hydrogenous layers is insignificant.

A similar picture is obtained if the hydrogenous material is intermixed with the reacting material. If the hydrogenous material is present in sufficient bulk to slow down neutrons to thermal energies before they escape then a very small concentration of 25 is sufficient to give fission with a large fraction of these slow neutrons. Thus a chain reaction may be sustained.

If the material is in the shape of a hollow sphere of about 2 or 3 mm thickness, then the principal modification of Eq. (13) is in the small correction terms. Hence the outer radius will be approximately the same as for a solid sphere. As a result much smaller masses will become chain reacting. It must be remarked that these smaller masses will not become smaller (few hundred grams) than the masses needed to sustain a chain reaction in a water solution (discussed below). If a mass of the same order of magnitude as that obtained immediately above has a planar shape of some 5 mm thickness and is surrounded by a sufficient amount of hydrogenous material, the material will sustain a chain reaction.

According to calculations of Oppenheimer, Serber, Christy, and Wheeler a few hundred grams of 25 dissolved in a few liters of water are sufficient to give a chain reaction. Actually such small amounts become chain-reacting only if the solution is surrounded by pure water which serves as a reflector. But even if such a reflector is absent about 3 kilograms of 25 dissolved in about 50 liters of water will be probably chain-reacting. Even in the vapor state, chain reaction may take place if the tank is surrounded by hydrogenous materials. If we set

ν the number of neutrons per fission
γ the average albedo of fission neutrons on the hydrogenous wall
λ the fission mean free path of the reflected neutrons in the chain reacting gas
R the radius of the tank containing the chain reaction gas

The critical condition becomes

$$\nu\gamma\left[1 + \frac{\lambda}{R} e^{-2R/\lambda} \left(1 + \frac{\lambda}{2R}\right) - \frac{\lambda^2}{2R^2}\right] = 1$$

For ν we have the fairly reliable value 2.2. The albedo γ is more uncertain but may be estimated as 0.55. Therefore, the chain reaction will set in for $R \approx 1.5\,\lambda$. The mean free path λ is inversely proportional to the density of the gas, to the fission cross section and to the isotopic abundance x of 25. If we set the density equal to that of an ideal gas at NTP and use for the cross section the observed thermal fission cross section 600×10^{-24} cm^2, then λ in pure 25 is 60 cm and the critical radius becomes 90 cm. Of course, not all the neutrons reflected from the walls will have thermal velocities and thus the actual fission cross section will be smaller. In addition, the gas to be used is of a smaller density. Therefore, the actual critical radius will be several meters.