CERN TECHNOLOGY NOTE

## B54 THE ISOLDE TARGET AND ION-SOURCE UNIT

The assembly shown is a production target for radioactive nuclides, which is integrated with the ion source of an electro-magnetic isotope separator. In its different versions the apparatus yields an ion beam of one of the nuclear reaction produced elements shown in the table.

| Target material | Total weight (g) | Target element weight (g) | Temp. ($^{o}$C) | Product element |
|---|---|---|---|---|
| Sc-La alloy | 50 | 18 | 1300 | Ca |
| Sc-La alloy | 50 | 18 | 1300 | K |
| Sc-La alloy | 50 | 18 | 1300 | Ar |
| Y-La alloy | 60 | 50 | 1300 | Sr |
| Y-La alloy | 60 | 50 | 1300 | Rb |
| Y-La alloy | 60 | 50 | 1300 | Kr |
| La | 70 | 70 | 1400 | Ba |
| La | 70 | 70 | 1400 | Cs |
| La | 70 | 70 | 1400 | Xe |
| Th-La alloy | 98 | 30 | 1400 | Ra |
| Th-La alloy | 98 | 30 | 1400 | Fr |
| Th-La alloy | 98 | 30 | 1400 | Rn |
| U-Cr alloy | 190 | 182 | 1300 | Ra |
| U-Cr alloy | 190 | 182 | 1300 | Fr |
| U-Cr alloy | 190 | 182 | 1300 | Rn |
| Gd-La alloy | 96 | 90 | 1400 | Eu |
| Gd-La alloy | 96 | 90 | 1400 | Sm |
| Lu-La alloy | 90 | 59 | 1400 | Yb |
| Lu-La alloy | 90 | 59 | 1400 | Tm |
| Ge | 134 | 134 | 1100 | Zn |
| Sn | 203 | 203 | 1100 | Cd |
| Pb | 270 | 270 | 700 | Hg |

The system was developed for use with the reconstructed ISOLDE (Isotope Separator On-Line) facility near the 600 MeV Synchro-cyclotron (SC). This project, intended for the study of the nuclear properties of short-lived nuclides by means of several new techniques, is further described in Technology Note B53. The key problem in such an on-line machine is that of target and ion-source technology related to the methods for obtaining a continuous liberation of carry-free nuclides from large amounts of target material.

**Target and ion-source unit**

A schematic view of the target and ion-source assembly is shown in Fig. 1. The target material is contained in a cylindrical container clamped between two cooled electrodes and placed axially in the proton beam. In order to speed up the liberation of volatile reaction products, the target material is heated to above its melting point by ohmic losses from an alternating current of typically 1000 A. A stirring action obtained by an electromagnetic field at a right angle to the current path in the target (magnet now shown) gives in some cases a further increase. By means of a short side-tube kept at a temperature of 800-1500°C by ohmic heating, the volatile products are taken to the ion source of the electromagnetic isotope separator.

