ENERGY POLICIES Impact

WORLD AND NATIONAL SECURITY, ECONOMY, EMPLOYMENT, EDUCATION ENVIRONMENT, ECOLOGY

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During the first half of the twentieth century, the US produced most of the world's oil. Today, with only 3% of the world's total pumpable reserves remaining the US now only produces about 10% of the 84 million barrels per day world total. The US consumes about 21 million barrels per day, or 25% of the world's total production.

Foreign oil & gas imports cost the US nearly 200 billion dollars in 2004. By the end of 2005, that bill will be closer to 300 billion and heading towards 400 billion dollars in 2006 or nearly 40% of our total trade deficit. This contributes to the shrinking US dollar and loss of some *4-6 million US jobs and is a major threat to our national economic and political stability.* Our growing dependence upon foreign energy resources requires us to spend some 600 billion dollars per year maintaining and engaging the world's largest and most powerful military and diplomatic establishments, to secure our energy lifelines.

World pumpable oil production is currently peaking and will commence a rapid decline in the next few years as depletion far exceeds discovery and as Asian demand rapidly expands. *(Figure 1)* A similar trend is developing in the world's total natural gas supply used for *electric power, heating, fertilizers, insecticides, plastics, chemicals etc.* The US has only about 4% of the world's total natural gas reserves. Nearly 40% lies in Russia and another 40% lies in the Middle east, (*mostly IRAN and Qatar).* Despite these numbers, there has been a major *ENVIRONMENTAL* shift to natural gas for power generation. *(Note: 90%, (31/35), of new power plants in the US authorized in 2004 are to be fueled with natural gas).* Some foresee US natural gas depletion commencing within a decade and project the world's economically recoverable pump-able reserves to be vastly diminished within 30-40 years. At much higher costs, we will mine, liquefy and gasify coal, heavy bitumen tar sands, oil shale and eventually deep-sea methane hydrate crystals, at far more disturbing environmental impacts to provide most of this century's combustible carbonaceous fuels. In only two centuries, or 2-tenths of one millennium, we will have consumed most of the accessible carbonaceous fuel that took the Earth and Sun thousands of millennia to produce ...*And that was when the earth was warmer and.. wetter to nourish the abundant plant life source of carbonaceous fuels.*

Obviously, going without power in cities and suburbs is not an option. If we lose power, we lose light, clean water, sanitation, food refrigeration, transportation, and storage, communication, commercial, industrial, and government functions and civilization. Virtually the entire developed world has become much too dependant on foreign energy sources, and dwindling reserves. Alternative energy sources such as Solar and Wind are valuable, but cannot themselves replace coal, oil, gas or nuclear energy. Their discussion follows later. The need for an environmentally responsible, long-term alternative for our primary base load power-generation source is upon us. The proven answer is a ***RADICALLY DIFFERENT*** Nuclear Power approach. For years, Nuclear Power has been politically "out of favor." IT DESERVES ANOTHER LOOK. It is our best hope for maintaining our current populations and living standards.

NUCLEAR POWER - ANOTHER LOOK

Nuclear power is unique in its inherent ability to save our environment, ecology, domestic economy and reduce international tensions. Nuclear power is the only proven source of power that can provide the enormous energy needs of modern industrial and urban society, while remaining totally isolated from the surface of the earth. It need not breathe air nor exhaust to it. It is not vulnerable to weather, tornadoes, clouds, or darkness of night. Its environmental footprint is concentrated and compact by hundreds fold compared to any hydrocarbon, hydro, wind, or solar energy source. It can be the most environmentally clean and healthful source of energy, and can uniquely be isolated for public safety and protected from hostile attacks in coming centuries.

Major world powers: Britain, France, Russia, India, China, and Japan have active nuclear fuel reprocessing capabilities. The US does not. Smaller countries such as South Africa, Israel, and Pakistan have curtailed their programs under US pressure. The current unique and myopic US practice of a once thru nuclear fuel cycle uses only 0.3% to 0.4% of our uranium resource. Such unique waste limits our domestic nuclear reserves to about 30-40 years and results in large imports of natural uranium yellow cake from Australia, Canada, and Africa. The absurd policy also produces large volumes of long-lived radioactive spent fuel to be surface stored and cooled in 100 locales for about 30 years awaiting potentially hazardous long distance transport to a centralized repository across country. Nuclear power in the US currently produces about 20% of our electricity and may produce a repository site overload in the single proposed spent fuel storage repository. Planned shipment to the single remote Nevada repository near Los Vegas has justifiably met with considerable public resistance.

