Japan Revival Strategy by Thorium MSR

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"Operation Tomodachi"

Thank you to all.
We are facing lots of problems…

Transportation

Power generation

Global warming

China

USA

… Is there a solution?
We need clean energy…

…but safe one.
How can we answer to this question?

It’s thorium MSR.
Thorium itself is;

- No $\text{CO}_2$ emission
- Residual of REE
- Abundant in the world
- Less amount of radioactive waste
- No good for nuclear weapon
Thorium can be used in Light Water Reactor

Thorium Fuel Technology

Lightbridge develops and owns advanced nuclear fuel designs for existing light water reactors currently in operation around the world and new generation light water reactors that are being built or have been proposed for construction worldwide.

Lightbridge utilizes thorium-based nuclear fuel designs optimized to address key concerns typically attributed to traditional nuclear power, such as proliferation and waste. The result is an advanced fuel cycle which offers enhanced proliferation resistance, significantly reduced volume, weight and long-term radio-toxicity of used fuel, and improved fuel cycle economics.
Isn’t LWR suitable for earthquake?

Maybe. But most of the world market is out of earthquake.
Where is Japan?

It’s hard to find Japan in the flood of huge earthquakes. Just one lost of emergency cooling caused this catastrophe.
What will happen on MSR by earthquake?

Core and Common Concept

Coolant is Molten-Salt

↓

BT is 1430 C degree

↓

Operation at 700 C degree

↓

Just 0.5MPa

Freeze valve
(No need of electricity)

Moderator

Automatically Fall by Gravity
(No need of pump and electricity)

No existence of Zr for fuel rod,
No existence of H₂O for cooling,
No production of Hydrogen,
No explosion of Hydrogen.

SAFE
How about diffusion of radioactive materials?

If molten-salt fuel leaks from tanks...

Coolant is Molten-Salt
↓
BT is 1430 C degree
↓
MT is 450 C degree

Freeze as glass under MT.
Glass is excellent to keep materials in it.
Radioactive materials will be kept within this glass.
Of course, radiations are emitted around it.
Safe and small reactor should be put at demand side.
- Its economy must be high enough.
- If it is cooled without sea water, it is welcome.
- Such a reactor have to be operated in load following mode.
- Needless to say, it can not be used for weapon.

Thorium MSR is available.
How can we achieve a rise of thorium?

- Short term … LWR, HWR etc. (by USA, Canada, EU, China etc.)
- Middle term … MSR (China, US, EU and Japan?)
- Long term … Fissile breeding by ADS and nuclear fusion

In any case, the most important subject is “how to get fissile”.

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The diagram shows the timeline for the development of thorium-based energy systems from 2000 to 2050. The timeline includes the following stages:

- **2000**: 
  - U-LWR
  - U-HWR

- **2010**: 
  - Th-LWR (233U supply)

- **2020**: 
  - Th-HWR
  - Th-MSR

- **2030**: 
  - Power generation

- **2040**: 
  - Fissile production by ADS or fusion

- **2050**: 
  - Breeder
Proposal as comprehensive approach

Monazite → Refine plant

Thorium → Permanent magnet for Motor

Electric Vehicle (EV)

Pu in the spent nuclear fuel & weapon head

Thorium nuclear power station

Waste

Validation

Power supply

Residential use

Plug-in

Thorium is … “Not a Problem, But a Solution.”
Implementation of thorium MSR for the lower LWR scenario.
(Predicted by IAEA estimating 510 GWe of electricity capacity around at 2030.)
Global growth of thorium MSR (case 2)

Implementation of thorium MSR for the constant LWR scenario.
(Considering effect of Fukushima Daiichi accident: 370 GWe of LWR till 2030)
Of course, this is proposal for Japan’s revival

Thorium holds key to Japan’s industrial future

In Japan, electric vehicle technology is one of the key elements for industrial revitalization. Here, too, thorium has the potential to play a prominent role.

Magnets made from compounds which include rare earths, a type of rare metal, are indispensable for small motors that power electric cars. Last year, Japan’s demand for rare earth metals totaled some 20,000 tons. Since China accounts for 97 percent of global production of rare earths, any suspension of supply would be a major concern.

In June, Beijing decided on a policy of stockpiling certain amounts of rare earths. The United States, concerned about China’s monopoly in this field, started a project to assess its own deposits at the Mountain Pass rare earth mine in California and elsewhere.

Meanwhile, in July 2009, Japan adopted a strategy to secure a stable supply of rare metals. In October that year, Masayuki Nasuhima, minister of economy, trade and industry, visited China to seek a deal. But China turned down the request, citing the need for measures to prevent environmental pollution.

Behind China’s monopoly in the market for rare earth metals is thorium. Rare earth ores often contain thorium, whose radioactivity could cause environmental pollution. Therefore, the mining of rare earths is usually limited to mines with low ratios of thorium content. However, globally, there are few such mines.

If thorium can be used in nuclear power plants, rare earth deposits with high thorium content will be more actively developed. While Japan does not produce thorium, globally, thorium resources are more abundant than uranium. If thorium and rare earths can be utilized at the same time, it may be possible to halt China’s monopoly on rare earths and accelerate commercial production of electric cars. This is why thorium could be the savior of next-generation industries.

After U.S. President Barack Obama’s speech on a world without nuclear weapons delivered in April 2009 in Prague, thorium has attracted international attention.

Takashi Kamei is an invited researcher at the International Institute for Advanced Studies.
Proposal of “The Bank”

Country of rare-earth mining and use, thorium nuclear power

Country of rare-earth use

Country of rare-earth mining

Country of rare-earth mining and use

Country of thorium nuclear power

Profit:
- Security
- Guarantee
- Low cost of fuel

Profit:
- Environment
- Commodity of Th

Deposit (Th)

Debt (Th, \(^{233}U\))

Return (Th)

Interest (\(^{233}U\))

The Bank
THorium Energy Bank

Head Office and Local Branches in the world

Function of “The Bank”:
- Storage (Th, \(^{233}U\), FP, TRU)
- Reprocessing
- Fuel fabrication

Rare-earth
Thorium (Th)
Fissile (\(^{233}U\))
Smart Grid with thorium utilization

Supply
- Renewable Energy - Clean but unstable
- Thorium MSR
- Coal Fire Plant CCS
  - Clean and stable
  - Load following operation

Management
- Smart Meter
  - Smart Housing (LED, LCD)
- IT industry - such as Google
  - Clean and stable
  - Act as buffer

Demand
- Renewable Energy - Clean but unstable
- Electric Vehicle
  - Act as buffer

Mr. Eric Schmidt (CEO of Google)
a member of President Obama's Council of Advisors on Science and Technology.

Thorium MSR
- Electricity Supply and Rare-earth production
A new model to solve the world problem

No nuke weapon
(Pu incineration)

Support Uranium
(Pu in the spent nuclear fuel)

Promote EV
(by rare-earth)

Support developing countries
(technology support)

Climate change
(Low-carbon Energy)

Thorium Nuclear Power

Thorium MSR revives Japan.
Will it come soon?

Peaceful Energy
Thorium Nuclear Power

Does Gundam Dream of Thorium?
Takashi Kamei

Garyusha