TO:
Representative Mike Pompeo

Info CC:
Senator Pat Roberts
Senator Jim Moran
State Representative Virgil Peck

Date: 28 September 2012

Ref: your email response of 14 Sept 2012

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Thank you for your prompt reply. I do indeed have several observations and suggestions for specific actions by the federal government to "reactivate" or "reanimate" the American economy and thus the American dream. This is a complex topic and I have used an outline format. I would be pleased to discuss in greater detail any of the items shown or implied below with you or your staff. The best way to contact me is by email at gmcduffee@mcduffee-associates.us .

A MOST CRITICAL ITEM THAT REQUIRES YOUR IMMEDIATE ATTENTION is the rumored effort by the NRC to scrap several thousand kilograms of uranium-233 in the U.S. stockpile as unneeded "to save money." The reason this is critical is because a thorium fueled reactor does not directly "burn" thorium-232, but first converts it to uranium-233, which is what actually fissions releasing huge amounts of energy. It is thus necessary to provide an initial charge of uranium-233 to start a LFTR or other thorium fueled reactor. Disposal of the uranium-233 will not totally stop U.S. thorium reactor development and deployment, as other fissionable materials such as uranium-235 or plutonium can be used to start the cycle, but these are both highly dangerous and are bomb material, requiring very special handling. Any actual cost savings resulting from the scrapping or other disposal, at very considerable contractor cost (said to be several hundred million dollars) will be minimal as there will be no reduction in the required nuclear repository capacity. While I have no exact details, this appears to be yet another effort at sabotage by a captured regulatory agency (see item 2 below) of any progress toward replacing the existing orthodox uranium fission cycle nuclear power reactor with a much safer successor technology.

Executive Summary

The following memorandum is a brief outline of the following proposed integrated program to productize and deploy a proven, but currently unused technology, to produce large amounts of safe, dependable and cheap power, both conventional electrical power and process heat , up to about 700° C, and high pressure,/superheated steam.

The immediate benefit of the implementation of this program is the allocation of "stimulus" funds into areas which will produce lasting economic benefit, laying the foundation for economic recovery and providing meaningful employment to our highly skilled and educated Scientists, Technicians, Engineers, and Mathematicians [STEM], our heavy industry, and our expert construction sectors.

Little if any "new" money should be required, only the reallocation of existing funds.

In the slightly longer term, ***this program has immense National Defense implications***, as it will provide substantial, if indeed not total, independence in energy, petrochemical feedstock for existing plants, water and food, as well as restoring the traditional American technology and innovation preeminence in these critical areas, which should stimulate the direct and support economic sectors.

The fuel for this technology [liquid fluoride thorium reactor - LFTR] exists in large quantities in the United States, and development/deployment of this technology will provide not only a very significant, if not complete, degree of energy independence, but by replacing fossil fuels such as coal, natural gas and petroleum for many stationary uses, it will not only **reduce costs and air pollution**, but can make the fossil fuels currently used available for much more useful purposes such as feed stock for photochemical plants, i.e. plastics and fabrics, and can re-allocate the replaced petroleum to liquid fuels that cannot currently be economically replaced, such as gasoline, diesel and JP4, because of the immense investment in existing distribution systems and engines.

The very low cost generation of process heat and high pressure steam makes the conversion of not only the abundant domestic of coal and natural gas to synthetic petroleum, extremely attractive economically (currently estimated at 50$US/bbl) but can also economically justify the conversion of most any organic waste material, such as agricultural waste, forestry waste, food processing waste, municipal waste, medical waste, and sewage sludge, which must currently be disposed of in increasingly limited and expensive land fills, into synthetic petroleum, not only eliminating the disposal costs, but converting these wastes into an asset.

This technology will also solve another disposal problem, that of the so-called high-level nuclear waste or "spent" uranium/plutonium reactor fuel elements as these can be used as supplementary fuel, not only recovering the currently unrecoverable 99.5% of the wasted energy, but also reducing the physical bulk of the "waste" by 90 to 99%, and the radioactive half life by orders of magnitude, so that secure storage required of these products is only a few hundred years at most, rather than the tens of thousands of years projected for storage of the "spent" uranium/plutonium fuel elements at facilities such as "Yucca Mountain." ***There are an estimated 78 thousand tons of "spent" nuclear fuel elements, and this can provide many years of supplemental LFTR fuel at little or no cost.***

1 The material output per individual in all known societies depends on the amount of energy available to the individual, from the wind mills and water wheels of antiquity, to the nuclear power plants of today.

