The Global Nuclear Energy Partnership (GNEP)

“One fact remained inexplicable---that of the compass”

—Henry Lawson in “Journey to the Center of the Earth” by Jules Verne.
Feb. 6, 2006. U.S. Secretary of Energy Bodman announced a proposal to form an international partnership to promote:

The use of nuclear power.

Closing the nuclear fuel cycle to reduce waste and the risk of nuclear proliferation.
Goals of GNEP

To achieve these goals, GNEP sought to develop new reprocessing technologies in countries already possessing nuclear energy programs.

The new technologies to avoid producing additional pure plutonium from SNF: allow the plutonium to remain with uranium and the fission products.
Goals of GNEP

The new SNF separation approaches would be coupled with new fuel fabrication technologies to create fuel for fast-neutron reactors to burn MOX fuel.

Under GNEP, SNF would be returned to the fuel supplier and recycled using a process that does not produce pure, separated Pu.
### GNEP and Spent Fuel Reprocessing
Reprocessing Plants in Operation or Planned Today

<table>
<thead>
<tr>
<th>Country</th>
<th>Location</th>
<th>Capacity, t/y</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>Jiuquan</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>(Planned, 2020-2025)</td>
<td>800</td>
</tr>
<tr>
<td>France</td>
<td>LaHague (UP2-800, UP-3)</td>
<td>1,600</td>
</tr>
<tr>
<td>India</td>
<td>Trombay</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Tarapur</td>
<td>210</td>
</tr>
<tr>
<td></td>
<td>Kalpakkam</td>
<td>300</td>
</tr>
<tr>
<td>Japan</td>
<td>Tokai-mura</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Rokkasho-mura</td>
<td>800</td>
</tr>
<tr>
<td>Russia</td>
<td>Chelyabinsk (Mayak, RT-1)</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>(Planned, 2025)</td>
<td>1,000</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Sellafield B205</td>
<td>1,500</td>
</tr>
<tr>
<td></td>
<td>Sellafield THORP</td>
<td>1,200</td>
</tr>
<tr>
<td>United States</td>
<td>CFTC (Planned, 2020-2025)</td>
<td>2,500</td>
</tr>
</tbody>
</table>
GNEP Partners and Observers

GNEP Partners
(As of October 1, 2008)
1. Armenia
2. Australia
3. Bulgaria
4. Canada
5. China
6. Estonia
7. France
8. Ghana
9. Hungary
10. Italy
11. Japan
12. Jordan
13. Kazakhstan
14. Republic of Korea
15. Lithuania
16. Morocco
17. Oman
18. Poland
19. Romania
20. Russia
21. Senegal
22. Slovenia
23. Ukraine
24. United Kingdom
25. United States

GNEP Observers
1. International Atomic Energy Agency (IAEA)
2. Generation IV International Forum (GIF)
3. Euratom

Candidate Partner and Observer Countries
1. Algeria
2. Argentina
3. Bahrain *
4. Bangladesh
5. Belgium
6. Brazil
7. Czech Republic
8. Egypt
9. Finland
10. Georgia
11. Germany
12. Greece
13. Kuwait
14. Latvia
15. Malaysia
16. Mexico
17. Netherlands
18. Nigeria
19. Slovakia
20. South Africa
21. Spain
22. Sweden
23. Switzerland
24. Tanzania
25. Tunisia
26. Turkey
27. United Arab Emirates
28. Vietnam

* Invited as an observer until a comprehensive safeguards agreement is brought into force.

For more info: www.gneppartnership.org
The Partners who reprocess SNF

<table>
<thead>
<tr>
<th>LWR Fuel Processor</th>
<th>Type</th>
<th>tonne/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>France, La Hague</td>
<td>LWR</td>
<td>1700</td>
</tr>
<tr>
<td>UK, Sellafield (THORP)</td>
<td>LWR</td>
<td>900</td>
</tr>
<tr>
<td>Russia, Ozersk (Mayak)</td>
<td>LWR</td>
<td>400</td>
</tr>
<tr>
<td>Japan</td>
<td>LWR</td>
<td>800</td>
</tr>
<tr>
<td>UK, Sellafield</td>
<td>Magnox</td>
<td>1500</td>
</tr>
<tr>
<td>India</td>
<td>HWR</td>
<td>275</td>
</tr>
</tbody>
</table>

