peak plate is 2.1%/yr, with about 1.1%/yr due to fission. Comparing with conventional reactor fuel elements, a target lifetime in excess of four months can be expected.

TABLE I

GROWTH STUDIES FOR URANIUM PLATES

| Nominal U thickness | Fabrication | ℄ Temp (°C) | No. of Cycles | Total Growth | Growth /mm for $10^6$ cycles |
|---|---|---|---|---|---|
| 1 mm | HR | 350 | $10^6$ | nil | nil |
| 1 mm (same plate) | HR | 500 | $10^6$ | 5 | 5 ± 1 |
| (repeat same) | HR | 500 | $10^6$ | 5 | 5 |
| 2 mm | HP | 500 | $10^6$ | 17 | 8.5 |
| 2 mm | HP | 500-250 | $10^6$ ($0.25 \times 10^6$) | 4 | — |

B. SNS Target Station and Shutters, A. Carne, RL

1. Target Station

The SNS target station has been designed to reduce the radiation at the outside surface of the bulk shield to less than 0.75 mrem/h. The shielding will, however, be weakened by the proposed 18 neutron-beam tubes serving the instruments in the experimental areas. The bulk shield will be a massive structure of mainly iron and concrete; nevertheless the proposed conceptual design has the flexibility to meet future experimental requirements which may call for changes in beam-tube layout within the bulk shield. Within the bulk shield each beam tube will be terminated by a shutter.

The bulk-shield dimensions have allowed for the angular distribution of fast neutrons emerging from the target. For a solid ($10 \times 10 \times 30$ cm$^3$) uranium target the following shielding thicknesses have been obtained:

| | | | |
|---|---|---|---|
| to beam direction | 0° | 3.2-m Fe + 1.5-m concrete, | total 4.7 m |
| | 90° | 2.7-m Fe P 1.0-m concrete, | total 3.7 m |

To these dimensions are added 0.4-m Fe (1 TVL) to anticipate possible future trends in permissible dose rate.

The target assembly is contained within a "void vessel" of 1.5-m radius, this dimension being set by the requirement to have 18 neutron beam ports each of about 20-cm width. The atmosphere within the void will be helium, at reduced pressure.

The overall radius of the target station at the nominal 90° direction will then be 1.5 m + 3.7 m + 0.4 m = 5.6 m. However, for instrument design purposes, this radius will be taken to be 6.5 m to allow the addition of loose shielding and services. A rough plan of the target station is shown in Fig. II-B.1. At the outer region of the bulk shield (radius 3.5 m to 5.6 m) the neutron beam tubes will be contained within inserts into the shield, in a pill-box fashion as shown in Figs. II-B.2 and II-B.3. These inserts will be fabricated off-site and will enable accurate construction and alignment into the shield. The nominal angle between beam tubes is 18°, however the insert system will allow any beam tube to be moved to view any moderator within the target assembly.

2. Beam Shutters

In the inner region of the bulk shield (radius 1.5 m to 3.5 m) will be a system of vertically operated shutters. Each shutter will be 2-m deep by 0.4-m wide (75% Fe and 25% concrete) and will lie along radii with the target at center. With a shutter closed the radiation dose rate in the beam tube at 10 m from a wing moderator will be reduced from ~ $10^4$ rem/h to 2.5 mrem/h. The nominal aperture in the shutter is 20 x 20 $cm^2$ which will allow the flexibility mentioned above.

Collimators inserted within this aperture will be determined by instrument requirements.

The height of each shutter is nominally 4.5 m, in 3 sections the center one of which carries the beam aperture. The total weight of each shutter is about 20 tons. The large height of the shutters places the shielding voids at the top and bottom well away from the radiation source to reduce the shield weakening. The shutters will be operated hydraulically, or perhaps by simple mechanical means from the top of the target station and alignment tolerance of $\pm$ 0.1 mm can be easily met.