We might double or triple our fissionable reserves by re-employing the French-British-Russian spent fuel PUREX aqueous reprocessing practice. It involves total fission product separation from Plutonium and Uranium. The fission

products and long-lived trans-uranics are solidified into insoluble glass, placed into shielded canisters, and transported to a geologic repository for long-term isolation and decay to natural levels. The separated Plutonium and Uranium fuel, that is nearly free of radioactivity, is then conventionally re-enriched, re-fabricated, and re-transported for re-installation for further burning in widely dispersed current thermal neutron water or gas cooled reactors. Such a scheme in the US would still *encounter all of the public objections to nuclear power i.e.* large inventories of immobilized high level long lived radioactive waste and spent fuel containing very long lived low-level radioactivity. We would have even more multiple shipments to transport large volumes of even "hotter" fuel to the reprocessing facility from a hundred reactor sites. About 85% of the 104 operating, and aging, US nuclear power plants are in regions east of the Mississippi river where the highest energy demands and essential cooling water exist.

A BETTER WAY -- RENEWABLE NUCLEAR ENERGY!

It is technically possible to increase our fissionable energy reserves several hundred fold, to eliminate long distance transport of highly radioactive spent fuel, to eliminate potential Plutonium weapons proliferation and nearly eliminate very long life residual radioactivity. We should choose 10 to 20 locations to build permanent Regional Nuclear Energy Parks near population and load centers and cooling water. (*Figure 2*) That decision would enable us to close the nuclear fuel cycle with onsite Fast Breeder reactors utilizing the essential decommissioned weapons plutonium derived from the ongoing US and Russian dismantling of weapons stockpiles as starting "seed-cores." (*Figure 3*) The Current world inventory of Nuclear Weapons, stored mostly between the US and Russia might provide the Seed Cores for upwards of the order of 40 start-up seed cores for Fast Breeder and Thorium converter power reactors worldwide.

Fast reactors, unlike current Thermal reactors, can convert retained long-lived radioactive elements to short lived products. Fast Breeder reactors can also convert non-fissionable uranium and thorium to useful fissionable fuel. Consequently, we can convert mountains of useless long lived radioactive "Spent Fuel" containing over 75 thousand tons of non fissionable U^{238} and our 10 fold larger stock pile of uranium enrichment tailings, "depleted uranium", to fissionable Pu^{239}. We could also effect the conversion of the 3 fold more abundant Th^{232}, *(Thorium)* resources to fissionable U^{233}. Such a policy could extend the domestic North American and world sustainable nuclear fuel reserves potentially 900 fold to fulfill world energy requirements for up to 10 millennia with proven, even though not yet perfected, non polluting technologies. In the 1990s, the US terminated its last significant work in this technology. Russia, France, and India have been or are operating, designing, or building Breeder Reactors. China and Japan are pursuing the technology out of necessity. Mutual economic success, long-lasting security, and mutual trust will surely be expedited with close international cooperation.

The ongoing shipment of irreplaceable US-Russian weapons Plutonium to France for conversion to mixed oxide (MOX) fuel to be burned in existing once thru Thermal reactors is dangerous. It also precludes the opportunity to build the initial Breeder *Seed Cores* that are essential for a Fast Breeder Economy. *THAT SHOULD BE INTERDICTED NOW.*

The approaching obsolescence of the US's 104 operating nuclear plants that generate over 100,000 base load megawatts coincides with the rapid depletion of US nuclear, petroleum and natural gas reserves within the same 20-30 years. Such depletion will create an international energy crisis far beyond the tensions that lead to World War II.

The US population is expected to increase upwards of 30% to 50% over the next 50 years to approach 430 million persons. US electric power demands could increase from 460,000 megawatts base load (*850,000 megawatts installed*) to at least 600,000 megawatts base demand not allowing for electric battery or hydrogen fuel cell powered auto, bus, truck, or trains. All electric (or hydrogen) transportation could nearly double electricity demands again to over 1,000,000 megawatts. Clearly, every means of conservation and alternative energy is needed but not sufficient. Equally insufficient, is continuation of current thermal reactor nuclear policy contained in the recent NEW legislation. IF we start building new replacement nuclear facilities now at a rate of 5 reactors a year plus the current 5 to 10 years of site licensing and approval it will take 20 to 30 years just to replace our 104 current reactors.

Consider the current 10 to 20 year end-of-life spent facility cooling and dismantling; the disposal hazards & costs at 100 sites. Add the century-long military protection requirements; the public resistance to long-distance across country spent "hot" fuel shipping, and lastly, the cyclic migratory employment of specialists for construction of dispersed high-capital facilities. All of this, just to stay at 100,000 megawatts or 10% of our then needed power. We will create more nuclear "waste spent fuel". We would totally deplete our Uranium reserves. During the last half of this century, where would our existing grand kids get the globally clean energy needed to sustain their civilization?

CLEARLY BETTER POLICIES ARE NEEDED NOW. Fast Breeder nuclear parks with on-site reprocessing, Clean gasified coal, liquid coal, and tar sand and oil shale oil recovery developments must be high priority in the US today.

These improved fossil fuel technologies are being pursued by the US Department of Energy and some forward looking US industries. Critical fast breeder/actinide burner energy parks including on site reprocessing and fission waste isolation seems to be missing from the urgent development equation.

