



Advanced Mineral Research

Thorium Project Turkey

AMR Resources

www.amrminerals.co.uk

Company Overview

- ▶ AMR Resources Ltd. (AMR) is a Mineral Exploration and Mining Company with a long term strategy of discovering and advancing big deposits with strong production potential

Mine-to-Market Strategy

Company Overview

- ▶ 100% ownership of mineral exploration and operation licences covering approximately 2,500 sq km in Turkey
- ▶ Located in *Isparta Angle* in Southwestern Turkey, recognised as having a unique structural and geological history.
- ▶ The licence area is a composite of exploration project ground held under title by the AMR Group.

AMR Project Area Location



General Location of Aksu Diamas Project

Why Thorium?



- ▶ Only Uranium-235 (U-235), Plutonium-239 (Pu-239) and Thorium/Uranium-233 (U-233) are being used as Nuclear Energy Fuel.
- ▶ 1000kg of Thorium produces 1000MW of energy
- ▶ Only known Thorium producing country is India est. at 100 Tons/year
- ▶ USA, China, Russia, Canada and Norway and firms like AECL, Westinghouse, AREVA and GE put a certain weight on Nuclear Reactor Technologies based on Thorium

Thorium Developments

- ▶ India has reached to the final phase of her 3 Staged Long-Term Thorium Nuclear Programme.
- ▶ Canada AECL and China have finalized their Thorium Fuel CANDU Nuclear Power Plant Tests successfully.
- ▶ Light Bridge, Kurtchatov Institute-Russia and Brookhaven National Laboratory-USA are continuing their activities started in 1996 intensively for Thorium Based LWR Fuel-Cycle.
- ▶ Aker Solution-Prof. C. Rubbia; ADSL Accelerator Driven System development is continuing.
- ▶ Norway is carrying on to their Thor Energy Research and Development activities which was started in 2008.
- ▶ IThEMS International Thorium Energy & Molten Salt Technology Inc. had been established in 2010 to produce Mini Fuji/Fuji (**THORIMS-NES**) developed by Prof.Dr.K.Furukowa and they have already initiated works for a Demonstration Plant.

Thorium Fuel has significant benefits

- ▶ Huge global thorium (Th) resources – not in pockets
- ▶ Excellent material properties in reactor operations
- ▶ Superior proliferation resistance
- ▶ Efficient plutonium (Pu) destruction
- ▶ Generated fissile material (U233) can be re-used in LWRs
- ▶ Improved environmental credit in a closed fuel cycle
- ▶ Improved waste characteristics (less volume and toxicity / more stable)
- ▶ Can be used in existing commercial reactors
- ▶ Ordinary fuel fabrication techniques can be applied
- ▶ Licensable in ordinary regulatory environment

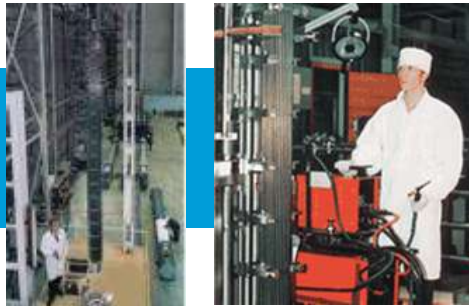
Source:



Worldwide activities on Thorium

- ▶ **Russia** to test prototype of Thorium's design in a commercial 1,000-megawatt reactor in Russia.
- ▶ Scientists at Kurchatov have been crucial to Thorium's work.
- ▶ **India** sees Thorium as main energy strategy
- ▶ Use surplus Pu-239 as seed fuel
- ▶ Only 450 kg Th/år
- ▶ Indian 500 MWe Thorium reactor construction