The shutters are basically plain rectangular boxes, guided by roller systems. They are thus not expected to lead to jamming problems (for example, against the shielding wedges between each shutter). If a shutter needs to be removed (possibly to replace a collimator) it can be removed piece by piece vertically. Thus no disturbance is caused to the experimental set up on the floor of the hall.

In operation, the shutters are fail-safe, the vertical fall required to completely close off a beam being less than 15 cm. If a shutter is closed for any reason the other beam tubes are unaffected.

The shutter systems are contained in annular shaped vessels (see Fig. II-B.3), and the atmosphere is again helium (but at slightly greater pressure than the void vessel). Thus, two windows are required. Neutron beam loss due to these windows and the helium gas is less than 2.5%. Access to the windows is possible through the shielding insert. To reach the inner window the shutter will be lifted above the window height. Remotely operating jigs are being designed to do this function.

The shutters will be cooled by circulating the helium gas in the vessels. Installation of the target station is scheduled to begin in September-October 1979.

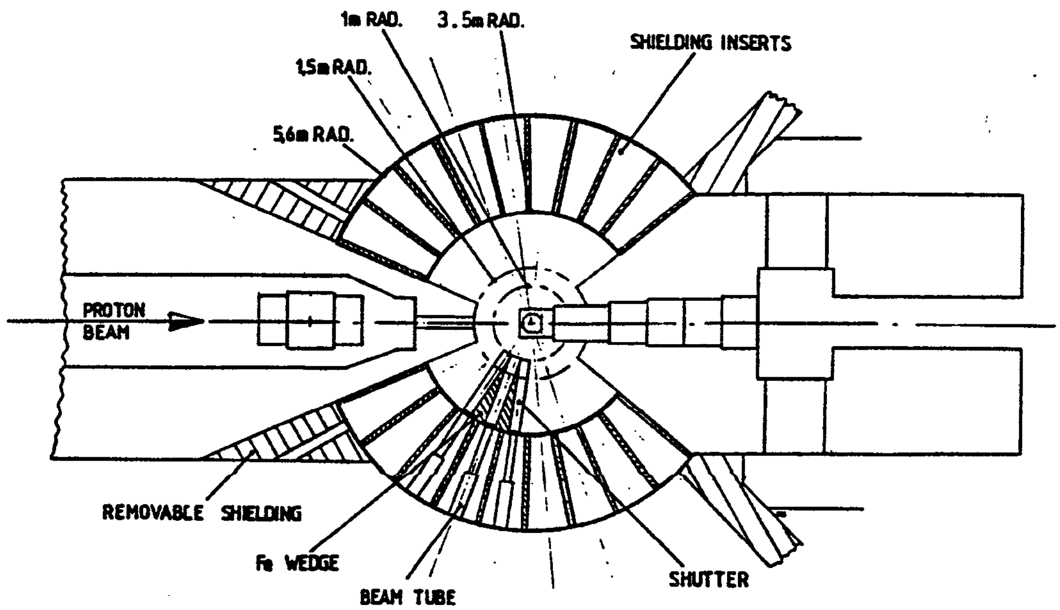


Fig. II-B.1. Target station layout showing shielding insert and shutter system.

