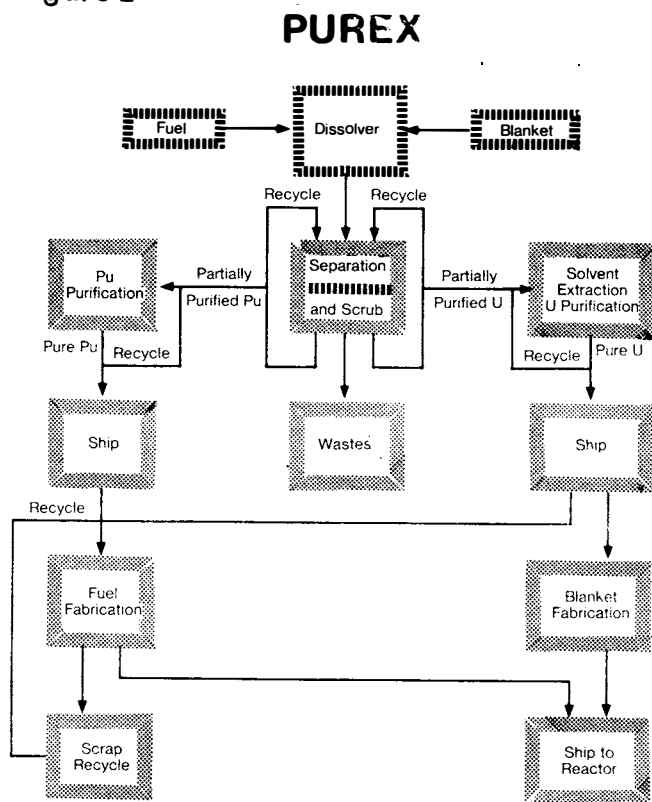


Figure 2



the future world demands for energy, capital goods, and agricultural products.

This and similar processes brings us another major step into the transition towards a fusion-based economy in terms of providing the new technologies, the higher skilled manpower, and the engineering capabilities that will be needed for the most advanced and efficient form of breeders — i.e., the fusion-fission hybrid reactor, and eventually full fusion reactors themselves.

Civex (Figure 1) is different than the Purex process (Figure 2) now being used, in that plutonium is never concentrated in the plutonium-uranium fuel mixture beyond 15 to 25 percent, i.e., that mixture required for new fast breeder fuel. It takes over a 60 percent concentration to make nuclear weapons. Furthermore, some of the most radioactive fission products (ruthenium, zirconium, and niobium) are left within the fuel mixture when it is refabricated into new fuel, thereby making it impossible for anyone to get anywhere near it without a several foot thickness of concrete. The Purex process completely separates *all* fission products from the new fuel mixture.

This high radioactivity combined with the design of the Civex process, which is a completely remote operation, fully self-contained, fully automated closed cycle, makes it "terrorist-proof" as well.

Under Civex most of the fission products are separated from the fuel mix (as in the Purex process), stored in a concentrated liquid form in tanks for five years, and then stored in a more concentrated solid form for several hundred years, underground. This is the most efficient and economic way to handle the storage of nuclear wastes. The fuel mixture (plus selected fission products)

is refabricated into new fuel elements within the Civex plant and recycled back into the fast breeder reactors.

The major advantage of the fast breeder reactor compared to the current Light Water Reactors (LWRs) is that the breeder can expand the supply of reactor fuel by over 70 times by "breeding" plutonium out of the abundant but now useless uranium-238 isotope. LWRs are now fueled by uranium-235, the only naturally occurring fission fuel, which makes up less than one percent of mined uranium and is expected to be in very short supply by the end of this century.

The Purex process is now only a fuel reprocessing plant, while the Civex process will, as a minimum, combine the fuel reprocessing and fuel fabrication operations. That is, highly radioactive burned-up fuel will enter one end of the plant while highly radioactive new fuel will leave the other end, with no personal access to it in between. Furthermore, the cycle can be completely closed if the "reactor park" concept is used. Here, several fast breeders and a Civex plant will occupy the same site and will be completely interconnected from the time the fuel is removed from the reactor core until it returns.

The issue is therefore not whether such a system is technically feasible, but whether an economically desirable commercial large-scale Civex system can be developed. Preliminary estimates of the costs of Civex versus those of the standard Purex process have indicated roughly comparable total costs. The normal process operating costs for Civex will be much less than for the Purex process because the plant is about half the size. That is, the number of separation-process streams are reduced by about half, since plutonium, uranium, and some fission products are now coprocessed rather than removed separately. On the other hand, the remote fabrication techniques required in Civex will make capital costs considerably higher than for Purex. On balance, therefore, the total costs appear to be about equal, within a range of 20 percent. However, as the automated Civex processes gain commercial operational experience and as mass production is introduced, its costs can be expected to decrease.

