Project Prospectus – GEM*STAR Subcritical Reactor Design

Dr. Charles Bowman, President ADNA and Dr. David L Blond, Consultant

Objective

ADNA Corporation is seeking investors interested in developing a new, zero carbon emission, sub-critical nuclear reactor designed around a linear accelerator using molten salt transfer producing clean, high temperature heat for purposes of electric power generation, industrial requirements including turning waste cellulose solids (from agriculture and fire damaged wood) into diesel fuel using a modified Fisher-Tropsch conversion method.

GEM*STAR reactor's design is inherently safe due to the use of sub-critical nuclear materials thus requiring simplified control features**. Neutrons to sustain the nuclear reaction are supplied using linear accelerators so shutting the power to the accelerator stops the nuclear reaction.** Waste nuclear by-products are used thus solving the problem posed by the hundreds of thousands of tons of nuclear by-products currently without viable and safe disposal alternatives. Multiple passes through GEM*STAR reactors renders remaining fissionable materials sufficiently reduced to allow long-term disposal in oceans mixing salt solutions with existing sea water without raising radioactivity in any measurable way.

Potential fuels for recycling include:

- Weapons Grade Plutonium salvaged under START agreements and without safe storage options (over 55 tons in the US and a similar amount in Russia);
- Spent nuclear fuel from existing light water reactors without current storage options (over 60,000 tons) stored on reactor sites accumulating at a rate of 2000 tons per year;
- Unprocessed uranium ores and deplete uranium; and
- Thorium

There are currently no solutions available to the problem of disposal of W-Pu and spent nuclear fuels, but the ADNA GEM*STAR reactor could turn these problems into solutions to the problem of long-term energy supply by reusing these fissionable materials in GEM*STAR Accelerator Driven reactors. ADNA estimates with advances in accelerator design and recurring use of these supplies there is sufficient unused energy potential to power the world economy for thousands of years.

ADNA is seeking second-stage investments that when combined with government guaranteed loans will allow the development of a reactor and liquid fuel plant to be built next to the current site or the LANSCE accelerator at Los Alamos making use of available beam from this underused accelerator and existing surplus structures next to the site. The goal is to build the reactor and liquid fuel plant to demonstrate safety and reliability to the Nuclear Regulatory Agency in a safe, government controlled, location selling the biodiesel produced to the US military thus remaining outside of the commercial sector.

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*ADNA currently has a small investment of $ 1 million and is entertaining a second stage investment of a minimum of $ 10 million to develop detailed engineering drawings and begin construction of reactor buildings at a site next to the existing LANSCE accelerator complex on property owned by DOE at Los Alamos. Additional financing will be required to complete the project although ADNA expects that government guaranteed loans may be possible under programs in support of nuclear energy. ADNA is interested in teaming with industrial partners to provide sufficient capital and managerial skills to make GEM*STAR type reactors a reality in the near future.*

Potential of Project

The initial phase project at Los Alamos is designed to demonstrate the scientific and economic advantages of accelerator driven nuclear fission as a solution to producing energy at low cost without adding to the amount of carbon in the atmosphere and contributing to global climate change. The pilot facility at Los Alamos Labs is designed to demonstrate a complete green fuel cycle by taking damaged wood surrounding the Lab into bio-diesel (or jet fuel) or petrochemical feedstocks for plastics without using crude petroleum, natural gas or coal.

The table shows how large the potential market is for this type of system based on the number of existing electric power plants using coal alone as a fuel source. As we will show in the second section GEM*STAR type reactors can be substituted incrementally as a heat source for coal, oil or natural gas in

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existing power plants rendering these older plants greenhouse gas neutral.

International Energy Summary Table (2006)						
	Electricity	**Heat**	**Electricity**	**Gem*Star Units**	**Green House Gases**	
World Total	***Unit: GWh***	***Unit: TJ***	**Mwe**	**Units**	**Metric Tons Carbon**	**Share Electricity**
Production from:						
- coal	7754636	4965736	1,001,891	4,554	2,023,959,996	40.8%
- oil	1096047	952329	141,608	644	286,068,267	5.8%
- gas	3806892	6704492	491,847	2,236	993,598,812	20.0%
- biomass	173332	317299	22,394	-	-	0.9%
- waste	66049	253917	8,533	-	-	0.3%
- nuclear	2793030	22399	360,857	-	-	14.7%
- hydro*	3120614		403,180	-	-	16.4%
- geothermal	59240	11577	7,654	-	-	0.3%
- solar PV	2781		359	-	-	0.0%
- solar thermal	1061	132	137	-	-	0.0%
- wind	130073	0	16,805	-	-	0.7%
- tide	550	0	71	-	-	0.0%
- other sources	10276	689319	1,328	-	-	0.1%
Total Production	**19014576**	**13917200**	**2,456,664**	**7,433**	**3,303,627,075**	**100.0%**

A Solution to Storage and Disposal of Nuclear Wastes

Currently there are no long-term solutions to storage of high level nuclear waste that eliminate the dangers of spontaneous nuclear reactions or weapons proliferation risks. GEM*STAR's design transforms high-level nuclear waste (W-PU and spent nuclear fuels) into lithium-salt solutions that are recycled until the remaining fissionable materials in the solution are too low to sustain any nuclear reaction. Disposal of remaining wastes in the oceans is a feasible and cost effective solution as ocean seawaters contain fissionable materials already.

ADNA estimates that known materials could power the world energy needs for a minimum of 5000 years. Accelerator driven nuclear reactors do not require major breakthroughs in physics.

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Stage One Plan – Demonstrate safety and reliability to the NRC

GEM*STAR is an accelerator-driven sub-critical reactor technology that combines neutrons supplied by an external source (linear accelerators) with subcritical fuel circulating in a molten salt graphite core. A prototype reactor is proposed by ADNA Corporation to be built at the site of the currently underused LANSCE accelerator facility at Los Alamos Labs to demonstrate the feasibility and simplicity of this solution to the world's energy needs.

Two concurrent technologies are under development – the ADNA Corporation GEM*STAR Molten Salt Reactor and the BCLF Corporation's biomass- to-diesel conversion technology (modified Fisher-Tropsch) with molten salt heat as the energy source. By using the existing accelerator and weapons grade plutonium on this DOE site, the cost for the 125-200 MWt reactor is just $ 32 million dollars avoiding the $ 100 million cost of building a linear accelerator. Adding the industrially sized liquid fuel plant able to produce 75 million gallons a year of diesel fuel is, based on the cost of the small pilot facility being constructed in Virginia, estimated to cost $100 million. Liquid fuels would be produced using supplies of fire damaged wood from the 400,000 acres of recently burned forest land. This diesel is to be sold to the Department of the Defense that presently consumes about four billion gallons a year of non-renewable diesel and gasoline. Because the reactor would destroy excess weapons plutonium, which is under the responsibility of the military, and because the sale of the diesel would be to the government, the usual NRC certification for a commercial license could be avoided. Once in operation then the NRC could study a working, full sized, plant and assuming the safety and efficiency is demonstrated then there should be no roadblocks to commercial certification.

