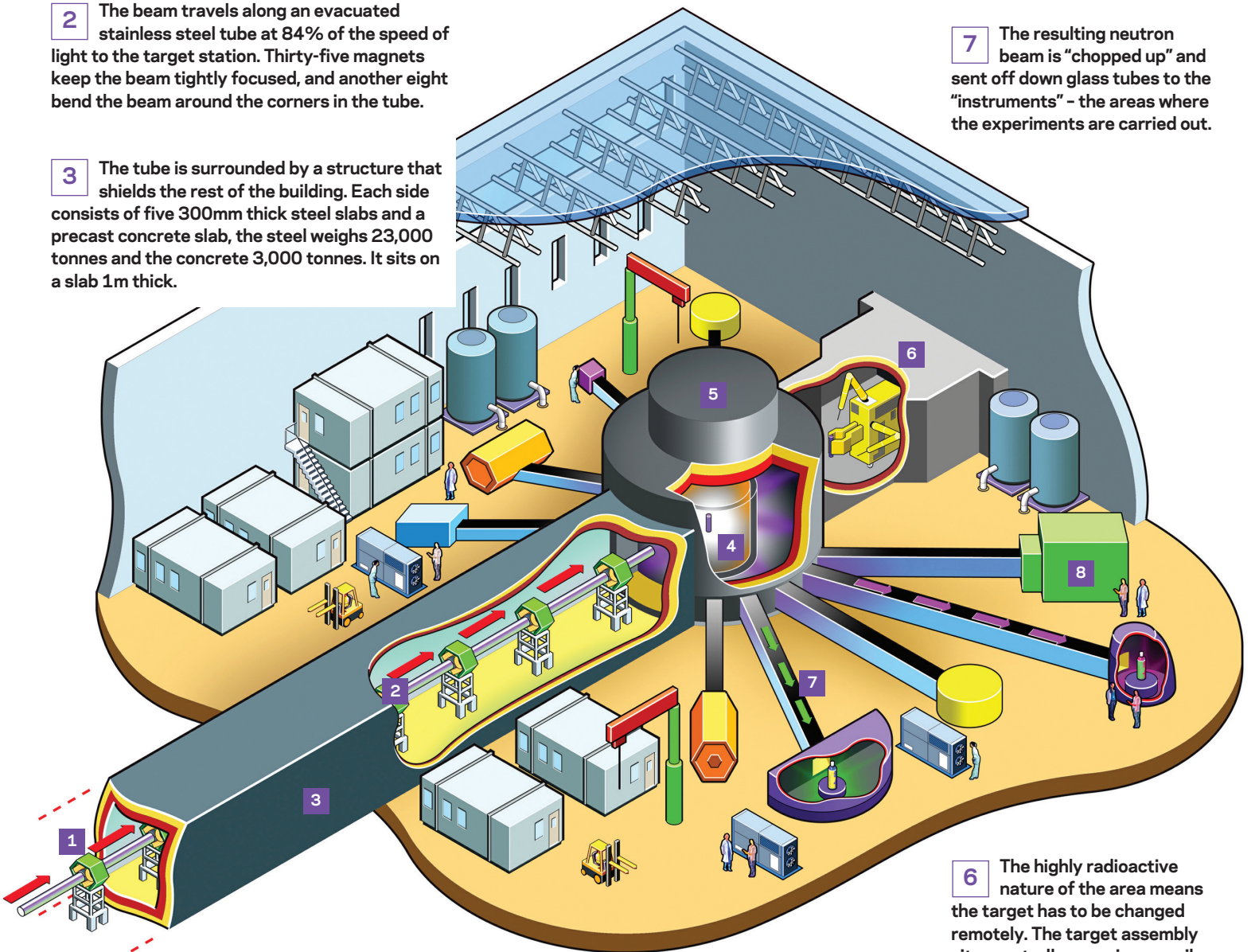
How it works

1 The existing synchrotron, or protron generator, in the neighbouring building produces a proton beam. This will be shared between the old and new target stations. The beam emits 50 pulses a second.

2 The beam travels along an evacuated stainless steel tube at 84% of the speed of light to the target station. Thirty-five magnets keep the beam tightly focused, and another eight bend the beam around the corners in the tube.

3 The tube is surrounded by a structure that shields the rest of the building. Each side consists of five 300mm thick steel slabs and a precast concrete slab, the steel weighs 23,000 tonnes and the concrete 3,000 tonnes. It sits on a slab 1m thick.



4 The proton beam strikes the target, which is housed inside a structure called the monolith. The target is a piece of tungsten the size of a packet of digestive biscuits, and has to be kept cool using deuterated water (that is, water made from an isotope of hydrogen). It lasts for five years. The target is surrounded by a water-cooled beryllium reflector.

5 The monolith is 12m high and 7.5m in diameter. It contains 5,000 tonnes of steel which make up 4m of the walls, and is encased in a further 1m of concrete weighing 1,000 tonnes. Another 1,000 tonnes of concrete is used to shield the floor. Some 1,700 pieces of individually shaped pieces of steel are used. Each piece is either cut on site using a computer numerical controlled oxyacetylene cutter or specially cast.

6 The highly radioactive nature of the area means the target has to be changed remotely. The target assembly sits on a trolley running on rails. When it is time for maintenance, this is wheeled into an area behind the target where robotic arms are used to change the target. The cooling equipment sits on another trolley behind the target and can be maintained in the same way.

7 The resulting neutron beam is "chopped up" and sent off down glass tubes to the "instruments" – the areas where the experiments are carried out.

8 The instruments are arranged radially around the monolith. Seven are being installed but there is capacity for 18. The quality of the neutrons varies depending on what each instrument is designed to analyse. The second target station is principally being used to analyse "soft" materials. It will be used for life sciences, plastics and special coatings, such as those used on glass. The instruments have boron and wax-filled steel blocks that protect the scientists from radiation.