We are approaching, if we have not already reached, the limits of per capita energy available using existing deployed technology. While there may be some increases in total conventional energy production, this is expected to be swamped by the increase in population, and thus available energy actually decreases on an individual basis.

2 Every stage of technical progress, for example the introduction of the wheel which rendered pack trains largely obsolete, through the canals which rendered the wagon trains obsolete, the introduction of steam trains which made the canals redundant, and the introduction of motorized road transport which challenged the entrenched goods transportation monopoly of the trains, progress has been resisted. What is different today is the use, by the industry being replaced, of the regulatory process to delay and in many cases thwart the introduction of the new technology. One example was the extensive use of the ICC by the railroads to delay any expansion of motorized road transportation. Of course, in the end such obstructionism is futile, but the process wastes enormous amounts of time and generates tremendous costs for the consumers and taxpayers.

3 The value of petroleum and natural gas as feedstock and derivative specialty liquid fuel for mobile use, **for which there is not yet any viable alternative**, i.e. gasoline, diesel, and JP4, especially when the existing distribution systems and stocks of engines is considered, is now simply too great to continue to use it as fuel for large scale stationary operation, where lower cost and less polluting alternatives exist.

4 Unless new sources of energy are quickly developed and rapidly deployed our economy will, at best, continue to stagnate and will most likely decline. While “renewable” energy such as solar, wave and wind have some potential in special circumstances, the clear progression must be to nuclear power.

4.1 There are two basic types of nuclear power, fission[1] and fusion[2].

4.2 While theoretically appealing, fusion power is many years from practical implementation, despite the enormous sums of tax payer money being invested by many countries.

4.3 There are two possible nuclear fission types categorized by the fuel used, i.e. uranium/plutonium and thorium.

1 http://en.wikipedia.org/wiki/Nuclear_fission
2 http://en.wikipedia.org/wiki/Fusion_power

5 Several types of uranium fission reactors[3] have been developed and deployed, but this is obsolete technology, roughly on the same order as vacuum tube technology in electronics. While there may well be a need for a few uranium fission reactors, for example to produce uranium-233 as the starter fuel for thorium LFTR reactors and/or the production of specialty radioisotopes for medical uses, uranium fission technology is simply too complex, too dangerous operating at high pressure, producing bomb making materials as an unavoidable byproduct, and too expensive/inefficient for continued development and general deployment where a viable alternative exists, namely thorium fission reactors.

Current uranium fission technology can only extract 0.50% or less of the potential energy in a fuel rod/element before this requires reprocessing. This reprocessing is so complex and expensive, the "spent" fuel rods, still retaining > 99.5% of their potential energy are simply stored, many on site, such as Fukushima, where they present a very considerable danger, prior to transport to expensive and contentious long term (c. 10,000 years) secure storage e.g. Yucca Mountain.

5.1 A properly designed and configured thorium fueled reactor can use existing "spent" nuclear fuel elements as an auxiliary fuel source, greatly reducing their physical volume, and reducing the required safety storage period to c. 200 years.

5.2 Uranium is a rare element about like platinum, while thorium is much more common, about like lead, and these are priced accordingly. Indeed, thorium is currently a nuisance byproduct of the production of rare earth elements such as niobium, as it must be handled as a low level nuclear waste.

6 It is therefor suggested, that the PROVEN alternative thorium fission technology be productized and deployed as soon as possible. This technology was invented at Oak Ridge in the late 1960s, **is owned by the U.S. Government**, but was never developed/commercialized as the pressurized water uranium reactor was selected by Admiral Rickover to power "his" nuclear Navy, as it had 15-20 more years of development than LFTR at that point. LFTR was developed specifically to power a ultra-long range nuclear power bomber, and when this was canceled, so to was all work on the LFTR reactor. LFTR is inherently much safer than uranium fission as it operates at atmospheric pressure, eliminating the possibility of a mechanical explosion, any bomb material produced is much more difficult to access or process than that produced by uranium fission, and the suggested molten salt moderated/cooled thorium fission process is intrinsically stable, making control much easier, and the reactor can easily be designed to be fail-safe. The suggested configuration of the thorium fission reactor is LFTR [liquid fluoride thorium reactor] and not thorium simply added to the fuel elements/rods of existing design uranium fission reactors as the only benefit of this "on the cheap" approach is a slight increase in the nuclear fuel supply.