Prototype Economics

The economics of the initial system are positive with respect to cost relative to income. Jet fuel made for the military from biofuels is sold at a premium. Current estimates are that the subsidy is at minimum $ 1.00 over wholesale prices. Prices today are at historical lows ($ 1.38 per gallon) and at these prices without the subsidy the system is marginally profitable. The main goal, however, of the project at Los Alamos is to demonstrate the safety and efficiency of the nuclear reactor unit. A reasonably detailed cost build-up on the reactor vessel and associated equipment, including the liquid fuel plant based on an industrial size of the prototype cellulose to diesel system being built in Virginia has been prepared (see Exhibit 1). We estimate the cost of the complete system at the high end including the liquid fuel plant and using LANSCE accelerator beam is $ 183 million. The plan would be to borrow the funds necessary to build it, using investor capital to pay the costs associated with the building loan until a mortgage can be secured. A seven year mortgage is proposed in the example below. The system is break-even without the subsidy and highly profitable with the subsidy.

As we have stated the plan is to demonstrate the nature of the GEM*STAR nuclear reactor to the NRC on the assumption that once the safety of the completed system is firmly established outside of the

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commercial realm then the NRC can give GEM*STAR type systems the necessary commercial license needed to make it useful for the larger market. After the initial system is in place is to pursue a number of different alternatives:

- Build a second larger plant with a new accelerator next to the prototype at Los Alamos to take advantage of the infrastructure and the Weapons Grade plutonium stored there with a larger liquid fuel plant.
- Build a plant with advanced accelerators tailored to GEM*STAR specifications at Savanah River using available waste cellulose and available (stored) Weapons Grade plutonium.
- License technology to power companies to convert existing, soon to be closed, coal fired plants using GEM*STAR reactors substituting for burning coal.
- License fuel technology to coal companies to convert coal to diesel fuels opening a new market for the coal industry.
- License GEM*STAR technology to companies with soon to be mothballed reactors allowing conversion of existing supplies of spent nuclear fuel stored on site to be used to generate power making use of generators, heat exchangers, and power distribution system.

Long-term Plans

ADNA Corporation owns the technology, but is not large enough to sustain a growth sufficient to meet the growing need of the world for carbon free, cost efficient, energy production. Our plan is to license the technology to companies with the expertise and free capital to expand rapidly while concentrating on improving the design for the reactor, accelerator, and liquid fuel plant. ADNA may pursue other business opportunities including specializing in running weapons grade plutonium conversion plants at sites owned by the US government thus minimizing the transport of W-PU off site while converting it into useful energy – electric power or biodiesel for sale to government or commercially.

Exhibit 1: Cost build-up for Phase I development

Gem*Star 120 to 200MWe Unit Cost Estimates						
		$ per Ton	$ per To			
Reactor Core	**Tons**	**High**	**Low**		**Material Costs**	
W-PU	0	$ -	$ -		$ -	$ -
Lithium	2.5	$ 7,000	$ 6,000		$ 17,500	$ 15,000
Graphite	175	$ 1,500	$ 1,000		$ 262,500	$ 175,000
Primary Materials Costs					$ 280,000	$ 190,000
Misc. Other Materials	Factor	0.50	0.50		$ 140,000	$ 95,000
Labor Fabricaton Costs	Percent of Total	0.30	0.30		$ 180,000	$ 122,143
Total Cost of Core Materials (includes processing)					**$ 600,000**	**$ 407,143**
Hastel alloy-N Shielding					$ -	$ -
Nickle	27.5	$ 52,300	$ 10,880		$ 1,438,250	$ 299,200
Mo	4	$ 45,000	$ 10,000		$ 180,000	$ 40,000
Chromium	2.5	$ 3,000	$ 2,000		$ 7,500	$ 5,000
Iron	1.5	$ 130	$ 70		$ 195	$ 105
Titanium	0.5	$ 9,500	$ 2,000		$ 4,750	$ 1,000
Primary Materials Costs					$ 1,630,695	$ 345,305
Misc. Other Materials Costs	Factor of Multiplicaton	4.00	3.00		$ 6,522,780	$ 1,035,915
Labor & Capital Cost		30%	30%		$ 3,494,346	$ 591,951
Cost of Hastel alloy-N Shielding					**$ 11,647,821**	**$ 1,973,171**
Outer Shell and Heat Exchanger					**$ -**	**$ -**
Steel for Vessel	79	$ 1,234	$ 682		$ 97,486	$ 53,878
Secondary Salt	14	$ 200	$ 100		$ 2,800.00	$ 1,400.00
Heat Exchange Piping	Height	Number U Shaped Tubes		Price per foot		
	12.5	80.00	1,000.00	250	$ 250,000.00	$ 250,000.00
Materials and Fabrication Costs for Reactor & Vessel					**12,598,107.43**	**2,685,592.29**
Salt Pumps	25	40000	25000		1,000,000.00	625,000.00
Targets	1	2000000	1000000		2,000,000.00	1,000,000.00
Assembly Costs, Contractor Overhead	Factor:	0.5	0.35		6,299,053.71	939,957.30
Total Costs of Reactor					21,897,161.14	5,250,549.59
Building Constructon Costs					**9,353,216.58**	**9,353,216.58**
Cost of Reactor & Buildig					**31,250,377.72**	**14,603,766.17**
Reactor & Building					$ 31,250,378	$ 14,603,766
Linkage to the LANSCE Accelerator		1			$ 10,000,000	$ 8,000,000
Miscellaneous Buildings					$ 5,000,000	$ 5,000,000
Liquid Fuel Plant	**75 million gallons per**	**1**			**$ 120,000,000**	**$ 95,000,000**
Contingency Factor (15%)		0.1			$ 16,625,038	$ 12,260,377
Total Cost					**$ 182,875,415**	**$ 122,603,766**
Weapons Grade plutonium supplied by government mixed with Lithium salt before use in Gem-Star reactor. Liquid fuel plant based on scale-up						
from 4 million gallon prototype under construction in Virginia.						