We must regain our past momentum in Fast Breeder, fuel reprocessing and recycle technology development. We have 10 years of education and re-development to conduct. We must cut to a third the current lengthy time required (*minimum 10 years*) for site selection, licensing, design and construction phases for replacement of each of the 104 current design nuclear power generation facilities. Starting now, we would require at least 20 to 30 years of intense 5 plant per year construction to stay even in nuclear capacity and 10 new plants per year for minimum growth needs.

SECURE UNDERGROUND NUCLEAR ENERGY PARKS (SUNREP) w/NUCLEAR FUEL RECYCLING

Modern geology, excavation, mining, tunneling, and ventilation, coupled with modern 21st century remote-controlled, robotic and automated operation and maintenance capabilities provide the technological opportunity to safely, economically and securely close the nuclear fuel cycle in a completely sequestered underground environment.

The US public should demand policy consideration be given now to facilitate immediate renewal of the education, research, development, design and licensing of 10 to 20 regional, fully contained, deep underground or mountain, nuclear energy parks. Each park may provide up to 10 to 20 thousand Megawatts of base load electric generation. Each park would include modern Fast Breeder, Thorium Converter and Actinide Burner reactors with new compact, non-aqueous molten salt fuel reprocessing or gaseous fuel reprocessing. The *long-lived low level* radioactivity, and sufficient short lived (*gamma hot radioactivity)* will remain in the fuel to circumvent the possibility of Pu theft or proliferation. All fuel re-enrichment, re-fabrication, and reloading into the Fast Breeder-converters and Actinide reduction Fast Reactors can and should be done with specialized onsite shielded remote handling equipment.

Power generation facilities and the short-lived fission product separation, immobilization and isolation will all be incorporated onsite. Any obsolescent reactor, with its relatively short-lived activity, may simply be de-fueled, closed-off, and allowed to decay to normal background and be abandoned or recycled in-place in its private underground vault. Excess separated shorter-lived fission products may be immobilized and interned for decay to natural background within on-site repositories - *each with less than 1% the volume, heat and decay life currently needed for wastes currently planned to be sent across the USA to YUCCA Mountain in Nevada. (Figure 4)*

ADVANTAGES OF - SECURE UNDERGROUND NUCLEAR ENERGY PARKS – "SUNREP"

Fast neutron breeder reactors, thorium converters and compact fuel reprocessing and re-fabrication are the enabling multipliers that provide for *Renewable Nuclear Energy Reserves*. SUNREP can effectively prevent the future diversion of fissionable material to weapons use. In current foreign and past US practice, in order to expedite easier and safer shipping and handling, fissionable weapons material is separated from radioactivity and decontaminated. This is done to facilitate off-site shipping *from centralized processing facilities to* dispersed reactor fuel and weapons fabrication facilities and deployment to military organizations. *BAD IDEA FOR CURRENT AND FUTURE POLICY!*

In the proposed fully contained energy parks, *all facilities can and* will be *designed and built* to limit fissionable material enrichment to reduced levels suitable for reactor fuel only. That action, and retaining the long lived trans-uranic nuclides and gamma hot fission products in the fuel, will destroy the potential for diversion to weapons use. All reprocessing and re-fabrication of fuel and reinstallation into the reactors for further burning can be accomplished with *high gamma active fission products and long half life actinides incorporated into the fuel*. The long-lived radioactive isotopes would shutdown current Thermal reactors, but can be incorporated into Fast reactors and converted to short-lived nuclides. This '*Fissium*' fuel has been demonstrated by Argonne National Laboratory personnel who successfully installed and operated it in the Experimental Breeder Reactor in Idaho. Work at Los Alamos, and at the Kurchatov Institute in Moscow, also confirm that much of the long-lived radionuclides can be converted to short lived nuclides in Fast reactors. These processes can all be automated and maintained with modern fully shielded, reliable, remotely operated and maintainable equipment. The facilities can be designed, built and maintained to handle highly radioactive fuel that is entirely unsuitable for theft or for off-site shipping and handling. Extensive shielded shipping casks, major facility modification and a very large long term and sophisticated invasion and occupation force would be required to affect any theft. The current public apprehensions concerning the establishment of geological repositories for sequestering spent fuel for multi millennia can be substantially alleviated. The 1970s Administration prohibition of fuel reprocessing is out of date with modern technology and circumstances. The ten plus proposed US subterranean energy parks would be monitored and defended far more effectively for the next centuries than can be the existing *104 US and 433 Worldwide* nuclear power sites. *Sixty-nine additional Nuclear Thermal Burner Reactors are currently being planned or built around the world, (not in the US)*

The past and current practice of open pool spent fuel storage in nearly 90 dispersed hard to defend surface facilities and the overland long distance transportation of radioactive fuel would be eliminated. Regional underground

facilities can provide centuries to millennia of safe, secure and environmentally clean base load electrical energy for North American and world kids needs with little or no ecological, economic, political or military threats or interference from potentially unfriendly nations in this and coming centuries. SUNREP will provide long-term high paying domestic jobs that otherwise would not exist. *Would it cost too much?* That may depend upon how we count our dollars. What is the value of a dollar sent to the Middle East or to war versus a dollar that provides an educated American job? This century's coming world energy wars can and must be averted. Civilization can, and hopefully will, be saved.

