Portable search devices of wide application on the basis of RSNS - Radioisotope Switchable Neutron Source

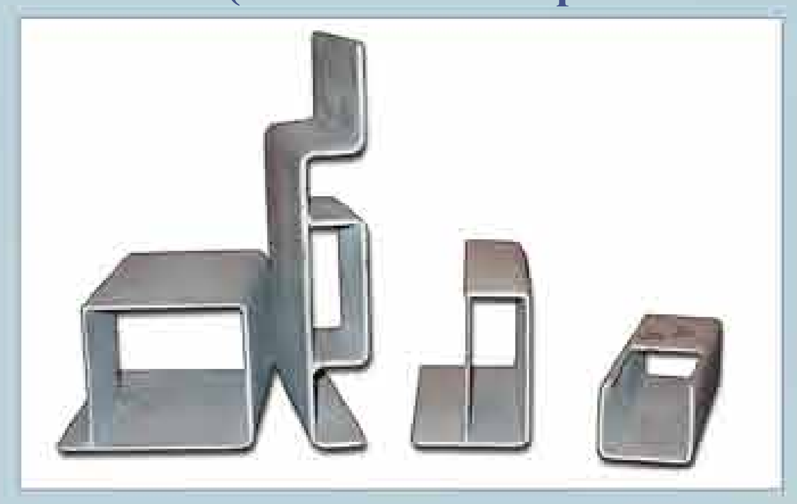
L. MESKHI, L. KURDADZE
NUCLEAR AND RADIATION SAFETY SERVICE OF GEORGIA. TBILISI, GEORGIA
E-mail: leri.meskhi@gmail.com

Despite development of hi-tech radiation complex monitoring systems of cargoes and luggage, the requirement for portable radio isotope search devices remains, for detecting of explosives, the drugs, highly enriched uranium etc. Such contraband often place in the hidden cavities, behind thick metal walls of vehicles - sea courts, cars, cargo containers etc.

On fig. 2 steel profiles of the latent cavities of the sea container are shown. The thickness of walls makes from 2,0 to 4,0 mm. The volume of these cavities in containers exceeds two hundred liters.

1

Among compact radio isotope devices of special, search appointment, it is allocated BUSTER K 910B (CSECO - Campbell Security Equipment Co) fig. 3. In the device the gamma-albedo a method with application of a radioisotope Barium-133 is used. It examine cars, trucks, walls of containers, fuel tanks, automobile tires, boats and ships etc., for detection of the hidden drugs, explosive material and other contraband.


2

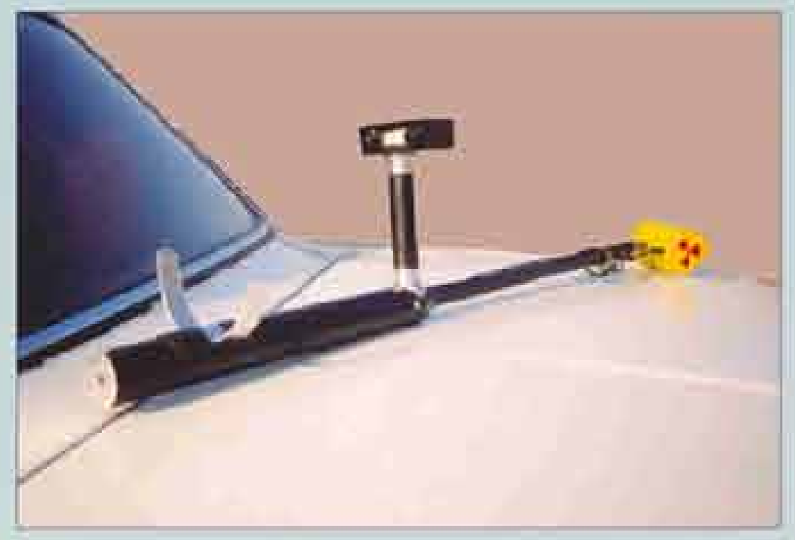

3

The successful design, good ergonomics and the provided radiating safety have caused the big popularity of these devices among customs officers and frontier guards more than 50 countries of the world. The basic lack of this device - a small thickness of barriers, no more 2,5 mm of a steel.

The neutron technique allows to find out confidently the explosive and narcotic substances hidden behind metal barriers in the thickness of 30 mm and more.

Prominent features of interaction of neutrons with substance, make neutron methods and devices NDT exclusive and often irreplaceable. Especially, when it is necessary to find out light substances behind thick-walled metal barriers.

However, the existing radio isotope neutron devices using traditional sources of neutrons, do not meet modern requirements of radiating safety for devices of wide application.