For LFTR background information and history see:
http://en.wikipedia.org/wiki/Liquid_fluoride_thorium_reactor
http://www.scientificamerican.com/article.cfm?id=next-generation-nuclear

3 http://en.wikipedia.org/wiki/Nuclear_reactor#Classification_by_type_of_nuclear_reaction

For a short video clip on current LFTR see:
http://www.youtube.com/watch?v=uK367T7h6ZY

For a long video clip with considerable detail on LFTR see:
http://www.youtube.com/watch?v=D3rL08J7fDA

N.B. It should be noted that the P.R.C., having large amounts of thorium produced as a byproduct from their mining of the rare earth elements, and having both an increasing need for clean energy and a need to make more of their existing petroleum and natural gas available as feed stock for their petrochemical industries (as have all the developed countries) has established an “accelerated” LFTR program. The PRC acronym for this is TMSR [thorium molten salt reactor] As the PRC is implementing an “accelerated LFTR/TMSR program, they may well develop the foundational technology and methodology required for commercial deployment and, as they have every right to do, patent this intellectual property. This will leave the U.S. companies and government two choices: pay the PRC royalties to use “their” LFTR/MSTR technology or do without.

For video clips on the P.R.C. TMSR program see:
http://www.youtube.com/watch?v=5UT2yYs5YJs
http://translate.google.com/translate?sl=de&tl=en&js=n&prev=_t&hl=en&ie=UTF-8&layout=2&eotf=1&u=http%3A%2F%2Fwww.freiewelt.net%2Fblog-4669%2Fchina-baut-thorium-reaktor.html

7 The rationale for suggesting that the thorium reactor should be “productized” is to prevent the traditional design and manufacture of custom bespoke/one-off reactors at excessive prices and lead times, with difficult to obtain replacement parts, and the training/maintenance complexity this introduces, where every unit is unique, every control system/panel layout is different, and special training/qualification is required for each unit. Serial production of standard units will generate cost savings at every stage, e.g. design, sourcing, production, training, maintenance, and decommissioning, and will promote evolution of reactor design based on field experience and feed-back.

8 There are a number of interlocking reasons why this should be a program of the federal government rather than a private effort. [4] Among these, in no particular order are:

8.1 No individual company or reasonable consortium of companies has enough venture capital.

8.2 The companies with expertise in reactor design all have a vested interest in the obsolete uranium fission technology, and therefore are highly unlikely to devote their best efforts to making their capitalized assets in this area of salvage value only.

4 http://fuelfix.com/blog/2012/09/24/decades-of-federal-dollars-helped-fuel-gas-boom/

8.3 As a federal effort, the obstructionism, delay, foot dragging, etc., expected from the industry "captured" regulators, such as the EPA, FERC, NRC, etc. can easily be bypassed, as can anti-/reactionary state/local agencies, with suitable language in the enabling act.

8.4 The immense amount of intellectual property such as technology, methodology, trade secrets, patents, and expertise, expected to be generated by a dedicated LFTR program should unquestionably be the property of the federal government, as trustee for the taxpayers, who will have paid for it.

For sone current examples of abuse of the patent system see:
http://tvnz.co.nz/business-news/patent-wars-spread-start-ups-5086536
http://www.forbes.com/sites/connieguglielmo/2012/08/24/apple-samsung-patent-war-a-quick-guide-to-the-courtroom-play-by-play/

8.5 A LFTR program will provide desperately needed suitable employment for our currently unemployed but highly educated, motivated and talented scientists, engineers, technologists, and technicians, in the fields for which they were trained.

8.6 Extensive LFTR deployment will significantly improve the domestic infrastructure for the 21st century in exactly the same way the Grand Cooley and Hoover dams did in the west, the TVA did in the eastern non-developed areas in the 1930s, and the interstate highway system did nationally in the 1950s. Development and wide deployment of LFTR reactors will provide the critical energy basis for not only an economic "recovery," ***but a significant expansion*** of the U.S. economy and improved individual incomes as well as significantly contributing to American energy independence and national security.

