Thorium, Rare Earths & Energy

A Brief History of China's Rare Earth Monopoly and How it Relates to Thorium Energy

My United Nations IAEA presentation can be viewed via: https://www.youtube.com/watch?v=fLR39sT_bTs



Thorium and Heavy Rare Earths are found together

Pm

Pm – Promethium does not have any long-lived isotopes and therefore cannot be mined. Promethium is only made in a laboratory and is not a "commercial" RE.

History of Thorium: 1890's to 1930's

Originally the Rare Earth ore Monazite was mined for Thorium -- to make gas mantles.

The rare earths were mostly a curiosity for Chemists.

Thorium levels in Monazite ~ 3 to 20%



The laboratory of von Welsbach in which he invented the incandescent gas lamp, see insert in upper left (1)

Initially Monazite was the leading source of rare earths and the only source for heavy rare earths



In the 1980's the NRC & IAEA lowered the threshold classification of Source Material to .05%, eventually ending the use of Monazite by all 'western' rare earth producers.



This sparked a rapid decline in U.S. RE mining, refining, metal, alloy & magnet companies. Most closed, moved to China or became 'captured'

The Chinese government, at the highest levels, makes a run at the Rare Earth industry, including government funded programs and targeted acquisition of 'western' technology. All programs were part of the public record.



The U.S. ignores this phenomenon, with Congress approving key technology transfers !

China achieves monopoly control over all aspects of the RE industry: forcing 'western' RE dependent technologies / industries to relocate inside China, aggregating global IP, manufacturing and jobs.



China boasts of two cities primarily committed to Rare Earth R&D, production, material science & commercial application.

China's human commitment to rare earths is many times larger than the U.S. commitment to the Manhattan Project during the peak of World War II.

U.S. / NATO are now 100% reliant on China for RE value added materials

China's Strategy is Winner Take All -Hyper Mercantilism

The total economic value of global rare earth mining and oxides is less than \$4 billion.

However, by also controlling the refining, metals, alloys, magnets, integrated components of rare earths, China ultimately controls \$7 trillion in finished goods – 10% of global GDP, concentrated primarily on high margin / high growth goods. China has built a global mercantile monopoly on rare earths.

Thorium Energy is China's next monopoly

China's monopoly in energy will end U.S. / 'western' economic and geopolitical relevance.

China is committed to global control of Th-MSR IP & Commercial deployment

History of Th-MSR Development

2007 – China hacks ORNL
2010 – China visits ORNL
2011 – China Funds Th-MSR Target date 2035
2012 – DoE Tech Transfer deal
2012 – Operating Salt-Loop
2013 – 450 in Th-MSR Prog.
2014 – 750 in Th-MSR Prog. Target date now 2025



This is <u>Dr. Jiang Mianheng</u>, who is leading the Chinese thorium MSR project in the Chinese Academy of Sciences. Dr. Jiang is a graduate of Drexel University with a PhD in electrical engineering. His father is <u>Jiang Zemin</u>, former president of the People's Republic of China from 1993 to 2003. He most recently toured Oak Ridge National Lab Fall of 2010 to see MSR.

January 26, 2011: Dr. Jiang Mianheng:

"the future of advanced nuclear fusion - nuclear energy, is the thorium molten salt reactor"... China will "have all intellectual property rights"

Why focus specifically on Th-MSR ?

SOUTH CHINA MONRINING POST

CHINA

Sun May 11, 2014 Updated: 4:08pm

Chinese scientists urged to develop new thorium nuclear reactors by 2024

PUBLISHED : Tuesday, 18 March, 2014, 11:42pm UPDATED : Wednesday, 19 March, 2014, 4:50pm

Stephen Chen binglin.chen@scmp.com



Beijing wants to cut its reliance on coal-fired power. Photo: AP

The deadline to develop a new design of nuclear power plant has been brought forward by 15 years as the central government tries to reduce the nation's reliance on smog-producing coal-fired power stations.