The US is currently exporting about 200 billion dollars in 2004 and nearly 300 billion dollars per year in 2005 for purchase of imported hydrocarbons. Such sums can support upwards to 4 to 6 million long-term high skilled prime US jobs and could capitalize the establishment of US energy independence with a diversified domestic energy program. 300 Billion $/yr spent on prime US jobs may turnover 5 to 10 times and create many fold secondary jobs before being lost overseas. Whereas, the oil import money might never return. The NEW ENERGY PROGRAM would include SUNREP's base load electric generation, distributed alternate energy generators and, *hopefully* "clean" coal fired electric generators with sequestered CO_2. A tariff of at least 3 to 10% on imported fuels could be assessed and devoted to engineering education and development of closed cycle nuclear fuel processing, fast reactor research, design, prototype development, and development of SUNREP sites. The government investments made at YUCCA Mountain in Nevada can be effectively salvaged by initiating the first prototype limited scale SUNREP demonstration for the southwestern United States. The participation of Nevada's and all major US Universities, National Laboratories and Chemical, Energy, Construction, Mining and Utility companies will be needed to train, develop, design, invest, construct and operate such complexes. We must enhance and reenergize our engineering schools in the fields of chemical, metallurgical, ceramics, geophysical, mechanical, thermo-thermodynamics, nuclear, automation, and remote handling engineering.

Our largest serious "Energy" companies have the preponderance of existing chemical, mechanical and civil engineers and geologists that will be essential to this undertaking. This enterprise is essential to the long-term economic survival of our country's largest industry.

BENEFITS OF A PRO-SUNREP POLICY

SUNREP, Conservation and Alternative energy concepts when applied worldwide can have a major impact upon reducing irreplaceable carbon and hydrocarbon depletion, reducing SO_2, NO_x, Hg, smog and CO_2 emissions, their negative health effects, their potential for global warming and possible drastic weather changes in this and coming centuries. SUNREP with maximum efficiency, CONSERVATION and the EFFECTIVE use of alternate energy sources can reduce the massive ecological degradation due to extraction, production, and transportation and application of fossil and biomass fuels, and will reduce the total environmental footprint of combustion and alternative energy generation. Possibly most important, we can avoid totally depleting the earth of valuable future resources instead of wastefully burning nature's gifts.

Millions of new high technology US citizen careers will be generated within current US expenditures. The US deficit imbalance of payments can be cut nearly in half and the US dollar re-established as a respected world standard. This would reduce our dependence on the rest of the world buying US bonds and corporations, and reduce the potential for collapse of the US economy.

The political, technical and economic cooperation of the US, Russia, France, Britain, China and India, as well as the UN and IAEA, are desirable and eventually essential. It is the only way to fairly, and evenly, track weapons reduction and to agree upon building effective construction, operating and inspection standards. The Russian gaseous fuel reprocessing technology and Argonne National Laboratory compact non-aqueous pyro-processing fuel technologies look most promising and the small two-gallon size Russian gaseous centrifuges are preferred for the remote shielded confined space re-enrichment of new "hot" radioactive fast reactor, seed-core fuels. Operating Russian, French and Indian fast breeder reactors are generating essential operating, control, breeding ratio, safety and materials endurance data. Modern computer engineering programs provide the capability to engineer more reliable, safer and efficient atmospheric pressure liquid metal (sodium) cooled reactors. New intermediate inert gas and stable organic coolants can eliminate the potential for sodium-water interactions in steam super-heaters and boilers.

Reduced Military expenditures should be affected with less vulnerability to physical and economic terrorism. Enhanced National Security, reduced international tensions and increased international cooperation and trust will result in a more secure world peace for your grand kids and mine.

LIMITATIONS OF CURRENTLY POPULAR ALTERNATIVE ENERGY SOURCES

Clearly, taking land, water and fertilizer out of world food production or natural state for a few decades to convert biomass fuels, *(trees, corn, sugar, etc.)*, to alcohol may be questionable resource and environmental management. If all 330 million acres of America's plantable farm acreage were converted to ethanol production they might produce

less than 10% of this century's total energy needs by 2050. The 30 Billion tax dollars appropriated to ethanol could greatly advance the herein proposed balanced Energy Program to achieve US energy independence, balance of trade and economic security.