8.7 Taking the highest estimates of domestic energy consumption growth and the lowest estimates of domestic economically recoverable thorium, there is enough domestic thorium to power the U.S. for at least the next 250 years, by which time the technology required for the commercial deployment of hydrogen fusion reactors should at last be available.

9 It is suggested the LFTR project should be a GSE [government sponsored enterprise] organized as a plain vanilla limited liability for-profit federally chartered corporation, with the federal government owning 100 % of the stock. There are many reasons for suggesting this particular form of organization, a few of which, in no particular order, are:

9.1 This organization allows easy "phased" "privatization" when desired, for example by selling small lots of stock into a "up" market. Serious consideration should be given to retaining 51% government ownership, or at least a "golden" share, as this can help prevent the hi-jacking of the company by a supranational corporation resulting in asset stripping, job exports, and technology transfer, ending in a "planned bankruptcy" or to use the more descriptive street name "bust out scam."

9.2 This form of organization keeps the real and personal property of the corporation on the local tax rolls.

9.3 This form of organization avoids adding to the civil service headcount, and allows much quicker and more flexible employee acquisition and management.

9.4 This form of organization isolates the assets/costs, requires annual auditing by an accredited accounting firm, issuance of quarterly and annual financial reports, and facilitates accurate accounting under GASB rules. Of course this is not “fool proof” as shown by Lehman, Enron, Phar-Mor, WorldCom, Freddy and Fannie, etc. but it is much better than nothing, e.g. the Federal Reserve Bank.

9.5 Organization as a standard corporation also bypasses the problem of uncertain annual funding due to the two year Constitutional limit on appropriations, as the initial stock purchase can be made at one time, and the capital released from internal imprest [http://en.wikipedia.org/wiki/Imprest_system] or escrow accounts over time to provide steady funding over several years without the need for additional governmental appropriations, with the potential for political interference.

10 A number of highly important consequences result from the availability of abundant supplies of cheap reliable and safe power provided by large-scale LFTR deployment which justify this significant and extensive effort. Some of these, again in no particular order, are:

10.1 Water Security - The recent drought has proven the susceptibility of America to water shortages, from individual usage, through process water for industrial operations, to crop production. **Climate models and historical analysis indicate the North American continent is entering a new dry age, where drought is the new normal.** Abundant, cheap and reliable power permits both the economical desalinization of large quantities sea water and the economic transport of this water to where it is needed by pipeline and pumping stations. Enclosing the water in pipelines will prevent evaporation loss and will help safeguard the water against accidental or deliberate contamination. The concentrated brine produced as a desalinization byproduct can be a useful source of minerals or can be returned to the ocean. Several desalinization plants have been constructed or are in the planning states in the U.S., but excessive energy prices have prevented activation or construction. *It seems obvious that one or several LFTR units located on site would provide ample low cost power to enable activation/construction as well as helping to meet local/regional needs for electricity.*
http://news.yahoo.com/desalination-no-panacea-calif-water-woes-174531736.html?_esi=1

For information and background on reverse osmosis desalinization see:
http://en.wikipedia.org/wiki/Reverse_osmosis
For video clips on reverse osmosis desalinization see:
http://www.youtube.com/watch?v=DT4FcyZmmJ4
http://www.youtube.com/watch?feature=endscreen&v=Eun90XW12Mo&NR=1

10.2 Food Security (Quantity) – With ample supplies of low cost and high quality water, American food production is safeguarded. To be sure, conventional irrigation is possible in many areas, but this is not the most efficient in its use of water, it is very labor intensive, and it requires special field preparation/leveling. While somewhat higher in energy requirements, both for the water pumped at higher pressure and the electricity required for the automatic movement of the sprinklers, proven center-pivot and lineal/lateral move powered sprinkler systems are suggested for field crops such as wheat, corn, soy, etc. Orchards can economically use drip-feed irrigation to provide water in exactly the locations and amounts required. In both cases, fertilizers and micro nutrients/trace elements can be added to the water, further reducing the labor required and improving crop yield/quality. The abundant cheap power from LFTR and the "waste" heat, make advanced, highly efficient and productive, agricultural techniques such as aeroponics, aquaponics, and hydroponics for produce and micro-greens such as tomatoes, lettuce, bell peppers, etc., much more economically viable in almost all locations including highly urbanized areas, as the two main growing expenses, heat and light, are much cheaper. The amount of labor required, particularly "stoop labor," is drastically reduced by these techniques. From a macroeconomic perspective, *this has the potential to drastically reduce our balance of payments deficits by eliminating the need to import most fruits and vegetables* although some imports will continue such as "out of season" fruits, e.g. apples from the southern hemisphere, or tropical tree fruits such as mangoes.