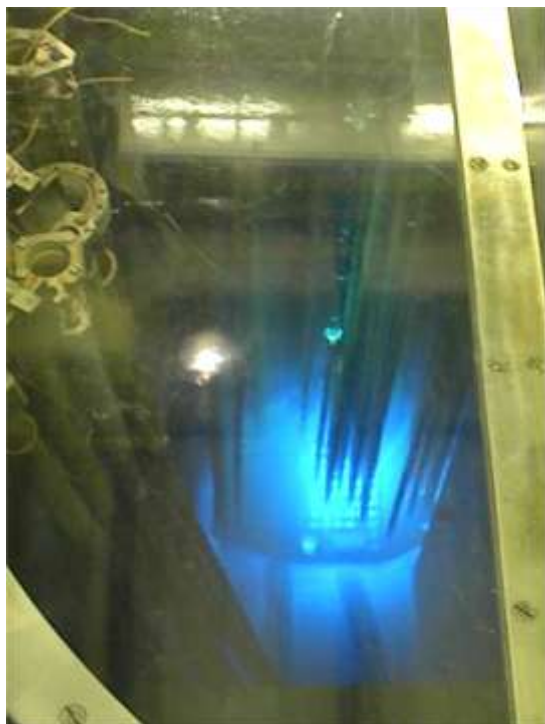
▶ **Russia**



▶ **India**



Work In Russia On Thorium Power Fuel

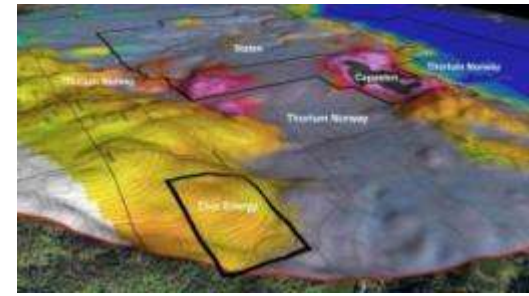


“Recent” BNL Work on Thorium-Based Fuel Cycles

Recent BNL Research on Thorium

- BNL-Kurchatov-Radkowsky Thorium Power Corp/Thorium Power project was started in 1996 under the DOE Initiatives for Proliferation Prevention (IPP) program
 - reactor design
 - safety analysis
 - prototypic fabrication
 - irradiation testing of U-Zr and (Th,U)O₂ fuel samples in IR-8 reactor,
 - T-H experiments.
- BNL NERI (1999): Tight-hex-lattice BWR
- BNL NERI (2000): Heterogeneous implementation in PWRs.
- Accelerator Driven Systems
 - Target design
- Generation IV- Gas Cooled, Fast Reactor
- Thorium Fuel Cycles

Thorium in Norway



Fen area

- ▶ This geological site in the Telemark region is an ancient volcano that contains a unique collection of minerals. Rare earth elements and uranium in addition to at least 1 million tons of thorium are also of commercial interest.

Thorium Norway ASA

- ▶ Three parties have mineral rights in Fen : The historic iron miner Cappelen Holding ASA, the Norwegian state and Thorium Norway AS. The latter shares the vision for a cheap and disruptive thorium energy infrastructure.
- ▶ 1 million tons of Th contain minimum 300 yrs of global energy.
- ▶ 1 ton of Th powers the city of Oslo for 1 year – using the MSR !

Debate and opinion

- ▶ Some see thorium taking over from North Sea oil. Vocal environmentalists have criticized both the Accelerator Driven System proposed by Dr Egil Lillestøl and varying Water Reactors proposed by Thor Energi AS. A stable majority of public opinion perceives thorium as acceptable as opposed to uranium.

Thorium in Norway



Thorium Electronuclear – Energy For the 3rd Millennium! Report

- ▶ In February 08 Thorium report committee chairman Mikko Kara handed over the document to the Norwegian Minister for Oil and Energy. The Molten Salt Reactor actually comes out in style : The Report recognizes the fact that the MSR is the only GenIV machine that can run on a closed thorium fuel cycle. Also thorium energy should be recognized as CO₂-free and sustainable. a Nordic collaboration is recommended

Our commentaries to the Report

- ▶ We think that more emphasis should have been focused in practical detail on reactor safety, operation simplicity, non-proliferation and cost.
- ▶ The committee echoed the Norwegian Geological Survey, NGU, that mining costs for Thorium are uncertain. **We remind that 10 000€ per kg Th is fully acceptable.** Due diligence in Thorium will reveal primary revenue streams from Rare Earth Elements REEs allowing for high environmental standards.
- ▶ Thorium Electro Nuclear published commentaries to the Thorium report on the Minister's website.
- ▶ The MSR was mentioned in the Norwegian technical weekly TU.