Many large landowners, politicians & environmentalists are enthusiastic over large solar and wind energy farms with their large environmental footprints, noise and potential bird kills. Generally, a kilowatt of wind or solar power requires another kilowatt of hydro, nuclear, coal, oil or gas fired power to produce when the wind rests or when the sun sleeps. Large electric energy storage costs and long distance transmission needed to support urban dependence upon wind and solar power generation can exceed the generation and distribution costs and include further environmental impacts.

However, rural, suburban, and urban residential solar heating architecture, planning and building should be enhanced. Limited rural-suburban wind-solar electric generation with local grid inter-ties and local onsite *energy storage* may reduce local import requirements, *(where climate is favorable and cost is tolerable).* The often touted, *"Best"* wind farms of Europe only average about 17% of their installed capacity due to wind variations and maintenance outages. A typical modern wind turbine produces no power with winds below 8-9 mph, 20% at 15-mph, full power above 25 mph and 0 again above 45-50 mph. Therefore, solar and wind may be utilized only where it is viable, or backed up by "base load thermal or hydro generators" and direct or indirect tax or rate payer subsidies.

The economically recoverable US Geo-thermal power may be about 15,000 Megawatts or 1.5% of future needs.

Clearly, the world is nearing a new crisis. For many millennia man, animal, wind and falling water provided the work energy for small world populations of up to 500 million only 500 years ago. After coal-steam was established, world population doubled in only 300 years to 1 Billion people by 1850. Since the first oil well in 1859 coal, oil and natural gas have been *the developed world's* primary sources of energy. By 1930, the world population doubled to 2 Billion. It is now approaching 7 Billion and is destined to approach 10 Billion near mid 21st century. Liquefied and gasified coal and shale must replace some of this century's oil and gas shortfalls, if we can sequester the noxious effluents. Population and prices are on the rise and reserves on the decline. If we fail to take major, intervention steps now as supply fades, future generations will be denied access to the benefits of hydrocarbon resources. The growing energy crisis needs US academic, industrial and political action now to provide for development of environmentally clean politically independent, internationally competitive SUSTAINABLE-SECURE-SAFE RENEWABLE NUCLEAR POWER.