4

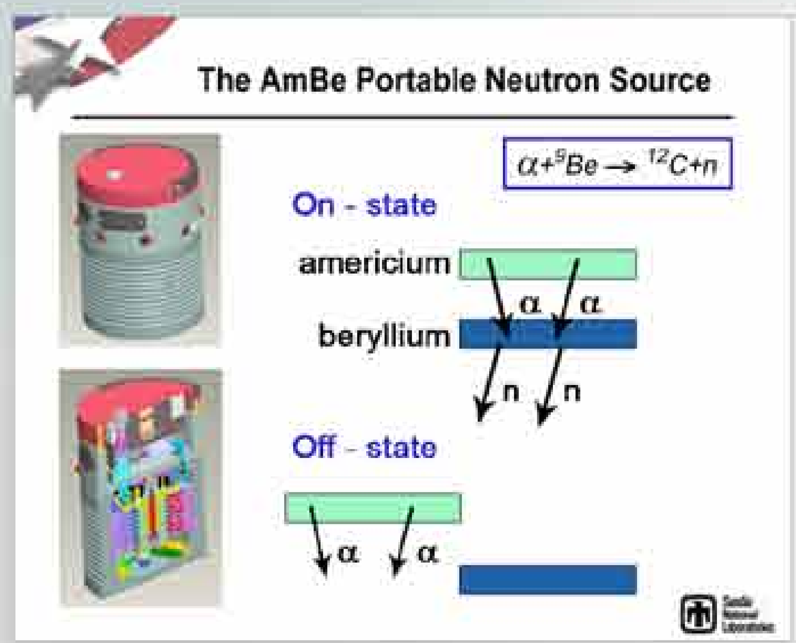

5


6


7

. . Developed by us in the beginning 90, for customs and boundary service of Georgia the neutron portable search device, with application Cf-252, is a prototype of the presented device (fig. 4,5,6,7).

For last two decades there was an essential progress in workings out of switched off sources of neutrons - radioisotope Switchable Neutron Source - RSNS and portable DD neutron generators. On fig. 8 the illustration of a physical principle of a switched off neutron source and realised in Sandia National Laboratories (Kristin Hertz) pulse SNS a source is presented.



8

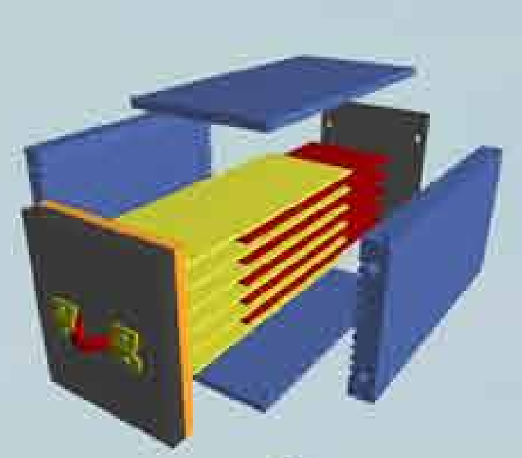
In a switched off isotope source it is necessary to bring in working position in contact an alpha a radiator and a target so that at deenergizing, they could be separated again, not having polluted one another. This requirement is fundamental to creation of a pure and reliable switched off neutron source.

Application SNS in portable search devices will provide radiating safety in a non-working condition - during transportation and storage. Creation of such sources can stimulate development of new generation NDT and multipurpose search-devices.

SNS developed in SNL generates a pulse stream of neutrons that is extremely important for synchronous detecting. But for this reason the source has turned out complex enough and, probably, enough expensive. In our project design SNS is as much as possible simplified (it is not required pulsed a stream of neutrons), switching on and off of source is carried out by a hand simple turn of the lever.

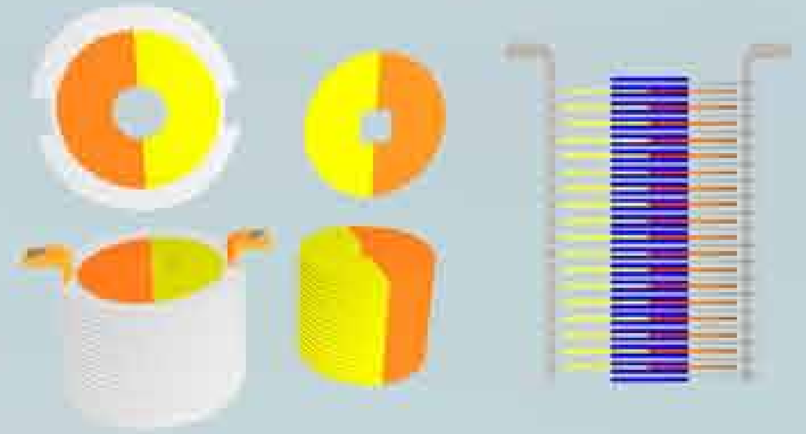
For maintenance of an yield of neutrons 2E5 n/s, the contact area of an injector and a target should make 120 cm2 for Am-Be pairs and 40 cm2 for Pu-Be pairs. The thickness an alpha of a radiating layer is sufficient 0.1-0.2 microns. Such thickness of a layer of a radiator makes approximately 10 % from size of the maximum run an alpha of particles in them. Alpha of particles Am-241 or Pu-238 allows to use it effectively about half.

Possibility to collect on layers the necessary contact area allows to create optimum geometry of a source box (fig 9) or the cylindrical form (fig. 10). In the first case switch on-off occurs displacement of a lateral wall to targets, and in the second - rotation of a package of disks on 180 degrees. The design case the scale of radiation of sources Am or Pu provides biological protection from accompanying soft gamma-rays.


