No Back Room A-Bombs

Details of Dutch gas centrifuge process show the method won't produce bomb-quality uranium in secret—or very cheaply either

For eight year, the U.S. has kept the lid on a supposedly cheap and easy way to produce uranium for nuclear fuel—and nuclear bombs. Research on the method in Holland and Germany was kept secret, by agreement with the U.S., where it is also highly classified.

The lid may be coming off, but proliferation is not around the corner.

Recent Dutch advances in the method —which uses a centrifuge to separate fissionable uranium 235 from its heavier isotope U-238—have led to plans to build a centrifuge plant, along with political pressure to break the eight-year-old secrecy agreement.

But technical details of the Dutch project reveal that the method is hardly likely to be useful to a small country that wants to build a cheap nuclear bomb secretly. Despite fears in Washington and other nuclear capitals, and hopes among nuclear have-nots, fissionable bomb materials would still be prohibitively costly, and the plants would be too big to hide.

The centrifuge technique aims at separating precious uranium 235 atoms, which make up less than one percent of natural uranium, from the rest—the slightly heavier uranium 238. U-235 splits or fissions easily in a reactor or bomb; U-238 doesn't.

In the centrifuge, uranium in the form of gaseous uranium hexafluoride is whirled at tremendous speeds—about 50,000 revolutions per minute in the projected Dutch process. The heavier atoms are thrown out farther than the lighter U-235 atoms, so the two kinds are separated like milk and cream in a dairy separator.

The centrifuge should have some advantages over the present-day gaseous diffusion process, in which the hexafluoride gas is driven electrically through porous membranes, with the U-235 passing through the membranes more easily than the heavier isotope. Gaseous diffusion requires thousands of stages, millions of kilowatts of electricity and acres of land.

Centrifuging requires stages too: Despite the advances, and the four-inch diameter of each centrifuge, the Dutch plant would need, depending on desired end-product purity, between 10,000 and 100,000 centrifuges, hooked together in a cascade, to produce enriched uranium. That kind of installation just isn't adapted to a kind of cottage industry producing bomb-quality uranium in secret.

What's more, there isn't much room for cost reduction, no matter what the process, according to nuclear consultant Dr. Ralph Lapp. This is because about half the cost of producing bomb-quality uranium is in supplying the uranium hexafluoride itself.

According to Dr. Lapp's estimates, a pound of uranium consisting of 90 percent U-235—the purity required for A-weapons—costs about $4,700 in gaseous diffusion plants, including ore, power, plant amortization, labor and administrative overhead. Of this, $2,300 goes for the uranium hexafluoride itself. Another $900 pays labor and overhead. Paying for the plant over a 30-year period—a practical course for gaseous diffusion plants, but not so certain in the centrifuge process—would add another $500 a pound. Ten pounds would produce a 20-kiloton, Hiroshima-sized bomb.

In the centrifuge-diffusion contest, electric power represents a potential saving. Dutch project leader Dr. Jacob Kistemaker estimates that his plant will draw only 1,000 to 10,000 kilowatts of power.

This is only 100 watts per centrifuge, a large reduction from U.S. ultra-centrifuges used in biological research, which draw about 400 watts running at comparable speeds.

Comparison with gaseous diffusion power requirements is difficult because there is no indication how much U-235 the Dutch plant would produce. The U.S., in its three giant diffusion plants, can swallow 6,000 megawatts of power.

The more comparable Chinese diffusion plant draws 150,000 kilowatts. Assuming that the Dutch centrifuge plant would produce as much uranium—and there's no indication that it would be any where near that effective—this would reduce the power costs by about $900 per pound. While significant, this optimistic figure is dwarfed by the high original cost of uranium ore.

The much smaller power requirements of the centrifuge would be important to a small country that didn't have the huge generating capacity necessary for diffusion plants. But since clandestine centrifuge plants seem out of the question, a more practical route for a country that openly planned to develop A-weapons would be by nuclear power reactors. A by-product of reactors is plutonium 239, which is also good material for atomic bombs.

A country that aspired to become a super-power, with hydrogen bombs, couldn't use the plutonium route, since H-bombs seem to require U-235 as a trigger. But here, the centrifuge method seems less practical than obtaining U-235 on the black market, possibly from China.

If the centrifuge is used to produce fuel for nuclear reactors, the cost picture changes. This is because reactors need only three percent U-235, which means that the amount—and cost—of the uranium hexafluoride is much less.

The Dutch are excited about the centrifuge because it looks like a way to give them reactor-quality uranium without having to ask the U.S. for it, and without having to invest in the French gaseous diffusion plant at Pierrelatte.

Among the advances announced by the Dutch engineers are electronic transformers using power transistors that produce a 1,000-cycle per second current. The high frequency power allows reduction in the size of the centrifuge motor, but it doesn't reduce power needs.

The Dutch researchers have also developed metals for bearings resistant to the strong corrosive effects of the fluorine in the uranium hexafluoride, and mastered the problem of channeling the gas stream into and out of the centrifuge. Steel is used for the centrifuge drums and protective shielding.

Costs of the plant have been estimated as between $80 million and $200 million. The latter figure is estimated to be about what the Chinese paid for their gaseous diffusion plant.