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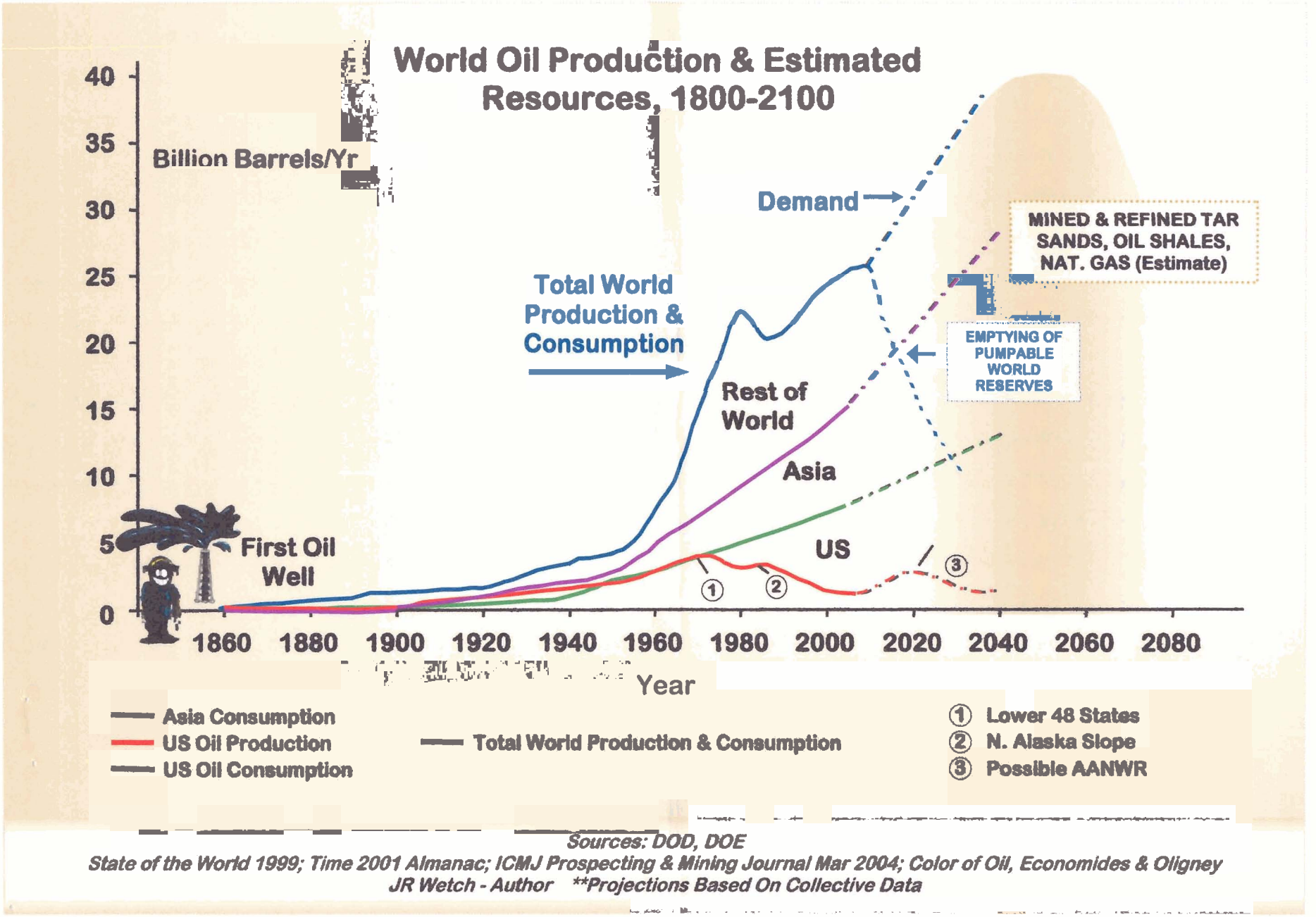
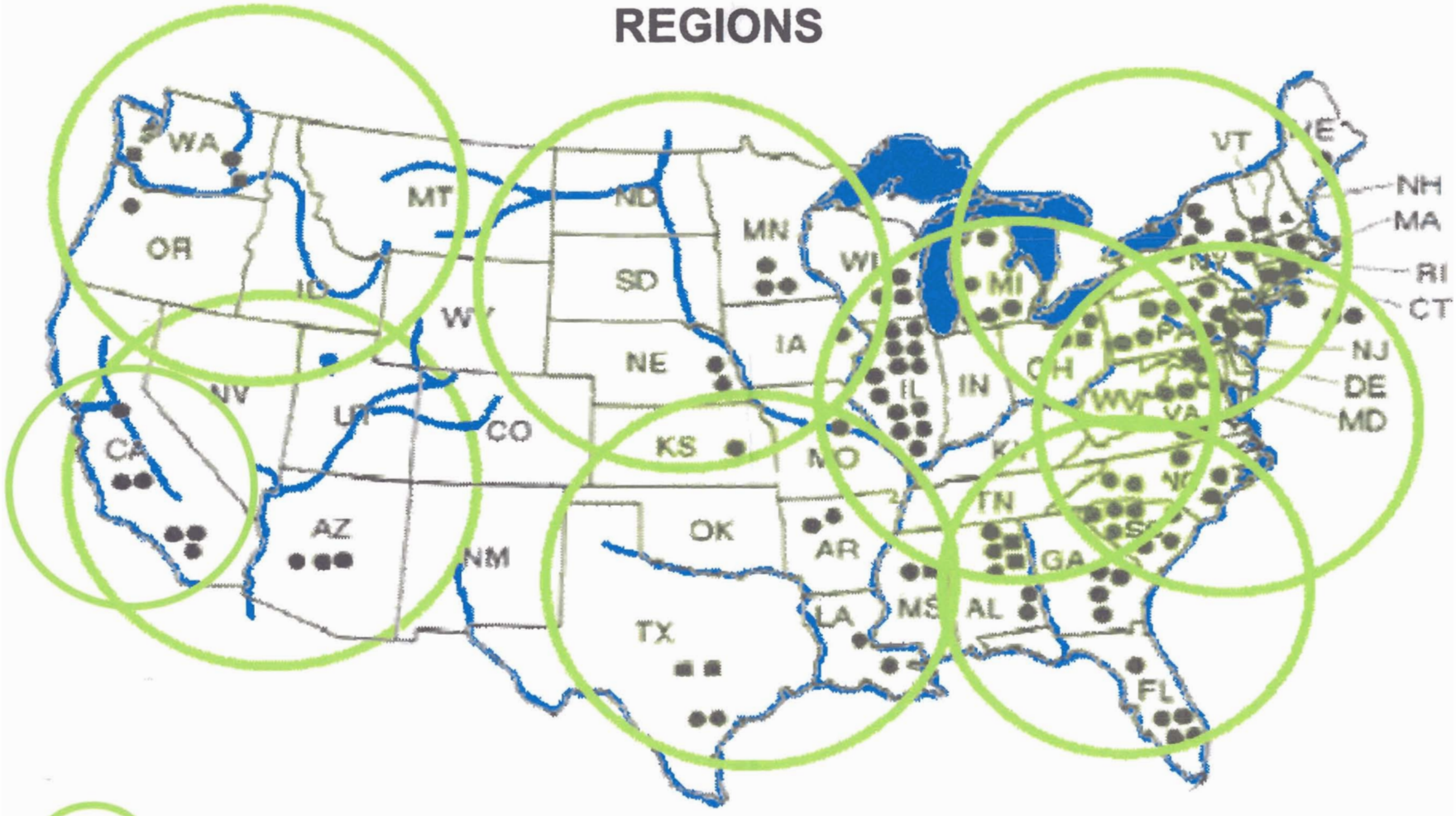
Retired from 50+ Yrs Advanced Power and Nuclear Engineering, Innovation, Development and Management Advanced Reactor Analysis General Electric-Hanford; Director Advanced Reactors Rockwell-Atomics International; CEO Space Power Inc. CEO International Scientific Products; US Director International Energy Technologies (INERTEK) Russian-American Joint Venture.