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Initial Combined Gem-Star & Liquid Fuel Plant with LANCE Accelerator				
High Cost of Reactor & Liquid Fuel Plant	$ 182,875,415			
Interest Costs (assumes 7%)	7%			
Term in Years (7 year payoff)	7			
Inflation Rate (3.5%)	4%			
	Year 1	**Year 2**	**Year 3**	**Year 4**
Risk Capital (interest on building loans, years -4 through -1	$ 25,751,279			
Initial Loan Distribution/Principle Remaining	$ 182,875,415	$ 161,743,572	$ 139,132,500	$ 114,938,653
Level Term Mortgage	$ 33,933,122	$ 33,933,122	$ 33,933,122	$ 33,933,122
Interest Costs	$ 12,801,279	$ 11,322,050	$ 9,739,275	$ 8,045,706
Principle Costs	$ 21,131,843	$ 22,611,072	$ 24,193,847	$ 25,887,416
Operating Costs	$ 18,287,542	$ 18,927,606	$ 19,590,072	$ 20,275,724
Damaged wood costs (57 gallons per ton & 35 per ton of wood)	$ 45,939,797	$ 45,939,797	$ 45,939,797	$ 45,939,797
Nuclear Fuel Processing Costs	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
Accelerator Beam Cost	$ 5,000,000	$ 5,000,000	$ 5,000,000	$ 5,000,000
Processing costs	$ 104,160,461	$ 104,800,525	$ 105,462,991	$ 106,148,643
Wholesale Price Diesel	$ 1.38	$ 1.43	$ 1.48	$ 1.53
Biodiesel subsidy	$ 1.00	$ 1.04	$ 1.07	$ 1.11
Revenues from Combined plans	$ 2.38	$ 2.46	$ 2.55	$ 2.64
Costs per gallon of diesel	$ 1.39	$ 1.40	$ 1.41	$ 1.42
Estimated Revenues	$ 178,500,000	$ 184,747,500	$ 191,213,663	$ 197,906,141
Estimated Costs	$ 104,160,461	$ 104,800,525	$ 105,462,991	$ 106,148,643
Estimated Profits (with credits)	$ 74,339,539	$ 79,946,975	$ 85,750,672	$ 91,757,497
Estimated Profits without Credits	$ (660,461)	$ 2,321,975	$ 5,408,797	$ 8,603,657
Profit Margin on Revenues	**42%**	**43%**	**45%**	**46%**
	Year 5	**Year 10**	**Year 15**	**Year 20**
Risk Capital (interest on building loans, years -4 through -1				
Initial Loan Distribution/Principle Remaining	$ 89,051,237	$ -	$ -	$ -
Level Term Mortgage	$ 33,933,122	-	-	-
Interest Costs	$ 6,233,587	$ -	$ -	$ -
Principle Costs	$ 27,699,536	-	-	-
Operating Costs	$ 20,985,375	$ 24,924,042	$ 29,601,943	$ 35,157,823
Damaged wood costs (57 gallons per ton & 35 per ton of wood)	$ 45,939,797	$ 45,939,797	$ 45,939,797	$ 45,939,797
Nuclear Fuel Costs (processing costs of W-PU into lithium 7 salts)	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
Accelerator Beam Coss	$ 5,000,000	$ 5,000,000	$ 5,000,000	$ 5,000,000
Processing costs	$ 106,858,294	$ 76,863,839	$ 81,541,740	$ 87,097,620
Wholesale Price Diesel	$ 1.58	$ 1.88	$ 2.23	$ 2.65
Biodiesel subsidy	$ 1.15	$ 1.36	$ 1.62	$ 1.92
Revenues from Combined plans	$ 2.73	$ 3.24	$ 3.85	$ 4.58
Costs per gallon of diesel	$ 1.42	$ 1.02	$ 1.09	$ 1.16
Estimated Revenues	$ 204,832,856	$ 243,277,178	$ 288,936,972	$ 343,166,485
Estimated Costs	$ 106,858,294	$ 76,863,839	$ 81,541,740	$ 87,097,620
Estimated Profits (with credits)	$ 97,974,562	$ 166,413,339	$ 207,395,232	$ 256,068,865
Estimated Profits without Credits	$ 11,910,337	$ 64,196,037	$ 85,993,143	$ 111,881,267
Profit Margin on Revenues	48%	68%	72%	75%

Some Facts About ADNA & GEM*STAR

GEM*STAR, unlike current nuclear power plants, ***is a sub-critical reactor using linear accelerators to provide neutrons for fission.*** It is inherently safe and simple to build requiring no new breakthroughs in physics. GEM*STAR's safe design and modular nature appealed to me as the solution to many of the most difficult and intractable roadblocks to eliminating greenhouse gases both here and abroad by reducing dependence on fossil fuels for transport fuels, electric power generation, and as industrial heat sources.

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What Makes It Unique

GEM*STAR, an accelerator driven non-critical reactor technology, was by-passed during the Cold War build-up of our nuclear weapons program that was based on the perceived need for enormous amounts of weapons-grade plutonium. GEM*STAR is needed now to solve the problems that have come about from choices made at the start of the Atomic Age including:

- The decision to implement low enriched uranium with its dangerous waste by-products (over 70,000 tons of spent fuel), and the need for continuous chain reactions with the potential for meltdown. The need for costly multiple layers of defense against dangers inherent in today's design have driven capital costs so high as to make today's reactor designs difficult to deploy. The small modular reactors (SMRs) receiving much attention presently solve few of the fundamental problems of nuclear power even if they might prove to be somewhat advantageous for deployment.
- Uranium enrichment and reprocessing, which are essential for all of the U.S. DOE's present and future reactor designs for more complete exploitation of the uranium resource, couple nuclear power to nuclear weapons technology. GEM*STAR requires neither enrichment nor reprocessing.
- With nuclear energy too dangerous in much of the public mind, countries have expanded use of coal leading to rapid expansion of carbon-rich sources in the West and making "leaving coal" harder and costly both financially (sunk costs) and politically (unemployment in Coal Country).
- Industrial agriculture expanded with more enclosed animals in dairy farms, chicken coops, and animal feedlots adding to unsolved byproduct waste disposal problems.
- New reactor technologies – nearly all dependent upon enriched uranium – found their path towards commercialization blocked by long delays at the NRC and the risks associated with having to use enriched uranium from a safety point of view.
- Fusion even if ultimately successful will not be available soon enough, and alternative sources – wind, solar, and wave – all have problems in terms of maintaining baseload power and usually are not close to major population centers adding to the cost of transmission.

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Table 8.2 Cost and Performance Characteristics of New Central Station Electricity Generating Technologies

