NUCLEAR ENERGY AND BOMBS:
A BRIEF HISTORY OF EFFORTS TO GET ONE WITHOUT THE OTHER

VICTOR GILINSKY

JANUARY 2015

THE PROBLEM WAS FRAMED AT THE BEGINNING: 1946 ACHESON LILIENTHAL REPORT

A-L Report: "*The development of atomic energy for peaceful purposes and the development of atomic energy for bombs are in much of their course interchangeable and interdependent*. . ."

- Enrichment technology (typically centrifuges) to produce low enriched uranium reactor fuel can also produce explosive *Highly Enriched Uranium*.
- Reprocessing of spent fuel coming out of a reactor extracts *Plutonium,* a fuel and an explosive.

The A-L Report: international inspection was not enough to protect these activities from misuse. If they were carried on by individual countries,

"*the chances for safeguarding the future are hopeless*."

A-L REPORT PROPOSES INTERNATIONAL MANAGEMENT

The international approach to nuclear energy use was politically unrealistic, and the proposal died.

An unfortunate residue remained: The report introduced the idea that plutonium produced in power reactors—unlike that from military production reactors—was "denatured" and intrinsically unusable for bombs.

This is wrong, at best a half truth. This was known at the time. But the tremendous desire to make use of nuclear energy submerged the concerns about the inadequacy of protection against misuse.

That has been the pattern ever since.

FROM ONE EXTREME TO THE OTHER: ATOMS FOR PEACE

In 1954 the US switched policies and launched Atoms for Peace to distribute nuclear technology with minimal supervision—the exact approach the 1946 Acheson-Lilienthal Report rejected.

US motives combined idealism and political calculation—using nuclear technology to gain advantage in the Cold War.

IAEA was created in 1957 to promote nuclear energy, and to inspect to ensure ("so far as it is able") that projects were not used for bombs. Initially, the mild inspections really served to legitimize nuclear trade rather than protect it.

There have been substantial upgrades in IAEA inspection and in national export controls, but basically we—at least the US—remain in the Atoms for Peace mode: the priority is global nuclear energy use, with protection following as best it can.

1968 NONPROLIFERATION TREATY DISCOURAGES BOMBS: ARTICLE IV ENCOURAGES "PEACEFUL USES"

To gain wide adherence, the NPT included "the inalienable right of all the Parties" to peaceful nuclear technology.

It was meant to be in conformity with NPT's basic bomb prohibitions—but where to draw the line on what is allowed short of a bomb has remained contentious.

Initially, any activity subject to IAEA inspection was considered peaceful, including production and use of HEU and plutonium.

The NPT was in fact written so as not to interfere with commercial plutonium use. The Germans and Japanese specifically insisted on limitations on IAEA inspections.

THE ULTIMATE DREAM: PLUTONIUM-FUELED FAST BREEDER REACTORS

At that time, it was widely assumed uranium was scarce. So you could not rely for long on current reactors that burn less than 1% of natural Uranium (0.7% U235, 99.3% U238).

For the long term, you had to convert inert U238 into plutonium, extract that by reprocessing, and use it to fuel Fast Breeder Reactors—that would "breed" more plutonium than they burn—and provide essentially limitless fuel.*

It's a captivating idea, but it also requires that reprocessing would be sufficiently cheap, and that FBRs would be reasonably cheap to build.

All these economic assumptions proved to be wrong. But the belief in the ultimate need for plutonium-fueled reactors entered the nuclear community's DNA, and remains there.

IAEA "SAFEGUARDS" WERE SUPPOSED TO PROTECT PLUTONIUM

Using plutonium commercially was supposed to be OK because the IAEA "safeguard" would protect against diversion through "deterrence of such diversion by the risk of early detection."

The trouble is, the IAEA itself estimated that separated plutonium or HEU could be put to bomb use *within a week*. In this case there could be no meaningful early detection—early enough to prevent the illicit action—and thus no safeguarding.

The distinction between inspection and real safeguarding got blurred. The IAEA claim that it can safeguard plutonium and HEU their production facilities, lent legitimacy to their "peaceful" label, and their acceptability under NPT's Art. IV.