FIGURE 1



Sources: DOD, DOE
State of the World 1999; Time 2001 Almanac; ICMJ Prospecting & Mining Journal Mar 2004; Color of Oil, Economides & Oligney
*JR Wetch - Author **Projections Based On Collective Data*

LICENSED NUCLEAR SITES & POSSIBLE SUNREP REGIONS

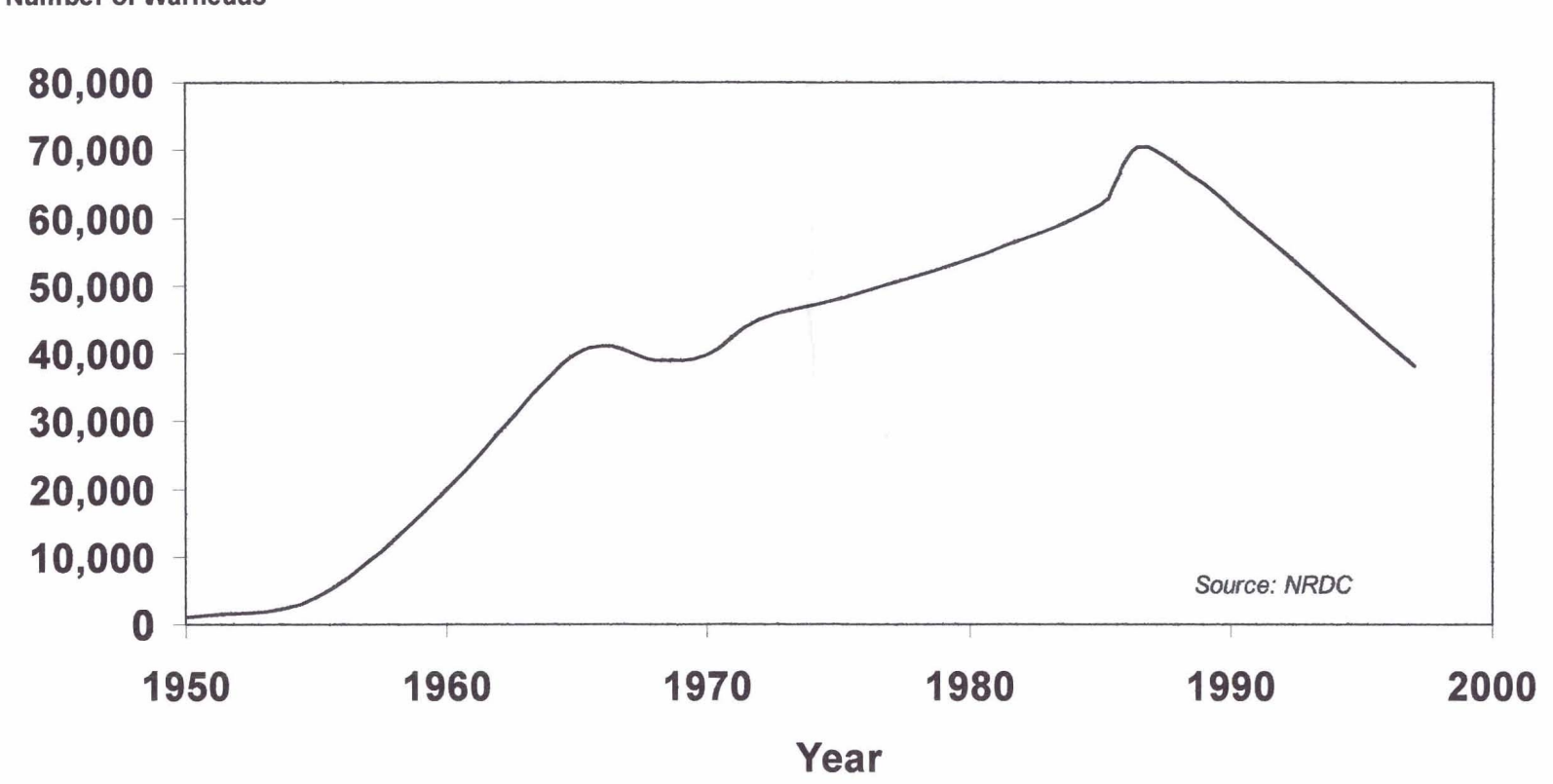


X — Arbitrary Representation of potential U.S. SUNREP sites to collect spent fuel from existing reactors.