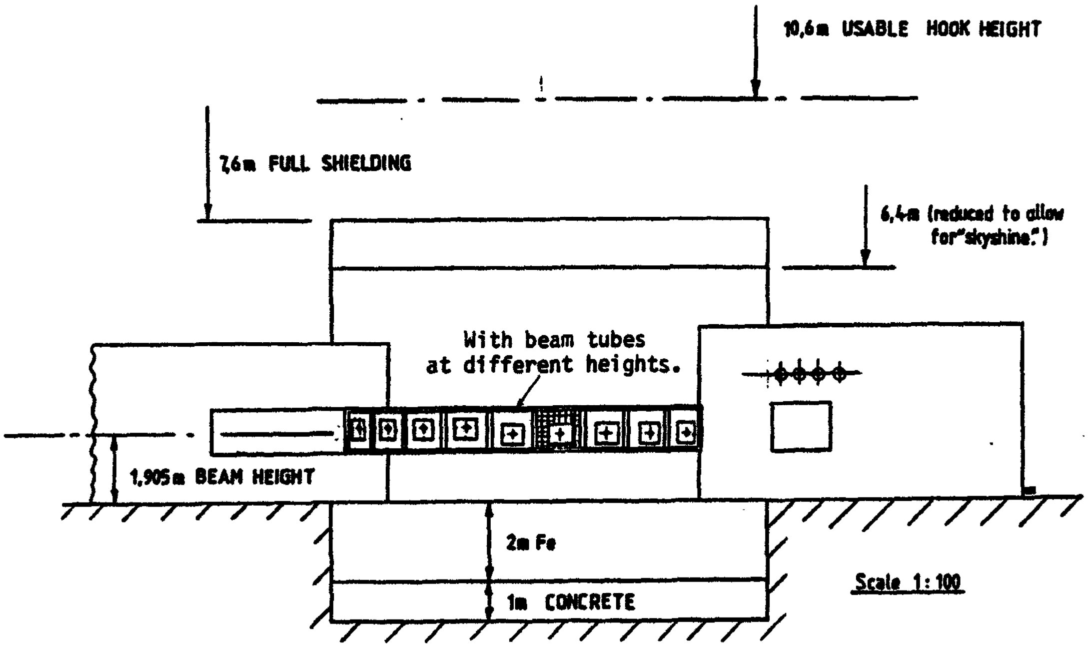


Fig. II-B.2. North side elevation of target station.

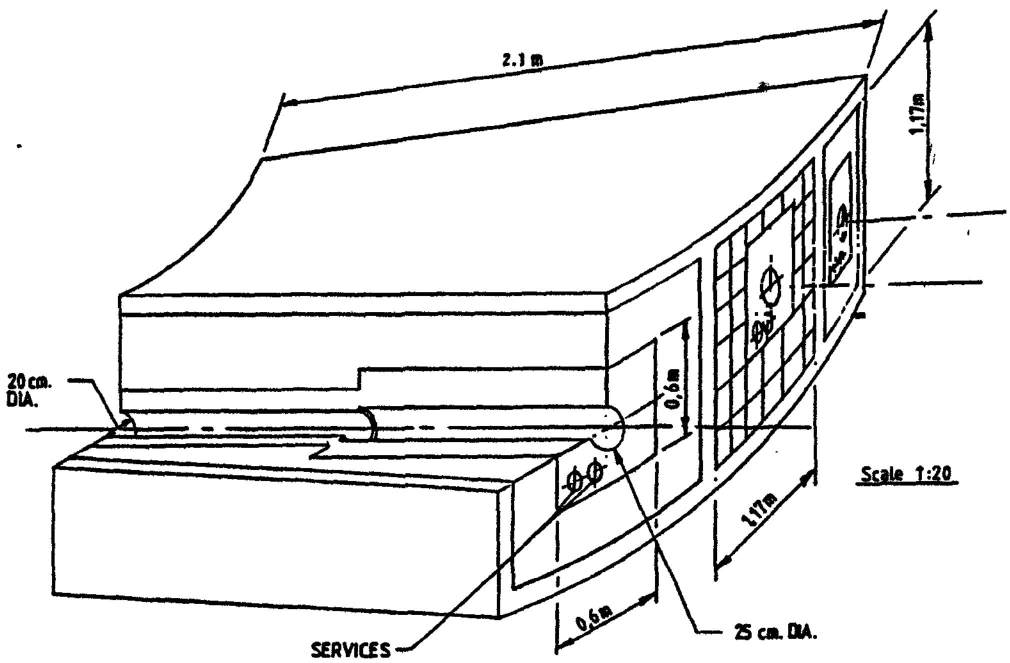


Fig. II-B.3. Cutaway view of a typical sector unit.