Technology	Online Year[1]	Size (mW)	Lead time (years)	Base Overnight Cost in 2009 (2008 $/kW)	Project Contingency Factor[2]	Technological Optimism Factor[3]	Total Overnight Cost in 2009[4] (2008 $/kW)	Variable O&M[5] (2008 mills/kWh)	Fixed O&M ($2008/kW)	Heatrate[6] in 2009 (Btu/kWhr)	nth-of-a-kind Heatrate (Btu/kWhr)
Gem*Star Accelerator Driven Fission	2014	60	4	3221	1.1	1	3543	3.36	35.34		
Gem*Star Accelerator Driven Fission	2014	200	4	2124	1.15	1	2443	2.02	30.48		
Scrubbed Coal New[7]	2013	600	4	2078	1.07	1.00	2223	4.69	28.15	9200	8740
Integrated Coal-Gasification Comb Cycle (IGCC)[7]	2013	550	4	2401	1.07	1.00	2569	2.99	39.53	8765	7450
IGCC with carbon sequestration	2016	380	4	3427	1.07	1.03	3776	4.54	47.15	10781	8307
Conv Gas/Oil Comb Cycle	2012	250	3	937	1.05	1.00	984	2.11	12.76	7196	6800
Adv Gas/Oil Comb Cycle (CC)	2012	400	3	897	1.08	1.00	968	2.04	11.96	6752	6333
Adv CC with carbon sequestration	2016	400	3	1720	1.08	1.04	1932	3.01	20.35	8613	7493
Conv Comb Turbine[8]	2011	160	2	653	1.05	1.00	685	3.65	12.38	10788	10450
Adv Comb Turbine	2011	230	2	617	1.05	1.00	648	3.24	10.77	9289	8550
Fuel Cells	2012	10	3	4744	1.05	1.10	5478	49.00	5.78	7930	6960
Adv Nuclear	2016	1350	6	3308	1.10	1.05	3820	0.51	92.04	10488	10488
Distributed Generation - Base	2012	2	3	1334	1.05	1.00	1400	7.28	16.39	9050	8900
Distributed Generation - Peak	2011	1	2	1601	1.05	1.00	1681	7.28	16.39	10069	9880
Biomass	2013	80	4	3414	1.07	1.05	3849	6.86	65.89	9451	7765
Geothermal[7,9]	2010	50	4	1666	1.05	1.00	1749	0.00	168.33	32969	30326
MSW - Landfill Gas	2010	30	3	2430	1.07	1.00	2599	0.01	116.80	13648	13648
Conventional Hydropower[9]	2013	500	4	2084	1.10	1.00	2291	2.49	13.93	9884	9884
Wind	2009	50	3	1837	1.07	1.00	1966	0.00	30.98	9884	9884
Wind Offshore	2013	100	4	3492	1.10	1.02	3937	0.00	86.92	9884	9884
Solar Thermal[7]	2012	100	3	4798	1.07	1.00	5132	0.00	58.05	9884	9884
Photovoltaic[7]	2011	5	2	5879	1.05	1.00	6171	0.00	11.94	9884	9884

1 - Online year represents the first year that a new unit could be completed, given an order date of 2009. For wind, geothermal and landfill gas, the online year was moved earlier to acknowledge the significant market activity already occuring in anticipation of the expiration of the Production Tax Credit.

2 - A contingency allowance is defined by the American Association of Cost Engineers as the "specific provision for unforeseeable elements if costs within a defined project scope; particularly important where previous experience has shown that unforeseeable events which will increase costs are likely to occur"

3 - The technological optimism factor is applied to the first four units of a new, unproven design, it reflects the demonstrated tendency to underestimate actual costs for a first-of-a-kind unit.

4 - Overnight capital cost including contingency factors, excluding regional multipliers and learning effects. Interest charges are also excluded. These represent costs of new projects initiated in 2009.

5 - O&M = Operations and maintenance.

6 - For hydro, wind, and solar technologies, the heatrate shown represents the average heatrate for conventional thermal generation as of 2008. This is used for purposes of calculating primary energy consumption displaced for these resources, and does not imply an estimate of their actual energy conversion efficiency.

7 - Capital costs are shown before investment tax credits are applied.

8 - Combustion turbine units can be built by the model prior to 2011 if necessary to meet a given region's reserve margin.

9 - Because geothermal and hydro cost and performance characteristics are specific for each site, the table entries represent the cost of the least expensive plant that could be built in the Northwest Power Pool region, where most of the proposed sites are located.

Sources: The values shown in this table are developed by the Energy Information Administration, Office of Integrated Analysis and Forecasting, from analysis of reports and discussions with various sources from industry, government, and the Department of Energy Fuel Offices and National Laboratories. They are not based on any specific technology model, but rather, are meant to represent the cost and performance of typical plants under normal operating conditions for each plant type. Key sources reviewed are listed in the 'Notes and Sources' section at the end of the chapter.

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	Conventional Nuclear (1 GWe)		5 Gem*Star Units (1 GWe)	
	Financed Costs	Base Price	Financed Costs	Base Price
	$ 5,692,500,000	$ 5,500,000,000	$ 2,528,614,964	$ 2,443,106,246
Interest Costs	7.0%		7.0%	
Term in Years	40		40	
Inflation Rate	3.5%		3.5%	
Calculated Mortgage	$ 426,989,523		$ 189,669,231	
Balance Remaining/Balance Financed		$ 5,565,897,143		$ 2,472,377,832
Level Term Mortgage	$ 426,989,523	$ 426,989,523	$ 189,669,231	$ 189,669,231
Interest Costs		$ 389,612,800	$ -	$ 173,066,448
Principle Costs		$ 37,376,723	$ -	$ 16,602,783
Operating Costs	2%	$ 117,580,944	1%	$ 34,819,726
Fuel Costs per year *	20%	$ 29,395,236	500%	$ 22,432,783
Total Carrying Costs		$ 573,965,703		$ 246,921,740
Operating Cost Share of Total		26%		23%
Electric Energy Costs per kilowatt hour				
	Kilowatt hours per year	$ -	Kilowatt hours per ye	$ -
Cost per kilowatt (operations+finance)	7,884,000,000	$ 0.073	7,884,000,000	$ 0.031
Finance Costs		$ 0.054		$ 0.024
Operating Costs		$ 0.015		$ 0.004
Fuel Costs		$ 0.004		$ 0.002
Greenhouse Gas Credits		$ 0.017		$ 0.015
Cost per kilowatt		$ 0.056		$ 0.015
Price Electric power				
Electric Powwer Price		$ 0.109		$ 0.095
Transmission Costs		$ 0.033		$ 0.029
Revenues from Generation		$ 0.076		$ 0.066
				$ -
Estimated Revenues		$ 597,106,708		$ 597,106,708
Estimated Costs		$ 573,965,703		$ 246,921,740
Estimated Profits		$ 23,141,005		$ 350,184,969
Estimated Profits (with GHG)		$ 158,847,075		$ 485,891,039
Margin on Revenues without GHG		4%		59%
Margin on Revenues with GHGCredit		27%		81%

Stage 2 – Longterm Future for Accelerator Driven Nuclear Power

Once NRC approval is given for GEM*STAR type reactors then the potential for changing the energy equation is significant for this system. GEM*STAR reactors use existing nuclear fuel stocks unable in a form that makes them useless for making weapons or starting uncontrolled chain reactions. Turned into salt solutions they offer incremental fissionable materials in a closed loop system where spent fuel is stored until the reservoir is removed and reused. As a high temperature molten salt system the heat can be used for multiple applications including industrial applications requiring high temperatures (smelting and processing of metals and in chemical plants).

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Economics of 200 MWe GEM*STAR Unit for Electricity Production

While economies of scale are possible by building units to power larger electric plants now powered by coal, the 200 to 250 MWe size is a useful standard unit that can be substituted incrementally in coal fired generators of this size or larger as well as in industrial applications. The cost of the unit with two accelerators is at the high end $ 500 million dollars and at the lower end 379 million incliuding the cost of finance during the construction period. The examples assume 25% investor capital with the remaining 75% borrowed for 30 years at 7% and a 3.5% inflation rate. Estimated costs for the generator and electrical distribution infrastructure is 129 million. The linear accelerator is based on the Oak Ridge LINAC which is based on a superconducting design. At the high end a single accelerator will cost $ 105 million and at the low end $ 75 million. It is reasonable to assume that once accelerators are mass produced and with competition that numbers could be halved.

