

In the mid-1960s a secret nuclear research facility was built around a remote inlet on the Russian Arctic coast. Shortly before the break-up of the Soviet Union decommissioning of the facility commenced and. Due to its remote location, and a lack of road access, it was decided to transport these drums to a reprocessing site by sea through the use of. The drums were loaded onto the barge where, due to the political and economic turmoil of the time, they were left and forgotten until 2013. After successful removal of the drums it was decided by the authorities that remediation of the rest of the plant should be undertaken and, after initial site surveys, two steel skips containing fissile materials were removed from the site yard, two waste dumps were cleared, and a fuel pond was emptied.

Adjacent to the main facility building, in a separate building, is a metal machining and recovery lab. This lab was used to recover and machine plutonium that is (originally) from natural uranium metal fuel rods irradiated in a graphite moderated reactor. This lab was in use from 1964 until abandonment of the site. The lab had low throughput and there is no criticality alarm system in place. Previously, during operations, neutron monitors were used when handling fissile materials. The nine metre square, six metre high lab was on the ground floor and had 30 cm thick floors, walls and ceilings. The site was susceptible to flooding of no more than 6" at a frequency of once per decade.

In the middle of the lab, surrounded by a steel mezzanine, and accessed (to fill) by a ladder, there is a batch dissolver. Made of 1" thick 316 stainless steel, this 60 cm diameter, Teflon-lined, dissolver is mounted on four, 2" diameter steel legs (located on a 90 degree pitch), as shown in Figure 2. The dissolver has a lid which can be removed and repositioned using a block and tackle (not shown), mounted directly above. When used previously, decanting of fissile liquors from the dissolver was accomplished by opening a valve (tap) at the bottom of the dissolver (flow under gravity). Debris was removed from the liquor by use of a filter placed between it and the receiving container. This dissolver currently remains half-filled with liquid (assumed to be nitric acid, potentially bearing fissile material) and the lid remains in place. Inspection indicates that, over time, debris has settled at the bottom of the dissolver. Directly beneath the dissolver is a spherical, Teflon-lined 180 cm diameter, 1" thick walled, stainless steel sump. The sump is filled to the top with borosilicate glass Raschig rings with diameter and height both 4 cm. The glass wall thickness is 0.5 cm. Spillages have accumulated in the sump over the many years of use although the waste volume or evaporation rates are not known. Access to the sump is via a 15 cm diameter drain from a sloped floor. The sump is buried in the ground beneath the floor. Previous experience showed that soluble boron was frequently used on site and that solutions with concentrations <1 kg/L plutonium nitrate were often present. The total fissile mass in the lab is not known.

The dissolver is scheduled for demolition and hence it, and the sump, needs to be drained and decontaminated. A chemical waste removal company has tendered for the work. The proposed process is to drain the sump into the dissolver using a binda-super-lario-b-piston-hand-pump and a 2" diameter nylon hose. This will be diluted with light water as required. The dissolver will then be drained in the normal way into any number of 15 cm diameter, 30 cm tall flat-topped polypropylene bottles (each of which has a 1" diameter, 1" tall cap protruding from its top). The waste engineers propose transporting the filled bottles from site in 45 x 30 x 35 cm cardboard boxes. They propose stacking these boxes three high, starting in the corner, in the north east corner of the room. As the bottles are filled, the process states that they are immediately placed into a cardboard box. Due to difficulties in shipping, the timetable for removal of the fissile waste from the room is not known and hence you should assume that the boxes will remain in position throughout.