CANDU Reactors for China



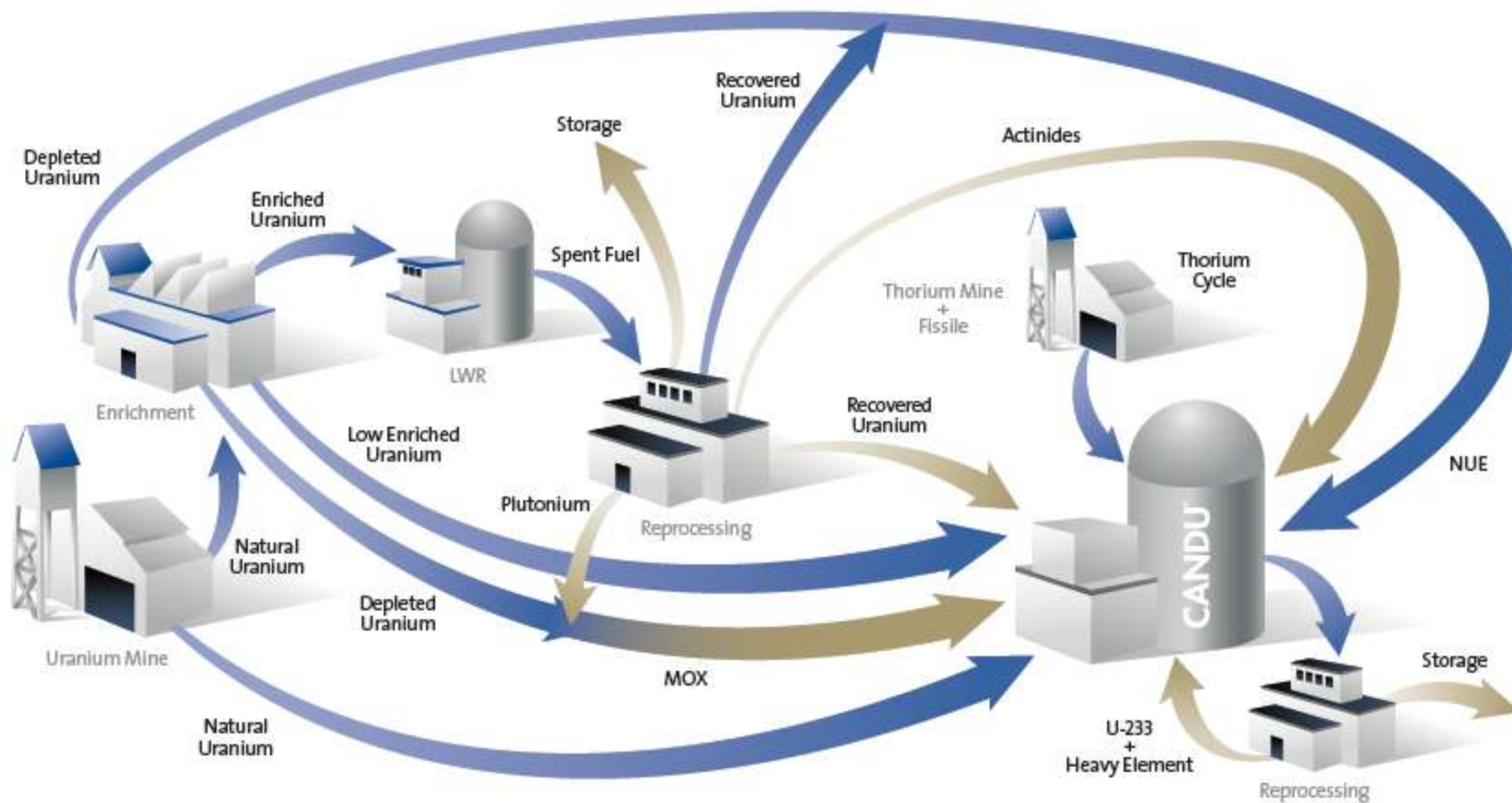
Advantages of Thorium in CANDU

- High neutron economy, smallest amount of fissile material required as driver fuel
- Favorable reactor physics (softer spectra)
- Simple and short fuel bundle
- On-power fuelling capability
- Smoother transition from one type of fuel to another
- Minimal amount of changes in reactor design
- Shortest development path relative to any competition

