in radiation protection by RPO. The training is closed by examination. The protocol of examination in written is archived in the Laboratory of Radioisotopes. Every exposed worker must pass once a year a training closed by written test. Records of training and tests are archived in Laboratory of Radioisotopes.

7. Laboratory of Radioisotopes keeps the records of all radioisotopes coming to the institute (bylaw regulation). The copy of **Certificate of radioactive source** accompanied by following information:

   - name of acceptor of the radionuclide
   - the storage place of the radionuclide (e.g. the fridge in the lab. 206)
   - date of reception
   - signature of the acceptor

   must be handed to the worker of Laboratory of Radioisotopes charged by keeping the records without delay.

   The laboratories fulfill the bylaw regulation on keeping the records of consumption of radioisotopes by including the radioactivity balance in experimental protocol.

8. For work with radioisotopes the following personal protective equipment is obligatory:
   - lab coat
   - examination gloves (chirurgical) made from nitrile rubber, PVC or latex
   - protective goggles when working with apparatus under either reduced or increased pressure

9. At one workplace the amount of activity handled must correspond with its isolation properties. The $\mathbf{A_{max}}$ activities for most often used radioisotopes are found in ANNEX I.

10. When the work with radioisotope is finished the worker must check the surface contamination of the workplace. If the contamination is higher than guidance level (see ANNEX II) the workplace must be decontaminated.
The surface contamination is checked using Contamination Monitor apparatus (e.g. CORA from Raytest, Berthold LB 124, RUST-3). When a contamination by tritium is suspected, the swipes must be taken and measured by Liquid Scintillation Counting (LSC) (see par. 17). The effectiveness of performed decontamination must be checked again. If the contamination cannot be removed by simple washing off the worker must inform his supervisor and the supervisor solves the problem in coordination with qualified expert and radiation officer.

11. The management of **Radioactive waste** (RW) is provided by Laboratory of Radioisotopes. The RW should be sorted according the instructions given bellow. Sorting of RW results in savings of the costs of its disposal.

Very short lived waste (VSLW) is sorted according to nuclide type content - ^{32}**P**, ^{33}**P,** ^{125}**I** - and than to following groups:

- solid waste (plastic ware, cotton wool, tissues, filter papers, glass, aluminium foil etc.)
- water solutions (containing less than 5% of organic material)
- organic liquids and their mixtures
- scintillation cocktails

Low level waste (LLW) - ^{3}**H**, ^{14}**C**, ^{35}**S** - is sorted into following categories:

- **incineration ready**
  - plastic ware, cotton, filter papers
  - organic liquids and their mixtures
  - scintillation cocktails
  - scintillation cocktails in PP vials (the vials must be well capped, with no leakage)

- **fire resistant with short half-life -** ^{3}**H ,** ^{35}**S**
  (and other radionuclides with the half-life less then 30 years)
  - compressible fire resistant solids (syringe needles, glass ware, aluminium foil etc.)
  - non compressible fire resistant solids (larger laboratory equipment, laboratory furniture, big transportation containers, Dewar vessels etc.)

- **fire resistant with long half-life** - ^{14}**C**
  (and other radionuclides with half-life longer than 30 years)
  - compressible solids (syringe needles, glass ware, aluminium foil etc.)
  - non compressible solids (larger laboratory equipment, laboratory furniture, big transportation containers, Dewar vessels etc.)

12. All categories of **solid RW** are collected at the workplace in PE bags labeled with the "Radiation hazard" symbol and indication of type of radionuclide. Glass scintillation vials can contain up to 1 mL of residual liquid and they are collected in separate bags.

13. **Liquid RW**s are collected at the workplace to PE canisters (up to 5 L volume) labeled with the "Radiation hazard" symbol. The category (water solution, organic liquid, scinitllation cocktail) and type of radionuclide must be indicated on the canister label. Dry organic solvents must be collected in special plastic canisters resistant to static charge development during pouring.