Zero Growther Attacks Civex

It was inevitable that the hardbitten advocates of energy no-growth would react to the announcement of the Civex breakthrough with outrage — and, of course, with a fresh batch of untruths about the insurmountable "proliferation" and environmental dangers of this and every other form of nuclear power.

Setting the tone (see box) was New Directions, which the day of the press conference announcing Civex rushed out a statement attacking the proposal. New Directions is the "lace-curtain" end of the most sinister and most significant current in the environmentalist movement, the faction most firmly devoted to negative growth, in energy, in Third World development, in the U.S. economy, in global living standards. As its leaders it brings members of the terrorist command center, the Institute for Policy Studies, and social-control ideologue Margaret Mead together with men like cold warrior Paul

Nitze and top genocidalist Robert McNamara of the World Bank (the latter, one of New Directions' founders, in fact).

In its statement, New Directions cited five "quotes" from Civex documents to show that all nuclear power is a dangerous source of nuclear weapons proliferation, and that the Purex process in particular is a proliferation hazard. When the New Directions quotes from EPRI are compared to the Civex documents referenced, it is clear that the quotes themselves are in almost all cases taken out of context, and even tampered with.

But more significant are the "tone-setting" arguments that the New Directions statement presents. Let's compare what New Directions claims that EPRI admits, with the facts.

"We Don't Need the Breeder"

New Directions says that "the U.S. can afford to defer plutonium reprocessing and the breeder," and "quotes" Civex documents as saying: "The U.S. is currently able to defer non-military reprocessing. . . and the breeder. . . ." "The benefits of all of these options in decreasing demands for resources and increased security of supply occurs mostly after the year 2000."

Contrary to what New Directions claims are concessions made by EPRI (and therefore the nuclear industry) it is in fact generally recognized not only in the United States but, even more so, in Europe and other "fuel-starved" parts of the world that the breeders *must* come on line commercially in the very near future and with it, of course, plutonium reprocessing. To make this fact a bit more real to our antitechnology friends in New Directions, it should be strongly reiterated that France, the Soviet Union, and even Great Britain all have Liquid Metal Fast Breeder Reactor demonstration plants (equivalent to the stalled U.S. Clinch River breeder project) in operation, some for several years already, and furthermore France and the Soviet Union have commercial-size plants under construction. France's 1200 megawatt Super-Phenix is slated for a 1984-85 start-up date, while others are not far behind. Fuel reprocessing for these countries is "standard operating procedure," and this is with processes similar to the U.S. Purex process. France, Great Britain, West Germany, Japan, will soon have no alternative -but the breeder, and later fusion, and this is a well-advertised fact!

The Soviet Union and the United States are committed to the breeder for the nearterm because it is the cheapest and most efficient energy source from the point of view of available resources. These two countries have led the way in developing new technologies which solve the problem of "limited" and therefore increasingly expensive resources. The breeder reactor is simply another important step in this ongoing process of development which in the area of energy will eventually lead to fusion-fission hybrid reactors and, finally, to full-scale fusion reactors — the ultimate solution to the question of virtually unlimited (and therefore cheap) energy.

"The Risk is Too Great"

New Directions goes on to say that "any new fuel cycle should not have a greater risk of diversion than spent fuel from light water reactors," that "breeder reactors are a major proliferation risk," and that "several weapons could be quickly fabricated from reprocessing

plutonium." These claims, too, are supported by a series of out-of-context quotes from EPRI.

These "concessions" which New Directions says that EPRI has made, all involve worn-out, tired issues. It should be clearly stated that this is primarily a political, not a technical question, and has been so addressed for decades. What is being regurgitated in undigested form by New Directions now is nothing more than the problems discussed and *solved* in the early 1950s by President Eisenhower and his "Atoms for Peace" program. It was decided then that the only solution to such problems was to break down the barriers which lead to a nation's desire for weapons and defense, by providing all nations instead with the basis for development around a source of cheap energy — nuclear energy. This still remains the only real solution, and it's about time that the U.S. again joins with the rest of the world and gets on with the business of development.

It is a long-established fact that *any* nation, given the financial commitment, can develop and construct an atomic bomb. This has already been done by several countries, the most recent being Israel (and probably South Africa), and before that, India. It would not be done using an expensive power reactor and commercial fuel cycle, but instead with a relatively less expensive research reactor, small-scale reprocessing plant, and by developing the appropriate high-technology bomb-manufacturing capability. This is not an easy task and would take upwards of 10 to 15 years, several hundred million dollars, and highly skilled scientists and engineers. Most nations have apparently decided that it is a ridiculous waste of valuable resources. Power reactors are for producing power, and the development of nuclear power around the world must be fully supported — precisely in the interests of peace and progress.