Summary

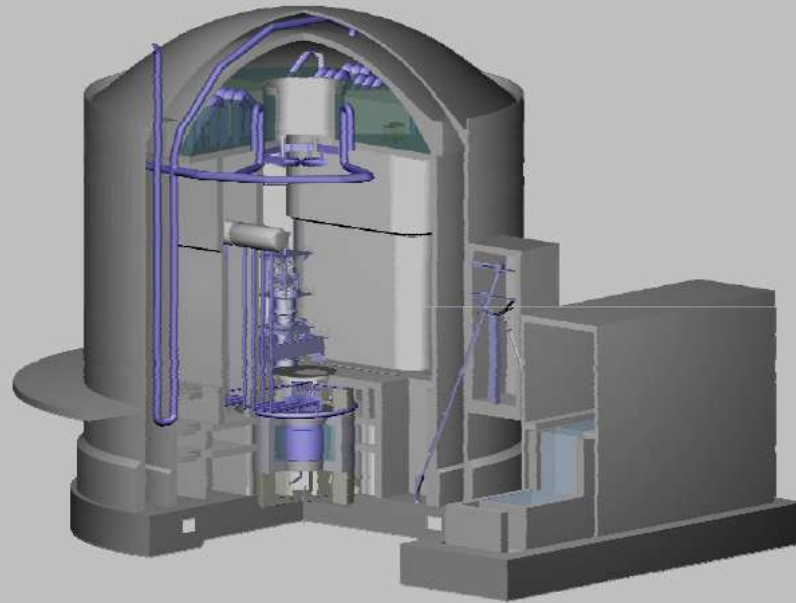
- The Qinshan 3 CANDU reactor technology is the most efficient user of uranium and most adaptable to alternative fuel types among all operating commercial nuclear power units in the world, providing an excellent basis for the further development of uranium saving technology in China.
- CANDU reactors are the ideal burners for recovered uranium from Chinese PWR spent fuel to form an important element of China's closed fuel cycle policy.
- The CANDU reactor is well recognized as the most promising commercial reactor technology which can efficiently utilize thorium-based fuel, providing a practical path for China to gradually unlock the vast amount of energy contained in its abundant thorium resources.