INDIA'S 1974 BOMB MARKED TURN IN NONPROLIFERATION

In 1974 India tested a bomb despite "peaceful use" pledges to Canada and US. Supplier states realized a country with reprocessing can easily and quickly make bombs.

They created the Nuclear Suppliers Group, mainly to control transfer of reprocessing plants. They didn't, however, confront the NPT's "inalienable right" language, or address the inadequacy of inspection, and timidly referred to reprocessing and enrichment as "sensitive" technologies.

In 1976 US President Gerald Ford urged a halt to reprocessing and recycling of plutonium until "*the world community can effectively overcome the associated risks of proliferation*." He said the US would follow the course it asks of others.

In 1978 the US Congress tightened nuclear export rules: required full-scope IAEA inspection of customers, which cut off supply of US fuel to India.

FAST FORWARD TO PRESENT —REPROCESSING

Because uranium resources were much greater than forecast, plans for plutonium-fueled FBRs got put off indefinitely. To keep reprocessing alive interest shifted to recycling plutonium in existing light water reactors (LWRs).

Such recycling is highly uneconomic, but still has adherents. Japan, with most reactors shut, still plans to open the large Rokkasho reprocessing plant. A US- Russian "arms control" project to recycle weapons plutonium is still ongoing.

Reprocessing and plutonium recycle could be eliminated from all civilian power uses without any economic penalty. But strong interests resist. Almost all governmental advanced reactor R&D involves fuel cycles that require reprocessing and recycle.

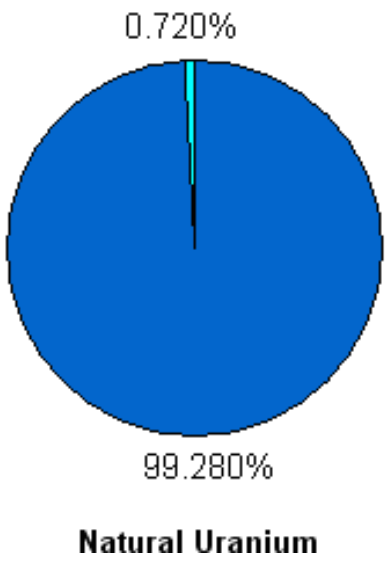
CENTRIFUGE ENRICHMENT

The main proliferation focus today is on uranium enrichment. Centrifuge technology lends itself to small scale, flexible operation and uses little power. A clandestine plant would be hard to find.

The problem is that enrichment is essential to produce fuel for almost all power reactors. There are no easy answers to limiting national access to this technology.

It is important to understand that a plant small in commercial terms can be large in military terms.* If it can supply low enriched fuel for a single reactor it could also produce HEU for dozens of bombs per year.

NAT U



Natural Uranium

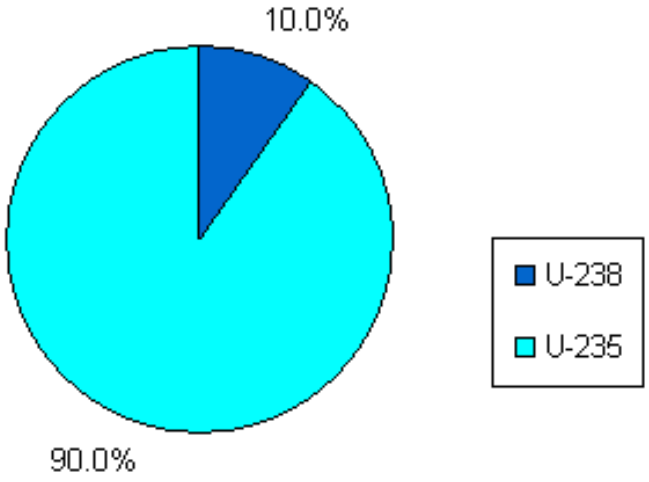
~115 tons Nat U

LEU

3.5% enriched Uranium (reactor grade)

15 tons LEU,
roughly the annual
consumption of
a power reactor

HEU



90% enriched Uranium (weapons grade)

~1/3 ton HEU if same enrichment plant fed with natural U.
Alternatively, ~1 ton HEU if same enrichment plant fed with LEU (3.5%)

LIGHT WATER REACTORS CAN MAKE BOMB PLUTONIUM

Despite frequent claims to the contrary, LWRs can be used to produce large amounts of weapons plutonium. In fact, in the 1980s the US Government intended to buy a commercial LWR to use for weapons plutonium production.*

The key is to withdraw fuel from the LWR earlier than in commercial operation to prevent accumulation of unwanted plutonium isotopes.