In the example we assume there's a 25% investor contribution with the balance financed (335 million). The fuel cost is included in the original price of the reactor (12 million assuming we use natural uranium, but probably less using either W-PU or spent nuclear fuels currently costly to store). We assume that after four years (in the fifth year) the reservoir of spent fuel will be cleaned and a new fresh amount of fissionable materials will be introduced. The lithium-uranium salt can be reused in another reactor and can be sold for around ½ of the cost of the new material. After costing out all the factors including operating costs 7% of the capital cost yearly the cost of a kilowatt is 3.9 cents and with the greenhouse gas credits assume to be 1.7 cents the net cost of power is 2.2 cents. Assuming energy costs of 10 cents per kilowatt of which 3.3 cents is transmission costs the generation costs of 7.5 cents the estimated profits in the fifth year is $ 85 million dollars with GHG credits. The margin without credits on revenues is 48% and with credits 70%. For the low cost estimate of the GEM*STAR 200 MWe system the potential profits is greater.

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High Cost -- 200 Mwe Gem-Star System					
	Cost of Single Unit				
High Cost	**$ 505,008,843**				
Interest Costs	0.07				
Term in Years	30				
Inflation Rate	0.035				
Calculated Mortgage	$ 30,522,635	**Year 5**	**Year 10**	**Year 15**	**Year 20**
Risk Capital	0.25	$ 126,252,211	$ 126,252,211	$ 126,252,211	$ 126,252,211
Balance Financed		$ 366,183,445	$ 355,500,523	344,817,600.92	$ 334,134,679
Level Term Mortgage	30522634.79	$ 30,522,635	$ 30,522,635	$ 30,522,635	$ 30,522,635
Interest Costs		$ 30,522,635	$ 30,522,635	30,522,634.79	$ 30,522,635
Principle Costs		$ 2,136,584	$ 2,136,584	2,136,584.44	$ 2,136,584
Operating Costs	0.07	$ 28,386,050	$ 28,386,050	28,386,050.36	$ 28,386,050
Fuel Costs	0.25	$ 3,040,000	$ 3,610,566	4,288,220.23	$ 5,093,060
Resale of Overfuel	0.5		$ (1,805,283)	(2,144,110.12)	$ (2,546,530)
Total Carrying Costs		$ 61,948,685	$ 60,713,968	61,052,795.26	$ 61,455,215
Electric Energy Costs per kilowatt hour					
	Kilowatt hours per year				
200 Mwe	1576800000	$ 0.0393	$ 0.0385	0.038719429	$ 0.0390
Greenhouse Gas Credits		$ 0.0172	$ 0.0204	0.024280418	$ 0.0288
Cost per kilowatt		$ 0.0221	$ 0.0181	0.014439011	$ 0.0101
Price Electric power					
Electric Powwer Price		$ 0.1090	$ 0.1295	0.15377598	$ 0.1826
Transmission Costs		$ 0.0333	$ 0.0395	0.046942141	$ 0.0558
Revenues from Generation		$ 0.0757	$ 0.0900	0.106833838	$ 0.1269
Estimated Revenues		$ 119,421,342	$ 141,835,092	$ 168,455,597	$ 200,072,405
Estimated Costs		$ 61,948,685	$ 60,713,968	$ 61,052,795	$ 61,455,215
Estimated Profits		$ 57,472,656	$ 81,121,124	$ 107,402,801	$ 138,617,190
Estimated Profits (with GHG)		$ 84,613,871	$ 113,356,372	$ 145,688,164	$ 184,088,191
Margin on Revenues without GHG		$ 0	$ 1	64%	$ 1
Margin on Revenues with GHGCredit		70.9%	79.9%	86%	92.0%
Return on capital		45.5%	64.3%	85%	109.8%
Return on capital with GHGCredit		67.0%	89.8%	115%	145.8%

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Low Cost -- 200 Mwe Gem-Star System					
Low Cost	**$ 379,030,557**				
Interest Costs	0.07				
Term in Years	40				
Inflation Rate	0.035				
Calculated Mortgage	$ 21,323,067	**Year 5**	**Year 10**	**Year 15**	**Year 20**
Risk Capital	**0.25**	$ 94,757,639	$ 94,757,639	$ 94,757,639	$ 94,757,639
Balance Remaining/Balance Financed		$ 277,950,605	$ 267,216,711	$ 252,161,868	$ 231,046,673
Level Term Mortgage	21323066.78	$ 21,323,067	$ 21,323,067	$ 21,323,067	$ 21,323,067
Interest Costs		$ 19,456,542	$ 18,705,170	$ 17,651,331	$ 16,173,267
Principle Costs		$ 1,866,524	$ 2,617,897	$ 3,671,736	$ 5,149,800
Operating Costs	0.07	$ 22,834,680	$ 27,120,437	$ 32,210,571	$ 38,256,054
Fuel Costs of initial costs	0.25	$ 1,900,000	$ 2,256,604	$ 2,680,138	$ 3,183,163
Resale of Overflow Fuel			$ (1,128,302)	$ (1,340,069)	$ (1,591,581)
Total Carrying Costs		$ 46,057,747	$ 49,571,805	$ 54,873,707	$ 61,170,702
Electric Energy Costs per kilowatt hour					
	Kilowatt hours per year				
200 Mwe	1576800000	$ 0.0292	$ 0.0314	$ 0.0348	$ 0.0388
Greenhouse Gas Credit		$ 0.0155	$ 0.0155	$ 0.0155	$ 0.0155
Cost per kilowatt		$ 0.0137	$ 0.0159	$ 0.0193	$ 0.0233
Price Electric power					
Electric Powwer Price		$ 0.1090	$ 0.1295	$ 0.1538	$ 0.1826
Transmission Costs		$ 0.0333	$ 0.0395	$ 0.0469	$ 0.0558
		$ 0.0757	$ 0.0900	$ 0.1068	$ 0.1269
		$ 119,421,342	$ 141,835,092	$ 168,455,597	$ 200,072,405
Estimated Revenues		$ 46,057,747	$ 49,571,805	$ 54,873,707	$ 61,170,702
Estimated Costs		$ 73,363,595	$ 92,263,287	$ 113,581,890	$ 138,901,703
Estimated Profits		$ 97,843,415	$ 116,743,107	$ 138,061,710	$ 163,381,523
Estimated Proifts (withGHG)		61%	65%	67%	69%
Profits on Revenues		82%	82%	82%	82%
Profits on Revenues (with GHG)		77%	97%	120%	147%
Profits on Risk Capital		103%	123%	146%	172%

Replacing Coal in Existing Coal Fired Plants

Unlike other ways of reducing greenhouse gases, replacing coal with GEM*STAR units is both cost effective and virtually eliminates the problem of carbon allowing more rapid reductions in net growth in greenhouse gases without disturbing existing energy distribution infrastructure. Existing plants range from many smaller plants of around 200 MWe size to larger gigawatt sized plants. GEM*STAR high temperature heat can be introduced incrementally allowing a gradual conversion of the larger plants from coal, oil or gas to nuclear. As we will show the economics of this conversion are quite sound allowing existing infrastructure to be used and reducing the disturbance to existing distribution systems.

