TITANIUM
THE MATERIAL OF CHOICE
FOR
THE NUCLEAR RENAISSANCE

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Gentlemen, as the lampooned inventor of the internet, the “hanging chad”, global warming and other anthropogenic climate system forecasting, let me propose some ideas....
Continued use of fossil fuels for electric power generation has recently emerged as the bane of the industry.

Fact or Fiction??
Green Power is being championed as the new *fuel de jour* kid on the block.

Fact or Fiction?
Environmentalists and other global warming advocates are successfully lobbying their political agendas for emission caps, carbon sequestration, NOx and SOx and other greenhouse gas limits.

Fact or Fiction?
These efforts have resulted in the outright cancellation, delay or unit reductions of new coal-fired plants.

Fact or Fiction?
Combined cycle gas turbine (CCGT) units, popularized during the Enron “gas bubble” era are at the mercy of unstable fuel prices.

Fact or Fiction?
Wind, biomass, hydro, photovoltaic and other renewables continue to produce an increased percentage of the power base but total contribution remains costly, inefficient and pitifully low.

Fact or Fiction?
Enter The Nuclear Renaissance

Fact or Fiction?
“TYPICAL” NSSS SYSTEM

A Containment Structure
B Control Rods
C Reactor
D Steam Generator
E Steam Line

F Pump
G Generator
H Turbine
I Cooling Water Condensor
J Cooling Tower
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NSSS Power Bloc

- Reactor Building
- Turbine/Gen Building
- Surface Condenser
CURRENT U.S. FUEL MIX BREAKDOWN

Total = 3,883 Billion Kwh
Electric Utility Plants = 63.4%
Independent Power Producers & Combined Heat & Power Plants = 36.6%

- Coal: 50.8%
- Natural Gas: 16.7%
- Other Renewables: 2.3%
- Nuclear: 19.7%
- Hydroelectric: 6.9%
- Petroleum: 3.1%
- Other Gases: 0.4%
- Other: 0.2%
Fuel Usage Forecast
**Advanced Reactor Designs**

**U.S. NRC Certified**

- Advanced Boiling-Water Reactor (ABWR) GE/Toshiba (1300 MW)
- System 80 Westinghouse (1300 MW)
- AP 600 Westinghouse (600 MW)
- AP1000 Westinghouse (1000 MW)

**U.S. NRC Under Evaluation**

- General Electric ESBWR 1390 MW
- Atomic Energy of Canada (AECL) 700 MW
- Framatome ANP (EPR) 1600 MW
- International Reactor Innovative & Secure (IRIS) 335 – 1000 MW
- Pebble Bed Modular Reactor (PBMR) 165 MW
- Gas Turbine-Modular Helium Reactor (GT-MHR)
160 New Power Reactors Over The Next 15 Years
<table>
<thead>
<tr>
<th>OWNER</th>
<th>PROJECT</th>
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<tbody>
<tr>
<td>TXU Corporation</td>
<td>Comanche Peak – 2x1700 MW (MHI)</td>
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<tr>
<td>Duke Power</td>
<td>Cherokee County – 2x1100 MW</td>
</tr>
<tr>
<td>Exelon</td>
<td>Clinton Unit 2</td>
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<tr>
<td>Constellation Energy</td>
<td>AREVA – 2x1600 MW – Unistar Nuclear</td>
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<tr>
<td>Entergy</td>
<td>Grand Gulf Unit 2 – NuStart Energy</td>
</tr>
<tr>
<td>Fresno Nuclear Energy</td>
<td>Fresno County / Unistar</td>
</tr>
<tr>
<td>Alternate Energy Holdings</td>
<td>Grandview/Bruneau County</td>
</tr>
<tr>
<td>Progress Energy</td>
<td>Levy County – 2x100 MW</td>
</tr>
<tr>
<td>Progress Energy</td>
<td>Harris – 2 x 1100 MW</td>
</tr>
<tr>
<td>NRG Energy</td>
<td>STP 3 &amp; 4 – 2x1350 MW</td>
</tr>
<tr>
<td>Entergy Nuclear</td>
<td>River Bend Unit 2</td>
</tr>
<tr>
<td>PPL Corporation</td>
<td>Susquehanna Unit 3</td>
</tr>
<tr>
<td>FPL Group</td>
<td>Turkey Point – 2x1500 MW</td>
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<tr>
<td>TVA</td>
<td>Bellefonte – 2x1100 MW NuStart</td>
</tr>
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<td>Ameren</td>
<td>Calloway Unit 2 - Unistar</td>
</tr>
<tr>
<td>Southern Company</td>
<td>Vogtle Units 3 &amp; 4 – 2x1100MW</td>
</tr>
<tr>
<td>SCE&amp;G</td>
<td>V.C. Summer – 2x1100MW</td>
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25 to 30 New Power Reactors Over The Next 15 Years in the U.S.
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  - Cost and availability of nuclear fuel is a consideration but not a constraint.
    - The lawyers will win.
Typical Steam Turbine

Steam Inlet

Steam Exhaust

6/100th sec or ~700 MPH
Typical Steam Surface Condenser

- Exhaust Steam to Condenser
- Cooling Water In
- Cooling Water Out
- Outlet Condensate
HOW MUCH WORLD MARKET TITANIUM MATERIAL AND WHEN ???????

• 350,000 – 400,000 tons OVER 10 YEAR PERIOD
  (35,000 to 44,000 TONS PER YEAR BEGINNING 2010-2012)
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- 22 BILLION USD ($) OVER 10 YEAR PERIOD ($2,000,000,000/yr. BEGINNING 2010-2012)
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• Compare this estimate vs. a Conference world forecast shipment of 110,000 to 120,000 metric tons in 2010.
CONCLUSIONS – Fact or Fiction?

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  • Several utilities have ordered long lead time items.

• Nuclear power isn’t a perfect answer but safely managed and regulated, it needs to be a bigger part of the world’s energy future.
References:

2. Fortune Magazine – August, 2007
5. CERA – Cambridge Energy Research Associates
6. UtiliPoint International
8. MATERIAL FORECAST represented by the author should be considered as an estimate only.
9. Forty (40) years of PowerGen experience by the author