A would-be bomb-maker would need a reprocessing plant. Oak Ridge National Laboratory published a design in the 1970s for a small, easy-to-build plant that would use off-the-shelf components from, say, a winery or a dairy.

Unless you can rule out this possibility, LWRs are not the "proliferation resistant" reactors they are made out to be.

OTHER "NOT TO WORRY" ARGUMENTS TO VINDICATE NUCLEAR POWER

"No previous nuclear weapons efforts relied on commercial facilities for plutonium/HEU and none would in the future."

What's different today is that all non-weapons countries are NPT members. Commercial facilities would provide the fastest path to explosives for a bomb. Speed would matter. Unless one believes there won't be any new nuclear weapon states, this is where the dangers lie.

"Finally, no matter how risky expanded nuclear energy use is, we need it to deal with global warming."

Consider that it would take well over a 1000 more reactors to make a *dent* in the climate problem, and several thousands to deal with it. Can we cope with that many LWRs and their fuel facilities in many more countries? And there are alternatives.

THE OBAMA ADMINISTRATION'S NUCLEAR ENERGY POLICY

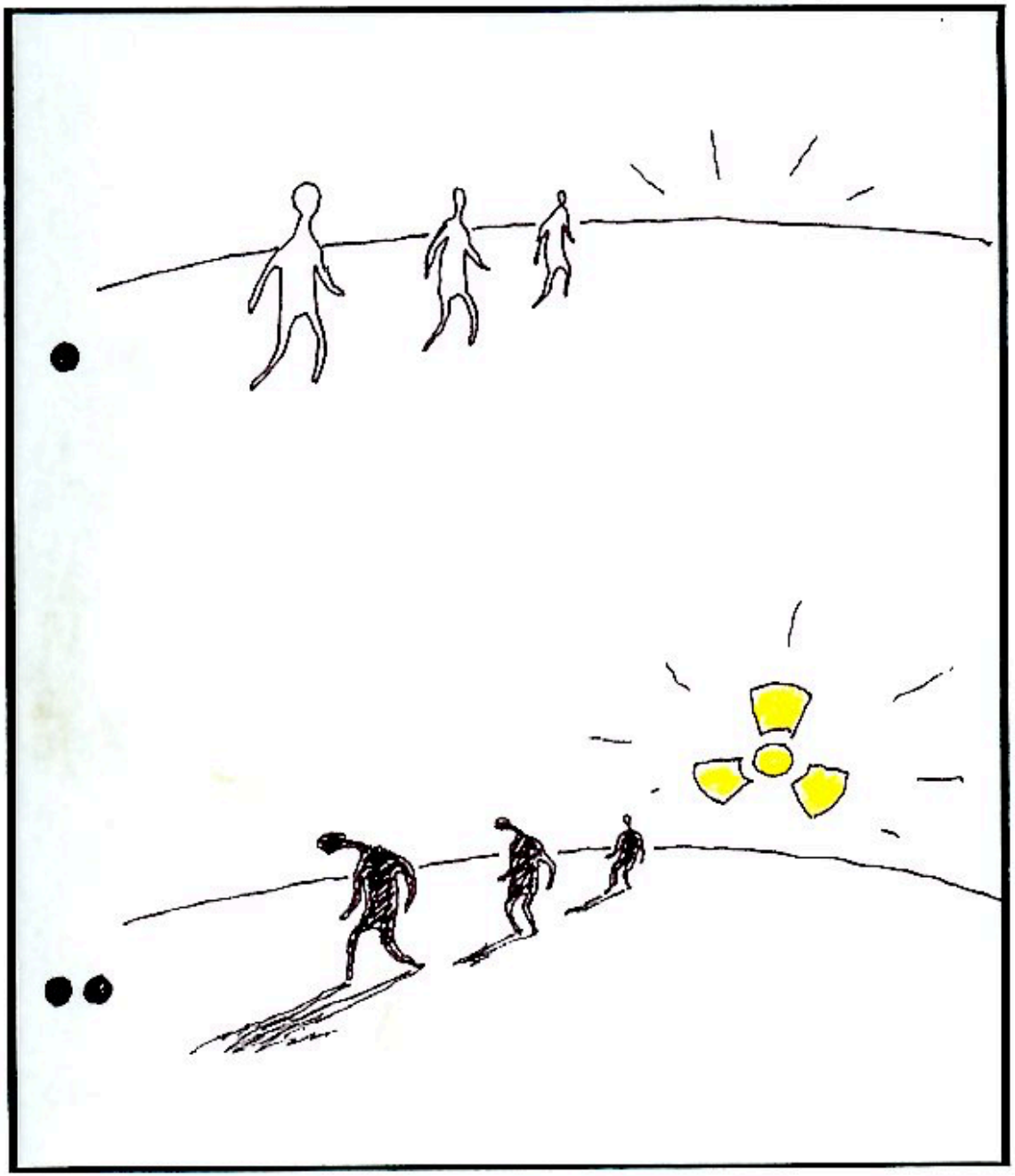
Basically continued Bush policies. Obama spoke of "a renewed commitment" to nuclear energy; subsidized US nuclear power plants, with global warming as justification.