For background information on modern irrigation techniques see:
http://en.wikipedia.org/wiki/Center_pivot_irrigation
http://www.dripirrigation.com/drip_irrigation_tutorial

10.3 Food Security (Safety) – While produce and micro-greens are of particular concern, as these are largely consumed raw, the safety of field crop and orchard products, and the impact this production has on the environment, can also be improved if desalinized water (without harmful trace elements such as selenium,chromium, mercury and arsenic) and high-tech irrigation is used, as the amount of fertilizers and micro-nutrients applied can be limited to what is required, run-off can be minimized, and with proper crop management/location/rotation biological problems can be minimized, reducing the need for biocides, all of which will help reduce the farmers' costs in addition to improving product and environmental safety.

As indicated, the major improvements in food safety resulting from cheap LFTR power for heat and grow-lights, is the hydroponic cultivation of produce and micro-greens. This will improve food safety for many reasons.

For some recent examples of food contamination see:
http://foodpoisoningbulletin.com/2012/recalled-romaine-lettuce-from-tanimura-antle-was-sold-at-walmart-safeway-and-pak-n-save/
http://www.cbsnews.com/8301-504763_162-57516798-10391704/kroger-recalls-fresh-selections-bagged-spinach-in-15-states-over-listeria/

10.3 continued ...

A few of the major food safety considerations, in no particular order, are:

10.3.1 As most of the produce can be grown domestically, this eliminates the need or economic motive to import from other countries which may use unapproved or banned pesticides, and/or are careless about sanitation in the growing, harvesting, processing and transport.

10.3.2 As hydroponics is almost exclusively done in green or hot houses, the produce is isolated from contamination from small animal or bird droppings, and as these crops are isolated, with proper sanitation, there is minimal to no chance of insect infestation or wilt/rust/fungus infection, eliminating the need for the application of any pesticides.

10.3.3 Cultivation of crops using hydroponics allows total control of the environment, including the water. This can be deionized or desalinized, removing harmful trace elements such as arsenic, selenium, mercury, and chromium, while allowing the easy application of micro-nutrients such as zinc, iron or potassium. Temperature and humidity can be maintained at the optimum. The light/dark cycles can be optimized, as can the light spectrum, to maximize growth. Although not currently in wide use, the atmosphere can be "spiked" with CO^2 to accelerate growth.

Because of much greater productivity per unit area (typically 5X or more) compared to field cultivation in most locations, hydroponics makes the local cultivation of produce and micro-greens, even in high-density urban environments, entirely practicable. This has several very beneficial consequences:

* Costs to transport are minimized. In this context it is worth remembering that most of the transport is by road, increasing congestion/traffic and consuming considerable fuel;

* The processes of consolidation, transport, and break bulk, all present opportunities for contamination, which are largely eliminated when produce is locally grown and consumed;

* **A bonus with hydroponics is a significant increase in suburban/urban jobs, which are so desperately needed.** While most of these jobs are indeed manual labor, it is not the "stoop labor" we typically associate with the production of produce, but more like assembly line work as shown in the video clips below. Some higher tech jobs will also be generated such as water analysis technicians and computer/PLC technologists. *An important feature is that these jobs can be performed by the typical residents of the area, possibly with some post high-school training, and Nobel Laureates are **not** required.*

See how hydroponics is being used on a small scale for hospital food:
http://www.wellness.com/news/12903/hospital-based-greenhouse-flourishes/health-and-wellness-news

hydroponics background and videos:
http://en.wikipedia.org/wiki/Hydroponics
http://www.youtube.com/watch?v=lk7-DS03n34
http://www.youtube.com/watch?v=tqcBCcSLDlo