9

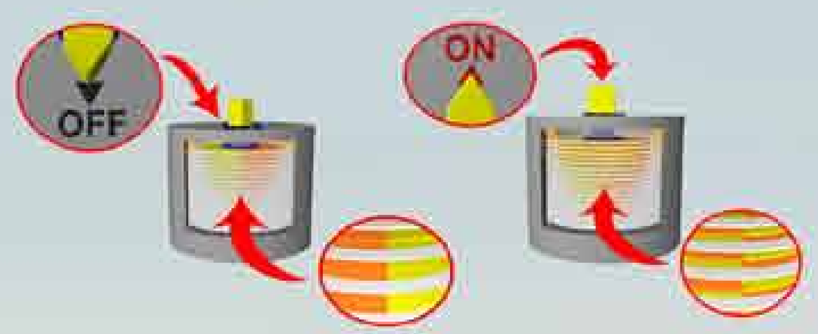

10

On fig. 11 are shown a set of disks static and rotating. Half of area of a disk covered two sides by an injector material, and other half - a target material. On fig. 12 are shown position of disks in the switched on and switched off position.

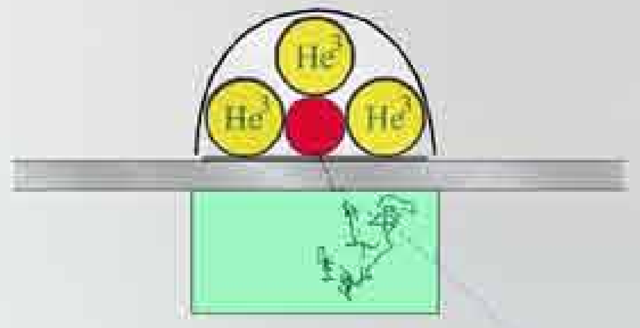

11

The sufficient an yield of neutrons, about 2E5 n/s, provides a source with dimensional in the sizes of the case approx Φ25x60 мм2.

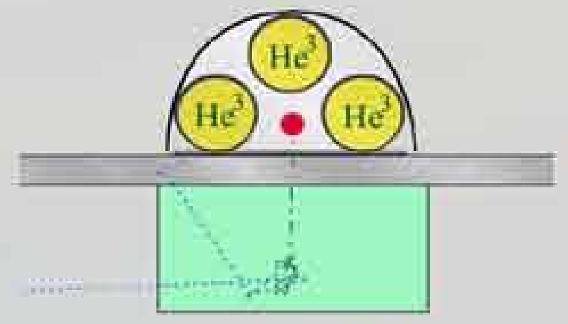
As a rule, when for contraband concealment their hidden metal cavities are used fill completely, i.e. the geometrical sizes of smuggling big enough. Therefore, rather big sizes SNS practically are not worsened sensitivity of the device. On fig.15 results of scanning (Monte-Carlo simulation) smuggling areas (polyethylene 10x10x5cм3) for thick (1.2 cm.) a steel wall the device with pointlike and with volume sources (a switchable source) are shown. From fig. it is visible, that results of scanning practically coincide. Proportions and conditions of calculation are given on fig. 13,14.



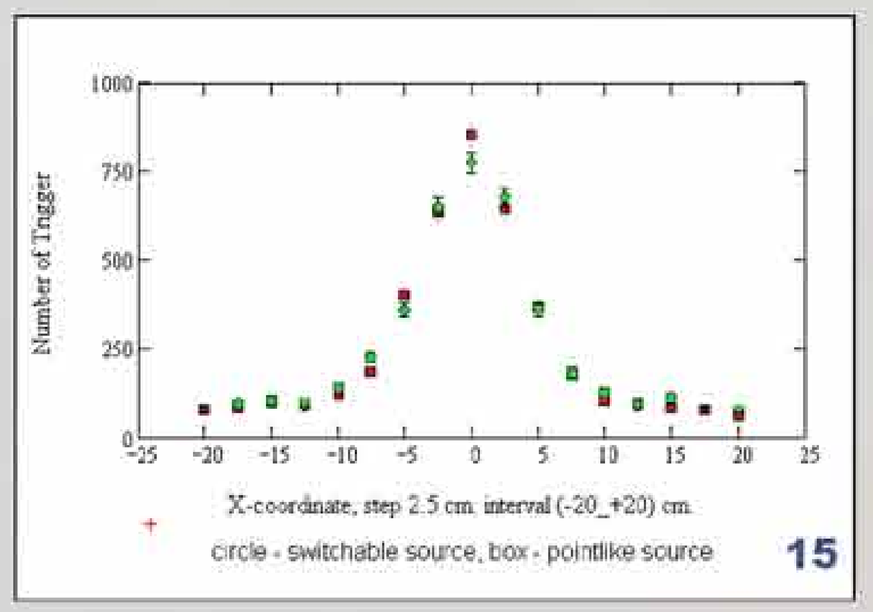
12



13



14



15

And in the conclusion, as Georgia has no nuclear technologies, for creation of a laboratory model of an included source, we require partners for manufacturing of injectors from Am-241 or Pu-238.