The Partners who can make MOX fuel

<table>
<thead>
<tr>
<th>Country</th>
<th>Company</th>
<th>Location</th>
<th>tonne/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>Belgonucléaire SA</td>
<td>Dessel</td>
<td>was 37</td>
</tr>
<tr>
<td>France</td>
<td>COGEMA</td>
<td>Cadarache</td>
<td>was 40</td>
</tr>
<tr>
<td>France</td>
<td>MELOX (50% COGEMA, 50% Framatome)</td>
<td>Marcoule</td>
<td>195</td>
</tr>
<tr>
<td>India</td>
<td>DAE Nuclear Fuel Complex</td>
<td>Tarapur</td>
<td>50</td>
</tr>
<tr>
<td>Japan</td>
<td>JNC</td>
<td>Tokai-Mura</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: WISE Uranium Project, "World Nuclear Facillities"
More MOX than the demand

Nowhere is the burning of plutonium in MOX fuels keeping up with the rate of reprocessing of SNF.

In Japan, Prefectures have influence over the use of MOX fuel in reactors and have discouraged reburning of accumulated separated plutonium.

In France, the number of reactors burning MOX has not kept pace with reprocessing.
More MOX than the demand

In the UK, reprocessing was adopted as a way of avoiding prolonged storage of aluminum-clad fuel but there is no integrated plan for reusing the separated plutonium.

An alternative to reprocessing spent fuel is the DUPIC concept, Direct Use of Pressurized water reactor spent fuel in CANDU reactors. The approach has been developed in the Republic of Korea but has not yet proven to be economical for commercial deployment.
DUPIC Fuel Cycle

“No radionuclides are separated during the fuel fabrication process. U, Pu, fission products and actinides are kept together . . . and bound together in the DUPIC fuel bundle. A high net destruction rate can be achieved of actinides and plutonium.”

DUPIC fuel manufacturing must be done remotely and behind thick shielding.
DUPIC details

With DUPIC, used fuel assemblies from light water reactors (LWRs) would be dismantled and refabricated into fuel assemblies for the right shape for use in a CANDU reactor.

This could be direct, involving only cutting the used LWR fuel rods to CANDU length, resealing and reengineering into cylindrical bundles suitable for CANDU geometry.
Fresh natural uranium could be added before being sintering and pressed into CANDU pellets. In March 2010, this technique began a trial period after fuel bundles containing recovered uranium from used fuel were inserted into China's Qinshan Phase III unit 1.
Problems with GNEP

Canada was reluctant to join GNEP because they did not want to accept SNF.

Australia was reluctant as well; didn’t want to accept SNF and wanted the right to enrich U in the future.
Problems with GNEP

South Africa declined to join; fear that GNEP could impede plans to enrich U and sell reactor fuel in the international market.

India declined because they fear that GNEP will hinder their ability to enrich U and reprocess SNF to meet the nonproliferation requirement.
Divide and Conquer

Critics of GNEP claim that it would divide the world into “haves” and “have nots”

“Fuel supplier nations” who would provide enriched U and take back SNF for reprocessing.
“User nations” who operate or will operate nuclear power plants, but will not enrich U or reprocess SNF.
Lack of support

“Members of U.S. Congress remain unenthusiastic about GNEP”

Concerns that the program will encourage nuclear proliferation, and will waste money on “excessively ambitious and unachievable technologies.”
GNEP abandoned by the US

For FY 2008 Congress allocated only $181 million for Bush’s Advanced Fuel Cycle Initiative which funds GNEP ($395 million was requested).

On April 15, 2009, a DOE spokesperson stated that the US would no longer pursue GNEP as its near-term domestic approach for investigating options for SNF management.
Too soon, too expensive?

DOE envisioned both an operating commercial-scale reprocessing plant and fast reactor by 2020 (or sooner).

There were fears about the plans to the US to reprocess SNF and proliferation (history repeats itself). Congressional Budget Office concluded that reprocessing SNF would likely cost billions of dollars more than a long-term geological repository.
GNEP became IFNEC

In 2010, the GNEP was renamed the International Framework for Nuclear Energy Cooperation. IFNEC is now an international partnership with 25 partner countries, 28 observer and candidate partner countries, and three international organization observers.

http://www.ifnec.org/