A team of scientists in Shanghai had originally been given 25 years to try to develop the world's first nuclear plant using the radioactive element thorium as fuel rather than uranium, but they have now been told they have 10, the researchers said. passive safety, low CAPEX
& modular potential;

SOUTH CHINA MONRINING POST

CHINA

• Sun May 11, 2014 Updated: 4:08pm

The Chinese Academy of Sciences set up an advanced research centre in Shanghai in January with the aim of developing the world's first industrial reactor using thorium molten-salt technology, according to a statement from the academy's Bureau of Major Research and Development Programmes.

> #1) its thermal profile is ideal for IP innovations in most heavy industries: synfuels, steel, chemicals, etc.

What is the Difference Between Th-MSR and LWRs

Th-MSR Technology can be:

Economically and commercially viable

Constructed on assembly line

Model-Design Permitting & Modular

Th-MSRs CAN NOT:

Blow Up

Melt Down

Cause Widespread Radiation

Traditional LWRs are:

NOT economically viable without massive government support, subsidies and the transfer of cost and risks to the public.

<u>LWRs Can & Do:</u> Blow Up Melt Down Cause Widespread Radiation

Th-MSR virtually eliminates the nuclear waste / spent fuel issue

Other Key Advantages / Disadvantages

Th-MSR Advantages

- Th-MSRs utilize nearly 100% of the available energy from the fuel – thus reducing nuclear waste / spent fuel issues.
- Safely operates at +700 C
- Fuel / coolant is not under pressure
- 100% passive safety
- Low CAPEX

LWR Disadvantages

- Traditional LWRs only utilize a fraction of available energy from its fuel – resulting in large amount of nuclear waste / spent fuel issues
- Typically operate at ~ 350 C
- Coolant is under tremendous pressure
- 100% mechanical safety
- High CAPEX

Economic & Environmental Impact

Industrial Applications

- Reformulation of global energy platform with zero green house gas emissions
 - Liquid fuels from coal
 - Hydrogen production
- Reformulation of the global Steel industry
- Reformulation of the global chemical industry
 - Fertilizer
 - Food
 - Medical Isotopes
- Water Desalination
- Ending Petroleum Dependence

Environmental Impact

- Ending Coal / Steam electrical generation would reduce :
 - Carbon emissions by 35%
- Converting Coal to liquid fuels

 Net Carbon emissions by 15%
- Replacing Hydrocarbon use for Petroleum & Chemical processing would reduce:
 - Carbon emissions by 11%
- Ending Coal based steel production would lower:
 - Carbon emissions by 5%

Lowering greenhouse emissions +65%

Good News / Bad News

The Good News:

DoE is working diligently to see this technology gets developed.

More good news:

Most large scale polluting industries will eventually be re-shaped into ultra-clean industries.

These reformed industries will be the growth and profit centers of the future.

The Bad News: DoE is actively helping China develop this U.S. technology.

More bad news:

China will control the IP for these technologies & industries, significantly degrading U.S. economic relevance throughout the world.

Yep, the DoE is transferring this U.S. technology to China...



U.S.-China Clean Energy Cooperation

A PROGRESS REPORT BY THE U.S. DEPARTMENT OF ENERGY

January 2011

More Bad News

Recent history has demonstrated that China's mercantile policy targets 100% of all possible economic returns through state sponsored commercialization of not just the primary value chain, but for all inter- related / interdependent technologies, industries and applications.

This will not change for energy !

It should be obvious that the full scope of energy applications and inter-dependence in the economy dwarfs the rare earth industry. Exclusive Chinese IP Control of Th-MSR will radically alter western economies

China's winner take all mercantile monopoly policy will result in the aggregation of all commercial & industrial applications of Th-MSR.

China will be in a position to enforce IP on a global basis.

Western nations will not be able to develop 'cheaper' alternatives: ultimately western multi-nationals prefer adoption and integration (including U.S. defense contractors).

China already has 750 people working on Th-MSR

China has demonstrated a cooperative top-down Industrial Policy that can rapidly coordinate National directives to new technologies by marshalling large- scale / long-term financing that ultimately results in monopoly scale market penetration on a global basis.