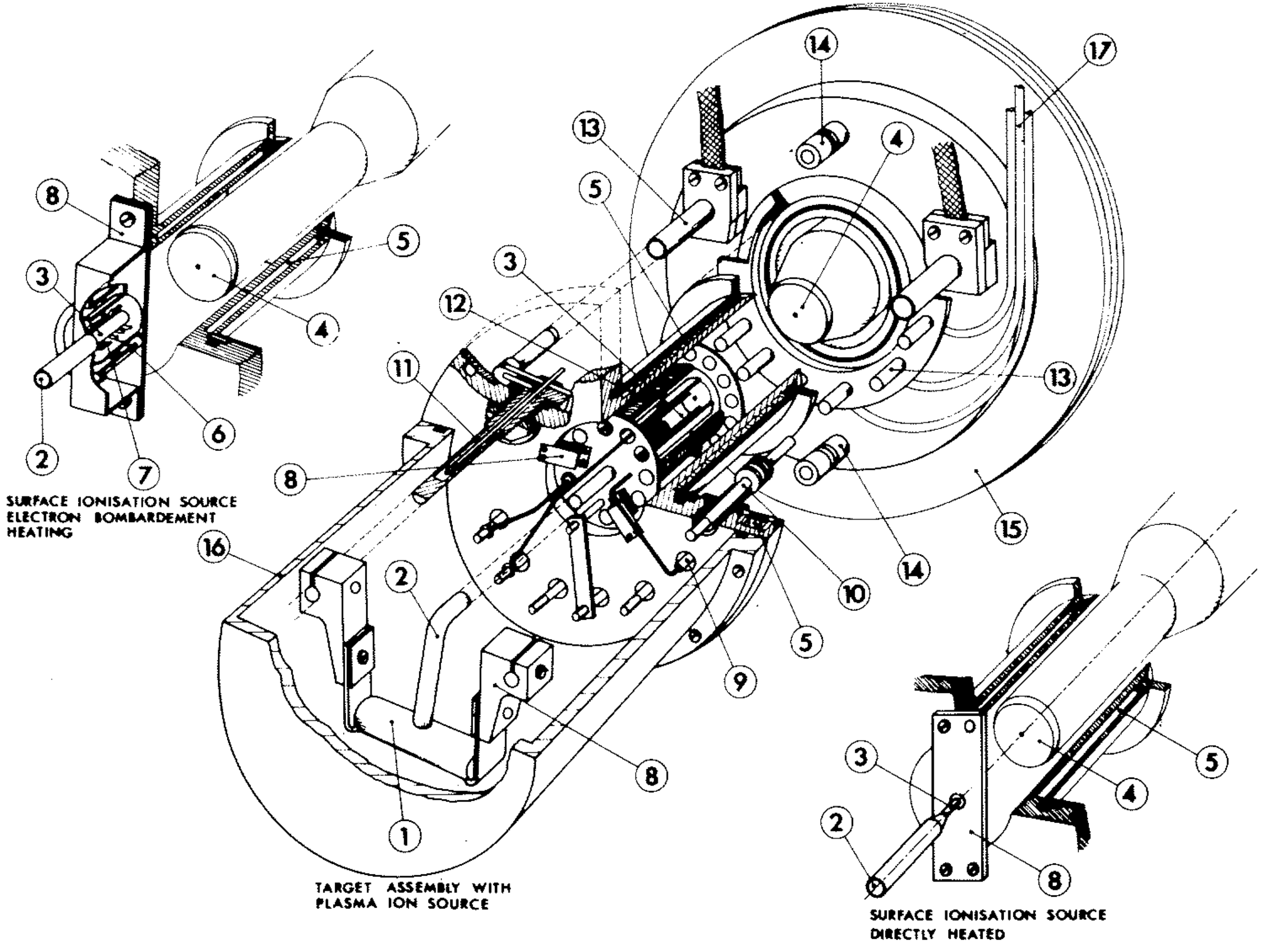
Containers for the extremely corrosive target metals presented a particular problem. Only by the choice of low-melting alloys combined with uniformly heated containers made of tantalum, tantulum carbide, or graphite, have container lifetimes of the order of 100 hours been reached.

In most cases several product elements are released from the target, but by proper choice of the type of ion source and the temperature on the transfer line a selective ionization of only one element has been obtained. For this purpose two new, surface ionization type, ion sources have been developed. Built into the unit shown in Fig. 1 is the plasma-type ion source used for ionizing elements with ionization potential > 7 eV. A surface ionizer heated by Joule effect, which allows temperatures up to 1700°C for ionizing the alkalis and the alkaline earths, is seen in the lower inset of Fig. 1. The constriction at the end of the transfer line serves as the ionizing surface. The upper inset of Fig. 1 illustrates the high-temperature surface ionization source developed for the rare earth target version. The ionizing surface is here made up of a rhenium tube (m.p. 3180°C) prolonging the transfer line and heated to ∿ 3000°C by means of electron bombardment from a surrounding filament.

The target and ion source are enclosed in their common vacuum container, which carries on its front all the necessary supplies in the form of quick connectors. By means of a mechanism, which is not shown here, the whole assembly can be connected or disconnected from the separator by remote control.

Further information can be obtained from H. Ravn, S. Sundell, NP Division, CERN.

12 February, 1974.




1. Target container
2. Target-to-ion-source transfer line
3. Ion source
4. Extraction electrode
5. Water cooling
6. Heat screens
7. Cathode for electron bombardment
8. Ion-source ground terminal
9. Gas inlet
10. Low-current feed-through
11. Water-cooled high-current feed-through
12. Ion-source magnet
13. Electrical plug-in connectors
14. Water-cooling connectors
15. Separator HV insulator
16. Target vacuum chamber
17. Electrical cables

Fig. 1 Target and ion-source assembly with insets showing the two different thermal ion-sources.