"Even Conventional Reactors Are 'Bombs' "

And finally, New Directions claims that the EPRI has now confessed that even light water reactors are a major proliferation risk, because of the unprocessed spent fuel.

Neither EPRI nor anyone else knowledgeable in the field of fuel reprocessing and nuclear power is claiming that the Purex process can not be made sufficiently safe to meet all necessary requirements for proliferation and terrorist resistance. In fact, several nations already have similar processes in operation and are successfully meeting all security criteria. Furthermore, it is likely that the Purex process will continue to be the standard reprocessing technique for at least the near future, and will also eventually be exported to other countries, with of course the appropriate international controls and safeguards, as various nations such as Brazil and Mexico develop their nuclear programs. Civex provides a system that not only meets all the requirements met by the Purex process, but in addition, provides a "put-down" for the phony fear-mongering scenarios which are knowingly put forth by people like the New Directions crowd. Furthermore Civex can eventually reprocess fuel more efficiently and perhaps more economically than the existing systems because it will use advanced, highly automated industrial processes that are tailored specifically to the commercial breeder reactor fuel cycle. This is why the *New York Times* blew its cool — its bluff has been called!

Civex's Objectives

The objectives of the Civex process as laid out by EPRI can best be summarized by simply quoting a small section of a paper titled "A Fast Breeder System Concept: A Diversion Resistant Fuel Cycle," written by Milton Levenson and Edwin Zebroski:

Any sovereign nation making the overt decision to become a weapons owner can probably do so and nothing can be done by means of technology to prevent it. That is rather an issue for international treaties and agreements. However, two related issues — small bands of terrorists or large terrorist groups (or subnational groups) can be addressed by technology. We set as an objective the tailoring of a process and facility for a breeder reactor fuel cycle that would be proof against terrorist theft and so resistant to subnational group diversion as to be considered diversion-proof. The

related objective is to demonstrate that the existence in any area of such a diversion-proof civilian reprocessing (Civex) plant would not shorten the time from "decision to acquire" to "time of ownership" of pure plutonium. The existence of a Civex plant cannot prevent a nation from clandestinely building a small reprocessing plant to make pure plutonium — but if it is more practical to do that than it is to modify the Civex plant, the objective will have been achieved: the Civex plant will not have increased the probability of, or shortened the time to, a new weapons-capable nation or entity.

Once one has established an objective, it is necessary to develop criteria to help define whether one is meeting the objective...

First, there shall be no pure plutonium in storage. Thus, a small terrorist band cannot overpower the on-site guard force, grab bottles of plutonium, and flee, much as a small terrorist band might steal money from a bank vault.

The New York Times's Reprocessing Cycle

In a March 1 editorial written in its best "consumerist" style, the *New York Times* charged EPRI and the other Civex proponents with conducting an unfair "Hard Sell on Nuclear Safety." The announcement of Civex, said the *Times*, actually "underscores the dangers in the world's current nuclear course." Backing up the *Times*' argument was a reference to "government experts."

It turns out that the "experts" behind the *Times* editorial were none other than New Directions.

The *New York Times* wasn't the only one on the New Directions debunking list. Sources say that Tom Cochran, a "physics expert" for the environmentalist Natural Resources Defense Council, hurried to the White House to deliver a copy of the New Directions charges to his good friend Kitty Shermer, an aide to President Carter.

It is therefore instructive to compare the *Times* editorial with New Directions' rush-job release on the Civex announcement.

Times: "If the claims hold up, the development (of Civex) would be a breakthrough in efforts to curb the proliferation of nuclear weapons. But the claims appear exaggerated — a hard sell on behalf of rapid development of the next generation of nuclear reactors."

New Directions: "EPRI is to be congratulated for facing up to the proliferation dangers of plutonium reprocessing, and accepting a 'no worse than light water reactor' nonproliferation. Unfortunately, the EPRI criterion still contains a major flaw and the fuel cycle proposed does not measure up to EPRI's own criterion."

Times: "There is irony in the new announcement...for it underscores the dangers of the world's current nuclear course. In describing the need for the new system, the researchers give a

frank appraisal of defects in the old systems. They argue that current nuclear reactors are producing vast quantities of material that could be fabricated into bombs."

New Directions: "The most surprising aspect of this proposal is that for the first time, EPRI has admitted the proliferation dangers of plutonium reprocessing and the breeder reactor. It also admits that both the breeder and plutonium reprocessing can be deferred....EPRI is now attempting to justify plutonium use by attacking light water reactors as major proliferation risks."