14. When the RW is disposed to the Laboratory of Radioisotopes the type of radionuclide must be indicated on the label and it must be accompanied with the **"Radioaktivní odpad – průvodní list"** Form. The Form is available on Intranet in .pdf and .doc formats. The total activity of the liquid waste must be assayed by LSC. The activity of the solid waste must be approximated by subtracting the activity of the liquid waste from the known activity taken to the experiment.

15. **Monitoring of the surface radioactive contamination** in the laboratories is intended to reveal the malfunction of protective facilities at the workplace (the fume hoods, glove boxes). It does not replace the surface contamination check of the workplace once the experiment is finished.
In the laboratories where the radionuclides are used daily the **control surfaces** are checked once a week.
In the laboratories, where the radionuclides are used occasionally the check of the control surfaces must be done when the experiment or series of experiments is accomplished. The results of surface activity measurements are recorded in "Monitoring book". A separate **Monitoring book** is kept for each separate **Supervised Area**.

16. The radioactivity can be measured either by taking the swipes (see par. 17.) or the surface can be measured directly with the Contamination monitor with large window detector. The monitoring and keeping the records is performed by the radiation worker appointed by the head of the group. The head of the group can ask the RPO for the checking of the laboratory surfaces by portable Contamination monitor. Reference levels for surface contamination in the laboratory of I. category are tabelated in the ANNEXE III.

17. **Monitoring of surface contamination by ^{3}H and ^{14}C using swipes:**

- **Control surface with dimension 10 cm x 10 cm** is regularly wiped in two mutually perpendicular directions by the cotton swab moistened by water or other solvent or solvent mixture, depending on the nature of labeled compounds handled in the laboratory.

- The swab is transferred into the scintillation vial, 10 mL of the scintillation cocktail are added (the scintillation cocktail for swipes is available in the LSC laboratory) the vial is tightly closed and the contents is vigorously shaken until the "gel" appearance of the content is achieved.

- As the first vial in the rack must be placed the BLANK – clean moisturized swab of cotton with 10 mL of scintillation cocktail (it is available in the LSC laboratory).

- For swipes assay method No. 29 "Stery 3-H a 14-C" must be used .

18. If the surface contamination level is lower than **Recording level** the "<" mark is recorded in the Monitoring book. If the Recording level is surpassed, the actual value (in kBq/100 cm^2) is recorded.

19. In the case the **Investigation level** is surpassed, the person performing the monitoring must pass this information to head of the group. The head of the group starts investigation on origins and possible consequences of the increased level of surface contamination in cooperation with Qualified expert and if necessary with RPO. The findings are recorded in the Monitoring book in the column "Poznámka" (Notes).

20. When the surface contamination exceeds the **Action level** the worker responsible for monitoring alerts his coworkers, head of the group and RPO without delay. Under their guidance the laboratory will be decontaminated. After the decontamination the control surfaces are checked and the values of residual contamination are recorded to the Monitoring book. The effectuated decontamination is recorded by head of the group in the column "Poznámka" (Notes) in the Monitoring book.

21. If **lost of control over ionizing radiation source** occurs (e.g. vessel breaks after falling on floor and there is a spillage of radioactive stock solution on the floor) the prime objective is to stop the spread of contamination (cover the spillage by absorbing material as cotton wool, paper tissues etc.) and alert immediately the coworkers. Thanation of radioactive spillage and decontamination of the site. Head of the group records the accident in the the head of the group must be alerted together with RPO. Under their guidance follows the liquid the column "Poznámka" (Notes) in Monitoring book.