The size of the potential market is huge as the table shows more than 40% of world electric power production depends upon coal as a heat source. Add to this the share of oil and gas and we have a potential market for conversion of well over 4000 units.

In the example we have developed the cost of the high end unit is reduced by the exclusion of the turbine generator set. The GEM*STAR units are introduced every two years until sufficient heat to power a 1 Gigawatt high temperature coal plant is in place. The cost of coal per kilowatt hour is estimated to be just over 3 cents per kilowatt. Replacing coal incrementally reduces this cost with the fully financed cost of nuclear power using existing capital (generators and turbines and heat exchangers) is estimated to be 1.6 cents per kilowatt with Greenhouse gas credits potentially worth another 1.9 cents per kilowatt. Making replacing coal profitable even without Greenhouse gas credits.

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International Energy Summary Table (2006)						
	Electricity	**Heat**	**Electricity**	**Gem*Star Units**	**Green House Gases**	
World Total	***Unit: GWh***	***Unit: TJ***	**Mwe**	**Units**	**Metric Tons Carbon**	**Share Electricity**
Production from:						
- coal	**7754636**	**4965736**	**1,001,891**	**4,554**	**2,023,959,996**	**40.8%**
- oil	**1096047**	**952329**	**141,608**	**644**	**286,068,267**	**5.8%**
- gas	**3806892**	**6704492**	**491,847**	**2,236**	**993,598,812**	**20.0%**
- biomass	173332	317299	22,394	-	-	0.9%
- waste	66049	253917	8,533	-	-	0.3%
- nuclear	2793030	22399	360,857	-	-	14.7%
- hydro*	3120614		403,180	-	-	16.4%
- geothermal	59240	11577	7,654	-	-	0.3%
- solar PV	2781		359	-	-	0.0%
- solar thermal	1061	132	137	-	-	0.0%
- wind	130073	0	16,805	-	-	0.7%
- tide	550	0	71	-	-	0.0%
- other sources	10276	689319	1,328	-	-	0.1%
Total Production	**19014576**	**13917200**	**2,456,664**	**7,433**	**3,303,627,075**	**100.0%**
OECD Total	**Electricity**	**Heat**	**Electricity**	**Gem*Star Units**	**Green House Gases**	
Production from:	***Unit: GWh***	***Unit: TJ***	**Mwe**	**Units**	**Metric Tons Carbon**	**Share Electricity**
- coal	**3930510**	**830038**	**507,818**	**2,308**	**1,025,863,110**	**20.7%**
- oil	**417023**	**321594**	**53,879**	**245**	**108,843,003**	**2.2%**
- gas	**2098406**	**1270406**	**271,112**	**1,232**	**547,683,966**	**11.0%**
- biomass	144148	232900	18,624	-	-	0.8%
- waste	60612	168315	7,831	-	-	0.3%
- nuclear	2355572	5271	304,337	-	-	12.4%
- hydro*	1361517		175,907	-	-	7.2%
- geothermal	38085	11358	4,921	-	-	0.2%
- solar PV	2626		339	-	-	0.0%
- solar thermal	550	48	71	-	-	0.0%
- wind	116182	0	15,011	-	-	0.6%
- tide	550	0	71	-	-	0.0%
- other sources	9211	295886	1,190	-	-	0.0%
Total Production	**10534992**	**3135816**	1,361,110	3,785	1,682,390,079	55.4%

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Converting Coal to Nuclear (4 250 Mwe Units over 8 years)				
	Nuclear Unit 1	Nucler Unit 1&2	Nuclear Unit 1,2,&3	All Nuclear
KWH per MWE	1971000000	3942000000	5913000000	7884000000
Finance Costs per kilowatthr	$ 0.016	$ 0.017	$ 0.019	$ 0.016
Operating Costs per kilowatthr**	$ 0.002	$ 0.002	$ 0.003	$ 0.003
Fuel Costs Nuclear	$ -	$ -	$ 0.001	$ 0.002
NetFuelCosts	$ -	$ -	$ 0.001	$ 0.002
Total Cost Nuclear Portion	$ 0.016	$ 0.017	$ 0.019	$ 0.016
Estimated Value of Greenhouse Gas Credit	$ 0.019	$ 0.019	$ 0.019	$ 0.019
Net Cost per kilowatt hour for Gem*Star Un	$ (0.003)	$ (0.002)	$ (0.000)	$ (0.003)
Coal Costs				
Operational Costs per kilowatt	$ -	$ -	$ -	$ -
Maintenance Costs	$ 0.004	$ 0.004	$ 0.004	$ 0.004
Fuel Costs	$ 0.025	$ 0.027	$ 0.029	$ 0.031
Total Coal Costs (no capital costs)	$ 0.028	$ 0.030	$ 0.033	$ 0.035
Average Cost (without sale of credits)	$ 0.025	$ 0.024	$ 0.022	$ 0.016
Average Cost net of credits	$ 0.021	$ 0.014	$ 0.008	$ (0.003)
Greenhouse Gases reduced				
Greenhouse Gas Credit Value	$ 37,449,000	$ 74,898,000	$ 112,347,000	$ 149,796,000
Price of Electricity	$ 0.098	$ 0.105	$ 0.113	$ 0.121
Distribution costs	$ 0.030	$ 0.032	$ 0.034	$ 0.037
Net Revenues per kwhr for generation	$ 0.068	$ 0.073	$ 0.078	$ 0.084
Total Kwhr electricity	7884000000	7884000000	7884000000	7884000000
Revenues	$ 538,556,040	$ 576,914,694	$ 618,005,443	$ 662,022,881
Costs (Coal+Nuclear)	$ 199,129,017	$ 186,121,367	$ 176,433,053	$ 126,898,625
Profits	$ 339,427,023	$ 390,793,327	$ 441,572,390	$ 535,124,256
Profits + GHGCredits	$ 376,876,023	$ 465,691,327	$ 553,919,390	$ 684,920,256
Return on Sales	0.630253861	0.677384943	0.714512137	0.80831686
Rerturn on Sale with GHG Credits	0.6997898	0.80721003	0.896301798	1.034586985

Assumes nuclear unit costs $ 359 million with final unit costing over $ 400 million. Operational costs of coal based on EIA estimates with $.003 for operational costs per KWH and .024 for fuel costs. Nuclear fuel costs assumed in reactor initial price for 4 years.