Times: "No more eloquent plea could be made for bringing spent fuel rods under better international control."

New Directions: "'Civex's criticisms of traditional plutonium reprocessing should ring the deathknell for the Windscale, Barnwell, and the Tokai Mura reprocessing facilities. None of these facilities as constructed or designed meets EPRI's proliferation criteria.'"

Times: "Still, government experts in energy and arms control...say it would still be possible to extract plutonium from the new system. And they fear that if plants incorporating the new system were spread around the world, they would increase the dangers of weapons proliferation by spreading nuclear expertise."

New Directions: "Secondly, Civex fails to meet its objective of being as proliferation-resistant as the light-water-reactor fuel cycle because it would place in many countries a plutonium extraction facility...a facility that can be easily converted to produce weapons usable material. Also, any country with a Civex reprocessing facility will have a trained cadre available to build a standard plutonium reprocessing plant."

The second criterion is that there should be no pure plutonium at any intermediate point in the process. This insures that a terrorist band that includes an "inside man" cannot readily open or close valves or add a drain line at a critical point, so that once it has overpowered the guard force it can collect pure plutonium rather quickly and escape.

The third criterion selected is that no relatively simple changes in chemistry or flow sheets should be capable of producing pure plutonium. Like the second criterion, this is for protection against the small terrorist band that includes an "inside man."...

The fourth criterion is that for the production of pure plutonium it must be necessary to make hardware, piping, and equipment changes and that the materials and resources necessary to make such changes should not normally be present on site. This means that simple piping changes, simple jumpers, simple rerouting of

plumbing, or similar activities cannot produce pure plutonium...

The fifth criterion is that to achieve production of pure plutonium, the modifications to be made and the new equipment to be installed cannot be achieved without either decontamination of highly radioactive areas or entry into very high radiation fields, either of which is very time-consuming as well as basically deterrent.

The sixth criterion is that the time required to convert the Civex plant to production of pure plutonium should be of such a length and the resources required so extensive that there is adequate time for international as well as national response forces to react.

The final criterion is that the flowsheet should be based on credible technology, every step of which has been at least laboratory tested, if not pilot-plant tested, in one or another application so that there is a very high probability that the proposed Civex flowsheet can indeed be developed with a minimum of technical risk....

What are the billion-dollar markets of TOMORROW?

Reports from **Advanced Technologies Enterprises, Inc.** tell you TODAY.

Fusion Power: Status and Prospects

An in-depth study of the status of the international fusion effort and the economics of fusion power (40,000 words).

Includes: "What is Fusion?"; descriptions of all major fusion devices, their advantages and disadvantages; the fusion-fission hybrid; applications of fusion power; fusion technologies; the comparative economics of each fusion device; the potential markets for fusion research and development; fusion reactor production to the year 2000.

A businessman's map of the energy supply of the future. Price: \$625.

Superconductivity: Applications and Opportunities

A thorough study of the burgeoning new superconductivity field, and the applications of superconductivity (30,000 words).

Includes: "What is Superconductivity?"; applications to computers — the Josephson effect; superconducting generation and transmission of energy, and superconducting motors; applications in fusion and magnetohydrodynamic advanced power systems; high speed transit; industrial applications — magnetic separation; medical applications. Full comparative economic analysis of superconducting techniques versus conventional methods, and detailed projections of the superconductivity market in the next 20 years.

An invaluable guide to a multibillion-dollar market. Price: \$625.

Advanced Fission Systems

A definitive economic and technical analysis of the coming technologies of nuclear fission energy generation, demonstrating the areas of fission technology development that will lead to marked reductions in the costs of electric power (30,000 words).

Includes: The high-temperature gas reactor; the gas turbine; the liquid metal fast breeder reactor; the gas-cooled fast breeder reactor; the pebble bed process heat generator; the molten salt breeder reactor; the plasma core reactor; analysis of alternative uranium and thorium fuel cycles; technical status of each type; detailed economic comparisons.

Essential for anyone in the fission field, and for anyone involved in energy production. Price: \$625.

Published by Business Communications Company, Inc.

**Advanced
Technologies
Enterprises, Inc.**
65 Hillside Avenue, Suite 6-F
New York, NY 10040

Please send me:

- FUSION:
STATUS AND PROSPECTS
- SUPERCONDUCTIVITY:
APPLICATIONS AND
OPPORTUNITIES
- ADVANCED
FISSION SYSTEMS

I enclose a check for \$ _____

- Send me more information
on Advanced Technologies
Enterprises, Inc.

Name _____

Title _____

Company _____

Street _____

City _____

State _____ Zip _____

(Please make checks payable to
Business Communications Company, Inc.)