

## MEMORANDUM

To: G. Daems, DSO AB; Ch. Hill, RSO AB; B. Pichler, SC-GS  
cc: H. Haseroth, AB-ABP; H. Kirk, Brookhaven National Laboratory;  
J. Aÿstö, Jyvaskylä University and INTC chairman;  
H.-G. Menzel, SC-RP  
From: Th. Otto, SC-RP

Conc.: Handling of irradiated mercury from a Hg-jet test experiment

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This memorandum focuses on the handling of a quantity of irradiated Hg (up to 10 litres) during and after its irradiation in a proton beam, irrespective of the place of the experiment's installation at CERN.

H. Kirk, one of the proponents of the experiment, estimated the residual activity of mercury with MCNPX, a standard Monte-Carlo program. In the model, the mercury jet was irradiated during 30 days with 200 proton pulses of  $1.6 \cdot 10^{13}$  protons each. The activity of those isotopes contributing at least 1% of the total activity after a waiting time of one month was calculated. The summed activity of these isotopes, 2.4 mCi (90 MBq), represents more than 50% of the total activity of the mercury at this time.

At CERN, unsealed radioactive sources with an activity exceeding the authorisation limit  $L_A$ , must be handled and stored in specially arranged work sectors in order to protect the workers and the environment. For a mixture of

$n$  isotopes, the numerical condition for free handling is  $\sum_{i=1}^n \frac{A_i}{L_{A,i}} < 1$ , where  $A_i$

denotes the activity of the  $i$ -th isotope in the mixture and  $L_{A,i}$  its authorisation limit. The limited selection of isotopes given in the compilation by H. Kirk after a waiting time of one month represent an activity of the 22-fold of the composite authorisation limit. The details of this assessment can be found in the appendix. Obviously, during the experiment and immediately after its end, the activity of all isotopes will be even higher.

There are two possible ways of action open:

- 1.) The area where the experiment shall be installed is converted into a work sector for unsealed radioactive sources.
- 2.) The experimental apparatus is qualified according to the technical requirements of International Standard ISO 2919 "Sealed Radioactive Sources - General Requirements and Classification".

In both alternatives, SC-RP can assist with giving information on the technical requirements for either the work sector or the experimental apparatus.

*Momas Otto*

## Appendix

Residual activity in a Hg jet target after 30 days of irradiation with 200 pulses of  $1.6 \cdot 10^{13}$  protons each and one month waiting time. Data courtesy H. Kirk, BNL

Isotope	Activity		Radiotoxicity	
	Ci	Bq	$L_A$	$A_i/L_{A,i}$
103 Rh	1.30E-04	4.81E+06	2.00E+09	0.00
105 Ag	2.00E-04	7.40E+06	6.00E+06	1.23
113 In	2.30E-04	8.51E+06	2.00E+08	0.04
113 Sn	2.30E-04	8.51E+06	3.00E+06	2.84
121 Te	2.30E-04	8.51E+06	2.00E+07	0.43
125 I	1.40E-04	5.18E+06	7.00E+05	7.40
127 Xe	1.40E-04	5.18E+06	3.00E+08	0.02
146 Eu	5.70E-05	2.11E+06	4.00E+06	0.53
147 Eu	6.50E-05	2.41E+06	5.00E+06	0.48
188 Ir	9.60E-05	3.55E+06	8.00E+06	0.44
189 Ir	1.70E-04	6.29E+06	1.00E+07	0.63
195 Au	3.10E-04	1.15E+07	4.00E+06	2.87
203 Hg	4.30E-04	1.59E+07	3.00E+06	5.30
<b>total:</b>	<b>2.43E-03</b>			<b>22.21</b>