10.4 *Production of Low Cost Synthetic Petroleum and Organic Waste Disposal* -

THIS IS A UNIQUE NICHE FOR LFTR TECHNOLOGY AS THE REACTOR OPERATING TEMPERATURE OF 700°C IS IDEAL FOR SEVERAL TYPES SYNTHETIC PETROLEUM PRODUCTION PROCESSES, AND CAN EASILY/CHEAPLY GENERATE THE LARGE AMOUNTS OF SUPER-HEATED STEAM REQUIRED. Depending on the location and availability of electrical power from other sources, it may be less expensive to erect a heat and steam only LFTR, thus greatly reducing the cost/time required for deployment as the very expensive and long lead time components required for generating electricity, i.e. turbines and generators, would not be required. A closed cycle Brayton, Erickson or Sterling engine[5], powered by the LFTR heat, possibly using a high efficiency working fluid such as compressed hydrogen or helium, can be used to directly power the process gas compressors.

It should be noted that if agricultural, forestry, municipal, industrial food processing, etc. wastes are used as a feedstock, additional fossil carbon will ***not*** *be liberated into the environment when the fuel derived from this synthetic petroleum is consumed, rather carbon that is already present in organic waste is simply being "recycled," and if a LFTR unit is used to provide the process heat, steam, and gas compression required (as high as 300 bar), no process fossil carbon, NOx, etc. will emitted either*

Two important qualifications about this use of LFTR should be noted:

* The production of synthetic petroleum, for the most part, is existing commercial technology. The drawback is that it is very energy intensive, and a significant amount of the feedstock must be consumed in order to produce the required process heat, steam, and electrical power for plant operation such as high volume/high pressure compressors. This means the processes, while for the most part economically viable, are not nearly as profitable as they could be and the synthetic petroleum yield is far lower than it should be. When low heat content feed stocks such as municipal waste, agricultural waste or sewer sludge are used, outside fuel, for example natural gas or coal must be used, and this process tends to be uneconomic. A LFTR unit can directly supply the process heat and steam, boosting yield by eliminating the use of feed stock as fuel, and eliminating another source of pollution as there are zero atmospheric emissions from LFTR operation.
* The "slag" or "dust" the videos refer to is the "fly ash" produced when coal is burned in conventional boilers/furnaces. Far from being a "waste" product, this contains commercial amounts of rare earth elements[6], currently a PRC monopoly, and significant amounts[7] of uranium and thorium. The energy contained in this thorium is greater than the chemical

5 http://en.wikipedia.org/wiki/Ericsson_cycle http://www.ornl.gov/sci/scale/pubs/SOL-05-1048_1.pdf
6 http://en.wikipedia.org/wiki/Rare_earth_element http://www.gazette.com/articles/ash-139528-power-fly.html
7 http://www.scientificamerican.com/article.cfm?id=coal-ash-is-more-radioactive-than-nuclear-waste
http://pubs.usgs.gov/fs/1997/fs163-97/FS-163-97.html

10.4 continued ...
energy released by burning the coal, and the uranium can be used as a "booster" but not primary fuel in a LFTR reactor. That is the LFTR chain reaction depends on the conversion of thorium to U233, and the fission of U233 in its core for its major energy production, but with the excess of neutrons generated, the fly ash or slag derived uranium can be made to fission, generating additional energy. The depleted slag or fly ash can then be incorporated into cement as an ingredient or concrete as fast setting aggregate/additive, solving yet another disposal problem.

Background information on synthetic petroleum production:
http://en.wikipedia.org/wiki/Synthetic_fuel
http://en.wikipedia.org/wiki/Fischer%E2%80%93Tropsch_process
http://en.wikipedia.org/wiki/Coal_liquefaction

Videos about synthetic petroleum production:
http://www.youtube.com/watch?v=5EKEOhxRFVs
http://www.youtube.com/watch?v=mWI85qM7Onw
http://www.youtube.com/watch?v=ILAiQURrMH0

10.5 Disposal/Utilization Of Existing High-Level Nuclear "Waste" -

One of the more interesting facts about high-level nuclear waste, which is almost entirely "spent" uranium fission reactor fuel elements is it is not waste at all, as 99.5% or more of the nuclear energy the fuel element originally contained is still present in the "spent" fuel elements.