Encouraged US-based nuclear exporters, created a high-level "Team-USA" to aid them. Opposed strict export rules: the State Dept. called instead for rules "our partners can accept and that open the doors to US industry."

A final note: Bush's 2008 US-India sacrificed US NPT policy in the hope of a bonanza for US exporters. Obama supported this. So far it gained nothing because US exporters fear India's law makes them liable for accidents.

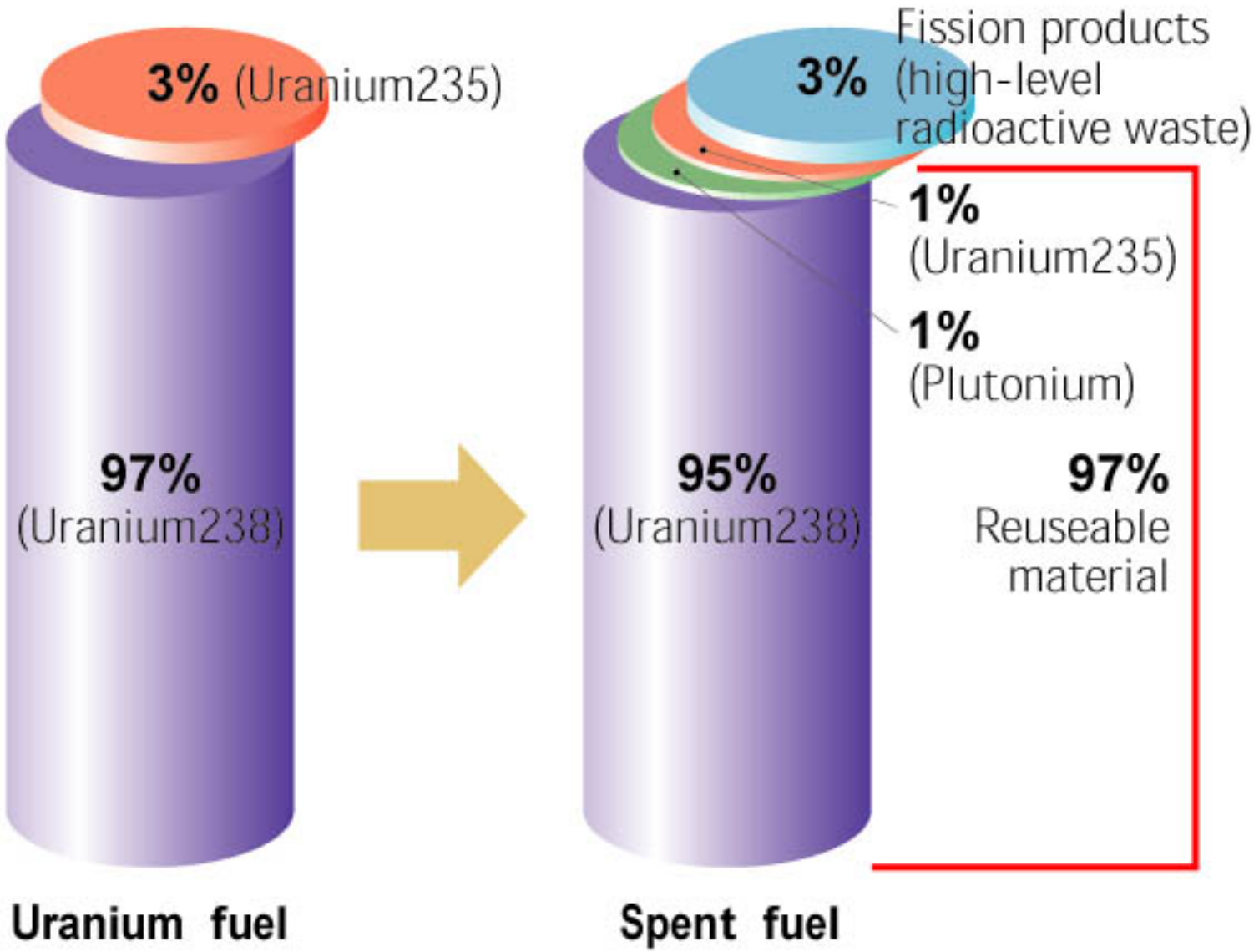
Pres. Obama and PM Modi will meet Jan. 25—nuclear issues will be high on the agenda. Modi will propose India join the NSG, the export control group formed in response to India's 1974 bomb. We have come full circle.