Nuclear waste materials to Liquid Fuels -- A Closed Loop System

The initial system was built to utilize the vast stocks of nuclear waste by-products and cellulose by-products demonstrating the feasibility of using the GEM*STAR nuclear salt transfer heat to make liquid fuels. Even if we move to a fully electric transportation system, there will

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remain the need for petrochemical feedstocks for the chemical industry. This set of spread sheet summaries cover the development of a 250 megawatt sized nuclear reactor with a liquid fuel plant larger than the initial plant – 250 million gallons a year. The liquid fuel component is estimated to be $ 216 million compared to $ 129 million for the 75 million gallon plant based on an industrial scaling factor of .8. This makes the high end reactor and plant $ 475 million. As the table illustrates even at these very low wholesale prices for diesel ($ 1.38 per gallon) this combination is profitable even without a subsidy. The ability of the plant to convert coal (a form of carbon) directly into diesel using the Fisher-Tropsch method without adding carbon by burning coal to produce the necessary heat (supplied by the molten salt from the reactor) turns coal itself into a green fuel source. Thus a closed loop GEM*STAR system can solve the political problem of how to reduce the negative effects of carbon taxes on coal.

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Weapons Grade Plutonium or Spent Nuclear Fuel Stored into Liquid Fuel (damaged forest wood, agricultural waste byproducts, or coal)						
Gallons diesel	250,000,000					
	Upper Bound Cost					
High Cost	$ 475,475,415					
Interest Costs	7%					
Term in Years	7					
Inflation Rate	3.5%					
Calculated Mortgage		Year 1	Year 5	Year 10	Year 15	Year 20
Expenditures per Year						
Risk Capital (interest costs on construction loans).		$ 64,783,279	$ 64,783,279	$ 64,783,279	$ 64,783,279	$ 64,783,279
Initial Loan Distribution/Principle Remaining		$ 475,475,415	$ 231,532,892	$ -	$ -	$ -
Level Term Mortgage		$ 88,225,994	$ 88,225,994	-	-	-
Interest Costs		$ 33,283,279	$ 16,207,302	$ -	$ -	$ -
Principle Costs		$ 54,942,715	$ 72,018,692	-	-	-
Operating Costs	10.00%	$ 47,547,542	$ 54,561,898	$ 64,802,419	$ 76,964,945	$ 91,410,211
Damaged wood costs	$ 57	$ 153,132,657	$ 175,723,246	$ 208,704,092	$ 247,874,993	$ 294,397,734
Nuclear Fuel Costs (processing costs only)	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
Processing costs		$ 289,906,192	$ 319,511,137	$ 274,506,511	$ 325,839,938	$ 386,807,945
	Gallons diesel					
Cost per gallon diesel	250,000,000	$ 1.16	$ 1.28	$ 1.10	$ 1.30	$ 1.55
Wholesale Price Diesel		$ 1.38	$ 1.58	$ 1.88	$ 2.23	$ 2.65
Biodiesel subsidy		$ 1.00	$ 1.15	$ 1.36	$ 1.62	$ 1.92
Revenues from Combined plans		$ 2.38	$ 2.73	$ 3.24	$ 3.85	$ 4.58
Estimated Revenues without Subsidy		$ 345,000,000	$ 395,895,435	$ 470,199,587	$ 558,449,610	$ 663,262,954
Estimated Revenues with Subsidy		$ 595,000,000	$ 682,776,185	$ 810,923,925	$ 963,123,241	$ 1,143,888,284
Estimated Costs		$ 289,906,192	$ 319,511,137	$ 274,506,511	$ 325,839,938	$ 386,807,945
Estimated Profits (with credits)		$ 305,093,808	$ 363,265,048	$ 536,417,414	$ 637,283,303	$ 757,080,338
Estimated Profits without Credits		$ 55,093,808	$ 76,384,298	$ 195,693,076	$ 232,609,673	$ 276,455,009
Profit Margin on Revenues		51%	53%	66%	66%	66%
Profit Margin on Risk Capital		471%	561%	828%	984%	1169%

Summary and Conclusions

GEM*STAR offers an investor a unique opportunity to help solve the problem of climate change by altering the image of nuclear as a costly and dangerous solution. Efforts to develop fusion reactors, well meaning, are likely to prove illusionary, while wind, solar, and geothermal can't solve the longer term problem of replacing base load power supply. GEM*STAR can be built at a fraction of the cost of

other forms of power and as the tables illustrate it not only solves the problem of how to transition from fossil fuels to alternatives, it also is a viable alternative to coal producers using reactors to transform coal into more valuable fuels and chemical feedstocks.

Appendix I: Estimation of Reactor and LINAC Costs

Estimate of the cost of the liner accelerators are based on the accelerator complex at Oak Ridge's costs. Actual costs assuming mass production and simplifications may make these cost estimates outdated. Newer more powerful designs have been developed and standardization will further reduce the cost of these scientific instruments as well as improve their reliability. Reactor costs are based on known parameters with respect to laying reinforced concrete and materials. Simplified designs of reactors and air cooling due to use of sub-critical nuclear fuels make the Gem-Star design easier to build and maintain.

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Fully Sized LINAC Unit (1 - 600 Mve)

	Oak Ridge Units for 1000 MVe Accelerator	Average cost per unit based on Oak Ridge Costs (1-1000 Mve)	Price per Unit (Oak Ridge)	Adjusted Oak Ridge Price (assuming technology proved (discount factor 40%)	Units	Upper Bound	Lower Bound
Non-Superconducting Linac (1-194 Mve)		**$ 71.07**		**49.7476**	$ 1	$ 49,747,600	$ 32,639,400
			Discount Fac	0.3			
		194-1000					
Superconductor components		**Total Cost Oak Ridge**			0.5		
High-beta linac section	**Units**	**SC Estimates (Millions 1999 $s)**					
Cost of Cryomoduals	20	$ 17.102	$ 0.855	$ 0.599	10	$ 5,985,700	$ 3,927,218
Installation cost	20	$ 3.065	$ 0.153	$ 0.107	10	$ 1,072,750	$ 703,831
Medium-beta linac section							
Cost of Cryomoduals	9	$ 6.261	$ 0.696	$ 0.487	$ 4.50	$ 2,191,350	$ 1,437,745
Installation cost	9	$ 1.164	$ 0.129	$ 0.091	$ 5	$ 407,400	$ 267,295
Cryogenics							
Refrigerator procurement	27	$ 9.583	$ 0.355	$ 0.248	14	$ 3,354,050	$ 2,200,592
In-house design labor for cryos	27	$ 0.910	$ 0.034	$ 0.024	14	$ 318,500	$ 208,968
Cost of cryo distribution	27	$ 3.656	$ 0.135	$ 0.095	14	$ 1,279,600	$ 839,546
Cryo controls cost	27	$ 1.342	$ 0.050	$ 0.035	14	$ 469,700	$ 308,170
Ancillary equipment	27	$ 1.629	$ 0.060	$ 0.042	14	$ 570,150	$ 374,075
RF power							
RF power supply cost	29	$ 15.682	$ 0.541	$ 0.379	14.5	$ 5,488,700	$ 3,601,136
Klystron total cost	29	$ 20.397	$ 0.703	$ 0.492	14.5	$ 7,138,950	$ 4,683,865
Circulator cost, one half of klyst	29	$ 10.198	$ 0.352	$ 0.246	14.5	$ 3,569,300	$ 2,341,818
RF control system cost	29	$ 9.651	$ 0.333	$ 0.233	14.5	$ 3,377,850	$ 2,216,207
RF transport cost	29	$ 2.782	$ 0.096	$ 0.067	14.5	$ 973,700	$ 638,845
Controls cost	29	$ 3.658	$ 0.126	$ 0.088	14.5	$ 1,280,300	$ 840,005
Auxiliary linac components							
Cost of pumping, steering, focu	29	2.175	0.075	0.0525	$ 15	$ 761,250	$ 499,456
Superconducting Accelerator (195-600)					SC	$ 38,239,250	$ 25,088,772
Conventional Accelertor (0-194)					NSC	$ 49,747,600	$ 32,639,400
Total Accelerator					Total 1-600 Mve	$ 87,986,850	$ 57,728,172
Construction Costs							
LINAC Housing		$ -			100%	$ 5,844,434	$ 5,844,434
SC Line							
Cryo building		$ 1			100%	$ 1,000,000	$ 1,000,000
Cavity processing and assembly		$ 4			80%	$ 3,200,000	$ 3,200,000
Misc. Linac Conventional Facilities		$ 3			80%	$ 2,000,000	$ 2,000,000
						$ 100,031,284	$ 69,772,606