FIGURE 3

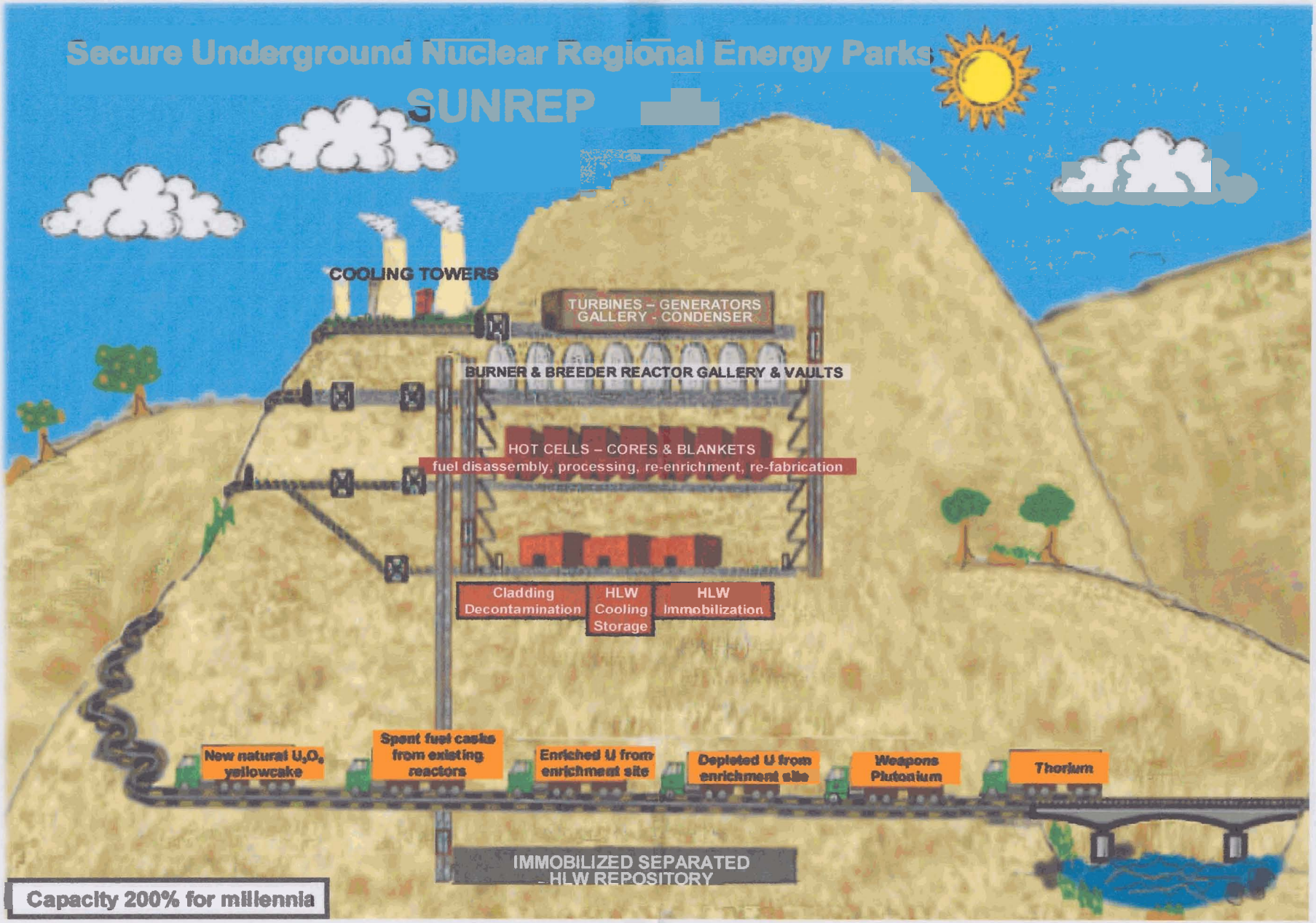
Global Nuclear Stockpiles, 1950-1997

Source: State of the World 1999



Estimate: **@ ~7 Kg / Warhead ~ = 280,000 Kg** **@ ~500 Kg / Seed Cores ≈ 400 Seed Cores to start**
Estimate Source: Joe Wetch (author)

FIGURE 4


Secure Underground Nuclear Regional Energy Parks
SUNREP
COOLING TOWERS
TURBINES – GENERATORS
GALLERY - CONDENSER
BURNER & BREEDER REACTOR GALLERY & VAULTS
HOT CELLS – CORES & BLANKETS
fuel disassembly, processing, re-enrichment, re-fabrication
Cladding Decontamination
HLW Cooling Storage
HLW Immobilization
New natural U_3O_8 yellowcake
Spent fuel casks from existing reactors
Enriched U from enrichment site
Depleted U from enrichment site
Weapons Plutonium
Thorium
IMMOBILIZED SEPARATED HLW REPOSITORY
Capacity 200% for millennia