ADDITIONAL SLIDES




ЭКОЛОГИ

URANIUM FUEL COMPOSITION: FRESH AND SPENT FUEL



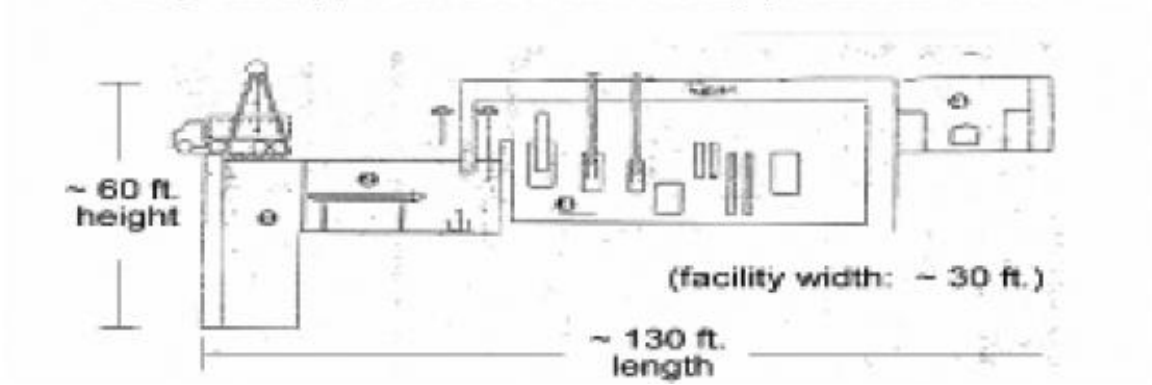
ROKKASHO REPROCESSING COMPLEX

WHAT CENTRIFUGE UNITS LOOK LIKE: AQ KHAN TO LIBYA

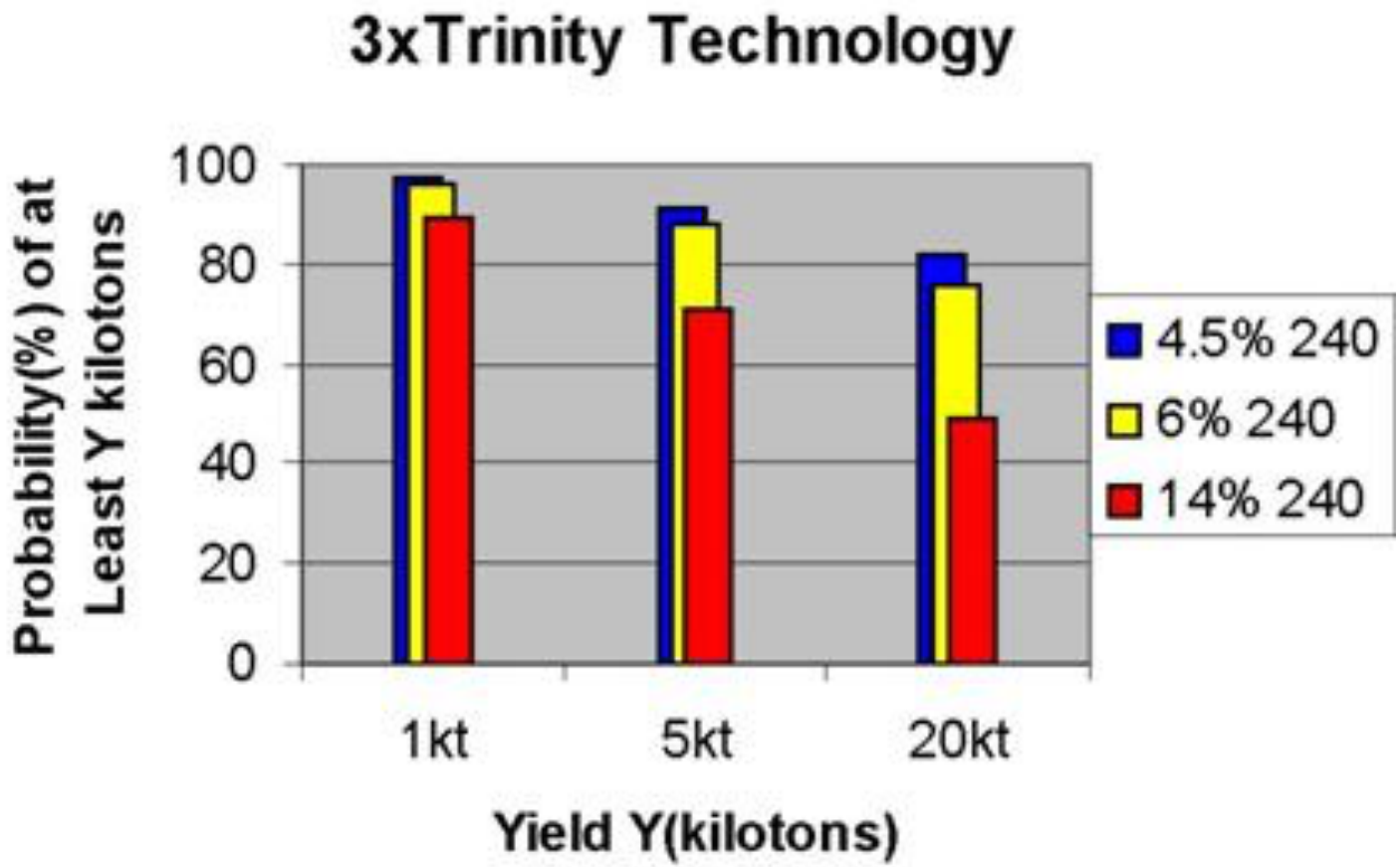
OAK RIDGE DESIGN FOR "QUICK AND DIRTY" CLANDESTINE REPROCESSING PLANT

Simple, Quick Reprocessing Plant Designed to Make As Many as 20 Bombs a Month (Ferguson-Culler)

10-day startup, 1 bomb's-worth-a-day production rate



BOMB YIELDS WITH LWR PLUTONIUM



LEU FUEL SPENT FUEL MOX