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Gem*Star 200MWe Unit Cost Estimates						
		$ per Ton	$ per To		High Cost of Ma	Low Cost of Matri
Reactor Core	Tons	High	Low		Material Costs	Material Costs
Uranium	76	$ 160,000	$ 100,000		$ 12,160,000	$ 7,600,000
Lithium	5	$ 7,000	$ 6,000		$ 35,000	$ 30,000
Graphite	350	$ 1,500	$ 1,000		$ 525,000	$ 350,000
Primary Materials Costs					**$ 12,720,000**	**$ 7,980,000**
Misc. Other Materials	Multiplication factor	0.50	0.50		$ 6,360,000	$ 3,990,000
Labor Fabricaton Costs	Percent of Total	0.30	0.30		$ 8,177,143	$ 5,130,000
Total Cost of Core Materials (includes processing)					$ 27,257,143	$ 17,100,000
Hastelloy					$ -	$ -
Nickle	53	$ 52,300	$ 10,880		$ 2,771,900	$ 576,640
Mo	8	$ 45,000	$ 10,000		$ 360,000	$ 80,000
Chromium	5	$ 3,000	$ 2,000		$ 15,000	$ 10,000
Iron	3	$ 130	$ 70		$ 390	$ 210
Titanium	1	$ 9,500	$ 2,000		$ 9,500	$ 2,000
Primary Materials Costs					$ 3,156,790	$ 668,850
Misc. Other Materials Costs	Multiplication factor	4.00	4.00		$ 12,627,160	$ 2,675,400
Labor & Capital Cost		30%	30%		$ 6,764,550	$ 1,433,250
Cost of Hastealloy-N Shielding					$ 22,548,500	$ 4,777,500
					$ -	$ -
Steel for Vessel	158	$ 1,234	$ 682		$ 194,972	$ 107,756
Secondary Salt	28	$ 200	$ 100		$ 5,600.00	$ 2,800.00
Heat Exchange Piping	Height (units) in feet	Number U Shaped Tubes		Price per foot		
	25	80.00	2,000.00	250	$ 500,000.00	$ 500,000.00
Total Materials Fabricaton Costs for Reactor					50,506,214.86	22,488,056.00
Assembly Costs, Contractor (	Factor:	0.35	0.35		17,677,175.20	7,870,819.60
Salt Pump	50	$ 40,000	$ 25,000		2,000,000.00	1,250,000.00
Neutron Targets	2	$ 2,000,000	$1,000,000		4,000,000.00	2,000,000.00
Total Costs of Reactor					74,183,390.06	33,608,875.60
Building Constructon Costs					9,353,216.58	4,603,216.58
Cost Reactor & Buildings					**83,536,606.64**	**38,212,092.18**

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Construction Costs for Reactor Building & Foundation			
	Cost per hour	**Hours**	
Grading Costs	$ 45.00	2500	$ 112,500.00
	Cost per Cubic Yard Moved	Volume Adjustm	Volume Moved
Excavation Costs	$ 12.00	0.1	
Depth	35		
Width	85		
Volume	252,875		
Cost of Excavation	$ 3,034,500		
	Cost per cubic yeard	Cubic Yards	
Gravel for Foundation	12	416.6666667	5000
		Volume	**Square Feet**
Reactor Building & Foundation		**4,569**	**27,375**
	Labor Costs per Square Food	3	$ 82,125
	Reinforcement	0.5	$ 13,688
	Concrete	80	$ 365,556
	Total Materials & Labor		$ 461,368
	Engineering, Management,Overhead	0.15	$ 69,205
Total Reactor Building Cost			$ 3,682,573
Contingency Set-aside	25%		$ 920,643
Total Reactor Building Cost			$ 4,603,217
Construction Costs for Accelerator Buildings & Foundation			
	Cost per hour	**Hours**	
Grading	45	2,500.0	$ 112,500
	Cost per Cubic Yard Moved	Volume Adjustm	Volume Moved
Excavation Costs	$ 12.00	0.1	
Number of Accelerators	1		
Length Feet	750		
Depth Feet	18		
Width Feet	50		
Volume Cubic Yards	25,000		
Cost of Excavation	$ 300,000		
		Cubic Yards	
Gravel for Foundation	12	**5925.925926**	$ 71,111
Accelerator Building	Accelerators #	**Volume**	**Square Feet**
	0.5	**33,704**	**77,500**
Length: 750' x 6 sides	Labor Costs per Square Food	3	$ 232,500
Width: 50' x 6 sides	Reinforcement	0.5	$ 38,750
Depth: 4' x 6 sides	Concrete	80	$ 2,696,296
	Total Material & Labor		$ 2,967,546
	Engineering, Management,Overhead	0.15	445,131.94
Total Accelerator Building Costs			$ 3,896,289
Contingency Set Aside	0.5		1,948,145
Acclerator Building Costs			5,844,434
Other Buildings	**Square feet**	Cost per Square	Cost of Building
Storage Sheds	**10000**	75	$ 750,000
Administration & Control			
Length	100		
Width	50		
Height	10		
Floors	2	Cost per Square Foot	
	Square Feet		

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Combined Cycle (High & Low Pressure) Steam Electric Turbines		
Electric Capacity (Kilowatt)	**Installed Cost per kilowatt (EIA)**	**Steam Turbine Cost**
500	$ 918	$ 459,000
3000	$ 648	$ 1,944,000
15000	$ 648	$ 9,720,000
60000	$ 648	$ 38,880,000
200000	$ 648	$ 129,600,000
Assumes no economies of scale as size increases.		
Source: EIA: Costs of Advanced Combined Cycle Turbine Sets		

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