Praha 13th May 2014

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ANNEXE I

Highest activities $\mathbf{A_{max}}$ of radionuclide $^{3}\mathbf{H}$ authorized for the laboratory of I. category

Material qualities and type of operation	$\mathbf{A_{max}}$ for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[Ci]	[GBq]	[Ci]	[GBq]	[Ci]
Standard	3 333	90	333	9	33	90
Handling of solutions	166 667	4 505	16 667	450	1 667	45
Volatile liquids	5556	15	1	15	56	15

Highest activities $\mathbf{A_{max}}$ of radionuclide $^{14}\mathbf{C}$ authorized for the laboratory of I. category

Material qualities and type of operation	$\mathbf{A_{max}}$ for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[Ci]	[MBq]	[mCi]	[MBq]	[mCi]
Standard	103	3	1 034	28	103	3
Handling of solutions	5 172	140	51 724	1 398	5 172	140
Volatile liquids	2	47	17	466	2	47

Highest activities $\mathbf{A_{max}}$ of radionuclide $^{32}\mathbf{P}$ authorized for the laboratory of I. category

Material qualities and type of operation	$\mathbf{A_{max}}$ for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[mCi]	[MBq]	[mCi]	[MBq]	[mCi]
Standard	19	507	188	5	19	5
Handling of solutions	938	25 338	9 375	253	938	25
Volatile liquids	3	8	3	8	3	8

Highest activities $\mathbf{A_{max}}$ of radionuclide $^{33}\mathbf{P}$ authorized for the laboratory of I. category

Material qualities and type of operation	$\mathbf{A_{max}}$ for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[Ci]	[MBq]	[mCi]	[MBq]	[mCi]
Standard	43	1	429	12	43	1
Handling of solutions	2 143	58	21 429	579	2 143	58
Volatile liquids	1	19	7	193	1	19

Highest activities A_{max} of radionuclide ^{35}S authorized for the laboratory of I. category

Material qualities and type of operation	A_{max} for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[Ci]	[MBq]	[mCi]	[MBq]	[mCi]
Standard	545	15	5 455	147	545	15
Handling of solutions	27 273	737	272 727	7 371	27 273	737
Volatile liquids	9	246	91	2457	9	246

Highest activities A_{max} of radionuclide ^{125}I authorized for the laboratory of I. category

Material qualities and type of operation	A_{max} for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[Ci]	[MBq]	[mCi]	[MBq]	[mCi]
Standard	4	116	43	1	4	116
Handling of solutions	214	6	2 143	58	214	6
Volatile liquids	71	2	1	19	71	2

Highest activities A_{max} of radionuclide ^{51}Cr authorized for the laboratory of I. category

Material qualities and type of operation	A_{max} for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[Ci]	[MBq]	[mCi]	[MBq]	[mCi]
Standard	1 667	45045	16 667	450	1 667	45045
Handling of solutions	83 333	2 252	833 333	22 523	83 333	2 252
Volatile liquids	27778	751	278	7508	27778	751

Highest activities A_{max} of radionuclide ^{55}Fe authorized for the laboratory of I. category

Material qualities and type of operation	A_{max} for standard workplace					
	Radiochemical Hood		Standard Hood		Laboratory Bench	
	[GBq]	[Ci]	[MBq]	[mCi]	[MBq]	[mCi]
Standard	65	1763	652	18	65	1763
Handling of solutions	3 261	88	32 609	881	3 261	88
Volatile liquids	1087	29	11	294	1087	29

ANNEXE II

Guidance levels of workplace surface contamination in laboratory of I. category

	^{3}H	^{35}S	^{33}P	^{55}Fe	^{14}C	^{32}P	^{51}Cr	^{125}I
Guidance level [kBq/100 cm^2]	30	30	30	30	3	3	3	3

ANNEXE III

Reference levels of surface contamination for monitoring laboratories of I. category

	^{3}H	^{35}S	^{33}P	^{14}C	^{32}P	^{125}I	^{51}Cr	^{55}Fe
registration level [kBq/100 cm^2]	3	3	3	3	3	3	3	3
investigation level [kBq/100 cm^2]	10	10	10	1	1	1	1	10
action level [kBq/100 cm^2]	30	30	30	3	3	3	3	30