China is well ahead of all 'western' nations... they will aggressively develop all potential industrial applications and enforce IP.

"Market solutions" are non-responsive

- The 'market' has failed to respond for over 40 years.
- Why? mostly due to regulatory constraints/uncertainty
- Now there is little time to respond, and:

Western financial markets are risk averse, have anti-trust issues, quickly erect IP boundaries, have short term investment horizons, avoid high CAPEX projects and continue to have zero tolerance for regulatory risk.

Any solution must have: 1) a regulatory pathway, 2) a cooperative structure, 3) multi-national in scope.

Solution: H.R. 4883 / S. 2006 NRECA – National Rare Earth Cooperative Act

- NRECA creates two privately funded and operated entities:
- A Multi-National Cooperative RE Refinery

 a) Resolving the Thorium Problem

 A Multi-National Thorium Storage, Energy &

 Industrial Products Corporation

 a) Resolving Regulatory Risk
- Allowing for Multi-National cooperation within a government sanctioned Anti-Trust framework

Multiple mining companies provide Monazite, Apatite & other Th-bearing REs to the cooperative, currently not commercial or waste byproduct of some other commodity





RE Refinery Co-op / oxides, metals, alloys, etc.

Not Endorsements – Potential Co-op Owners

U.S. Aerospace U.S. Defense Ind. U.S. Auto Ind.

Japanese Industry, Korean Industry, EU Industry,

N.A.T.O JOGMEC U.S., Japanese, Korean & EU **Government Entities**

AIST



Thorium liability

The Th-Bank assures that Thorium is no longer released into the environment



Thorium Bank holds all Actinide liabilities, but has Congressional authority to develop "Uses & Markets for Thorium, including Energy"

RE end-users own and control the Co-operative and off-take, but share profits with suppliers

U.S. Congressional Bills H.R. 4883 & S. 2006 Also Establish a Multi-National Development Platform for:

- The creation of a Thorium Bank that will take all liability and physically hold and safely store all Thorium and associated Actinide liabilities from the Rare Earth Cooperative.
- The creation of a Thorium Industrial Products Corporation with Congressional authority to develop industrial uses and markets for Thorium (including decay products) that include
 - I. alloys
 - II. catalysts
 - III. medical isotopes
 - IV. other uses

U.S. Congressional Bills H.R. 4883 & S. 2006 also establishes a Multi-National Development Platform for:

The Commercial Development of Thorium Energy Systems, that include:

- I. solid fuels from Thorium
- II. solid-fuel reactor technology
- III. beam / accelerator driven reactor technology
- IV. liquid-fuel reactor technology, to include
 - i. electric power
 - ii. thermal energy
 - iii. synthetic liquid fuel production
 - iv. desalination
 - v. nuclear waste reduction (actinide burners)
 - vi. hardened and deployable energy systems

S. 2006 & H.R. 4883

The National Rare Earth Cooperative Act Offers a Multi-National Investment / Development Platform, Based on Direct Investment from:

- Sovereign Governments

 a) With Top-Line Income Distribution
- 2) Sovereign Funds
- 3) Energy Users
- 4) Energy Consumers

Within an unrestricted development environment.

Don't be fooled; this is a winner takeall contest

China's mercantile rare earth policies have demonstrated that they will aggressively pursue ALL markets & related industries.

Western corporations have demonstrated that they will integrate their interest along economic, NOT Nationalist lines.

Time is of the Essence ! Can we win this ?

Never forget:

"No great human achievement or important industry ever began inside a regulated environment"

Technological Achievements

Manhattan Project – 4 years (1941 – 1945) Nautilus: First Nuclear Sub – 19 mo. (6/52 – 1/54) Moon Shot – 6 years (1961 – 1969) MSRE: Molten Salt Reactor – 5 years (1960 – 1965) Operational 6/65 – 12/69 (critical for 17,655 hours)

The NRC was created in 1974 – marking the end of true achievements in Nuclear Energy

Thorium Storage | Energy | Industrial Products



A multi-national corporation to develop uses and markets for Thorium, including energy