There are four main reasons why a fuel element which retains 99.5% of its energy is considered "waste:"

* The fission products resulting from uranium fission have different physical volumes, and as these accumulate, they cause the zirconium cladding to bulge, resulting in the possibility of a "stuck" fuel element in the reactor, unless it is replaced;

* Some of the fission products are gasses, and pressure builds up within the fuel element, to a point where a catastrophic physical failure with the sudden release of large amounts of highly radioactive contamination a possibility, unless it is replaced;

* Some of the material in the fuel elements does not fission, but is transmuted to another element, e.g. uranium to plutonium, which again is different in not only physical volume, but other important engineering characteristics such as lower heat transfer; and again results in not only the potential bulging of the cladding, but can result in localized overheating; and

* Perhaps the most important reason, many of the products that result from the uranium (or plutonium) fission process are nuclear "poison" in that they absorb large amounts of neutrons without fissioning, slowing, and eventually stopping, the nuclear chain reaction unless the fuel elements are replaced.

The difficulty, danger and expense of reprocessing these “spent” fuel elements is so great, this is seldom done commercially, so these accumulate. Additionally, with a uranium reactor, large amounts of plutonium, which is a deadly environmental poison, in addition to being a prime nuclear bomb material, is generated from the uranium fuel, and this is easily separated chemically (albeit at considerable personal risk of radiation poisoning) as it is a distinct element from, and not an isotope of, uranium. **There are an estimated 78 thousand tons of “spent” fuel elements in storage, and this represents many years of supplementary fuel for LFTR units.**

While, from a security, transportation, technology and economics viewpoint, *utilization of the spent uranium/plutonium fuel elements is most like practicable only at larger LFTR installations* (c. 250 Megawatt reactors), a LFTR unit can extract almost all of the energy present in the “spent” fuel elements when used as an auxiliary or supplemental fuel. **While overly simplified**, the “spent” fuel elements are dissolved in a bath of liquid salt coolant, the radioactive gasses dissolve (or are entrained) in the molten salt as are most of the solid elements, particularly the uranium, plutonium, and other actinide[8] elements, which are the source of the intense radiation of the “spent” fuel elements. Using standard mechanical techniques, such as skimming the sludge from the top of the salt, and allowing other materials to settle to the bottom of the processing tank, the remaining fissionable materials can be routed to the LFTR core. Any entrained gasses generated can be separated out of the molten salt by standard de-areation processes, and some of these gasses are very valuable. The physical quantity of high level nuclear waste is reduced from 90 to 99%, the waste material is much less radioactive, and the radioactive half life is much shorter, limiting the amount of time required for secure storage to a few hundred years. As almost all of the proposed LFTR salts are NOT soluble in water, the slag and sludge wastes are inherently “vitrified” for safe storage.

Background on High level nuclear waste / “spent” fuel rods
http://en.wikipedia.org/wiki/Spent_nuclear_fuel
http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html

A few videos on the utilization of uranium and using LFTR units to “burn” the “spent” uranium reactor fuel rods and fissile bomb material as supplemental fuel.
http://www.youtube.com/watch?v=Q3EGOL4J6yI
http://www.youtube.com/watch?v=mXH2rBRVAuc
http://www.youtube.com/watch?v=G26yh-0_SzI

8 http://en.wikipedia.org/wiki/Actinide

10.6 **Energy Independence and National Defense considerations -**

In the current era of unconventional warfare such as economic, trade and information wars, the implementation of this project, and the domestic developments this is expected to generate in the economic sectors which it will support, ***are critical***. *If a conventional war should occur, this project will be decisive* by insuring the supply, under domestic control, of not only the most necessary electrical energy and liquid fuels, but the feed-stocks for our petrochemical plants to produce plastics, fertilizers, textiles, and food, upon which prosecution of a successful conventional war effort has always depended.

Detailed information about the interrelationship between energy independence and national defense can be found at:
http://www.carlisle.army.mil/library/bibs/EnergySecurity2012.pdf

Development and widespread deployment of LFTR technology also eliminates the continual need for the US to become involved in distant, highly contentious and expensive, conflicts, as the required energy and petroleum feed-stocks will be available more cheaply (and dependably) when sourced domestically, with the added advantage that any industrial and infrastructure improvements required will be located domestically, will use domestic labor, and will use domestically produced materials, generating domestic economic growth and activity as well as domestic tax revenue.

For background information and detail see:
http://www.ndu.edu/inss/docuploaded/SF%20262%20Andres.pdf