FUEL CYCLE



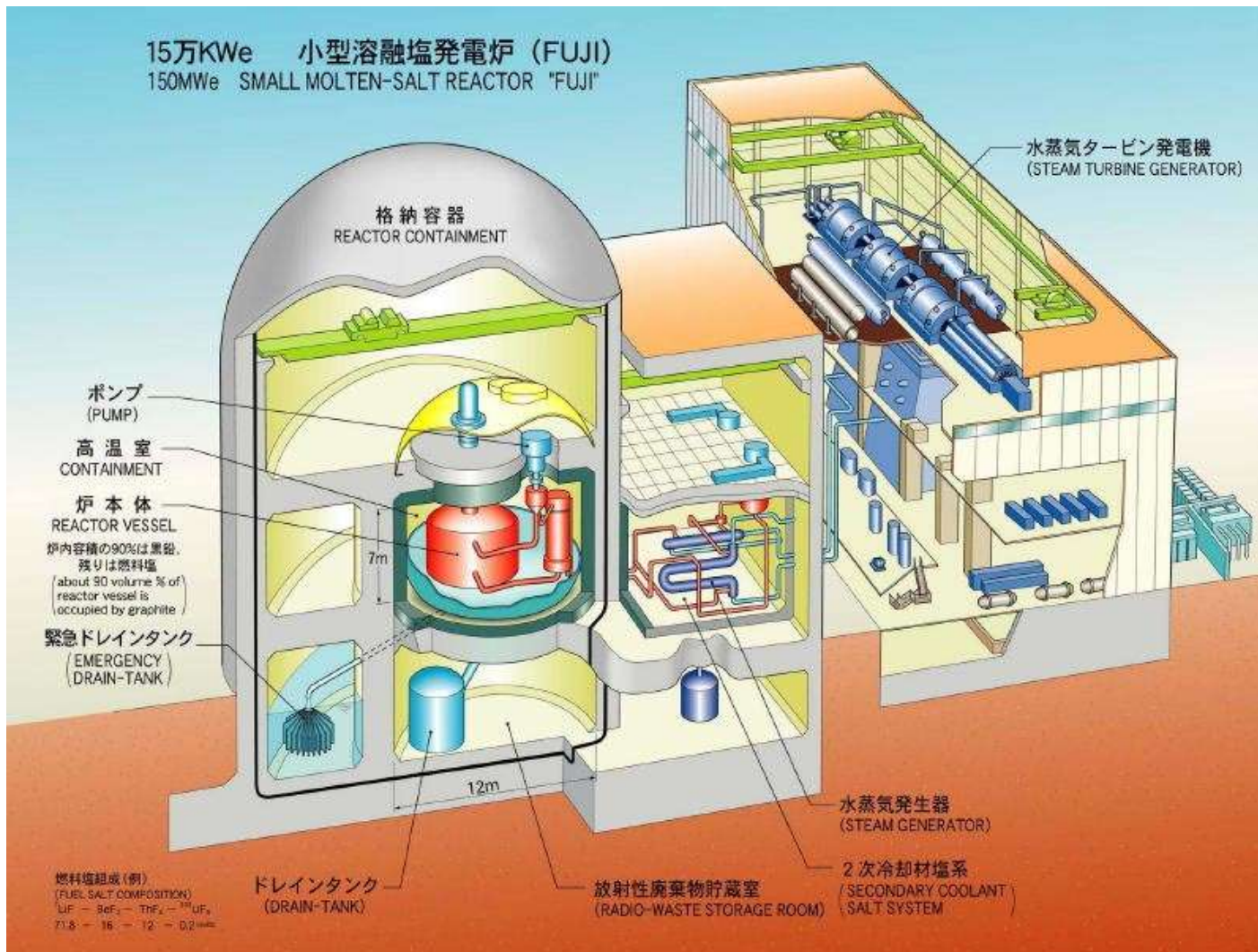
AHWR300-LEU

Advanced Heavy Water Reactor
with LEU-Th MOX Fuel



Bhabha Atomic Research Centre
Department of Atomic Energy
Mumbai, INDIA

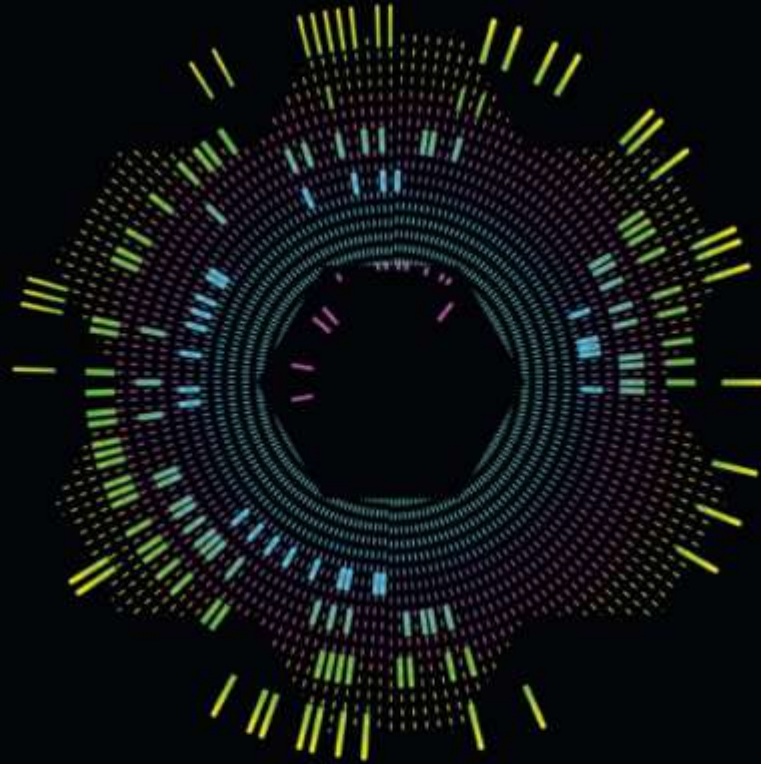




TOWARDS AN ALTERNATIVE NUCLEAR FUTURE

Capturing thorium-fuelled ADSR
energy technology for Britain

A report prepared by:
the thorium energy amplifier association
2009-2010



Thorium as a Nuclear Fuel

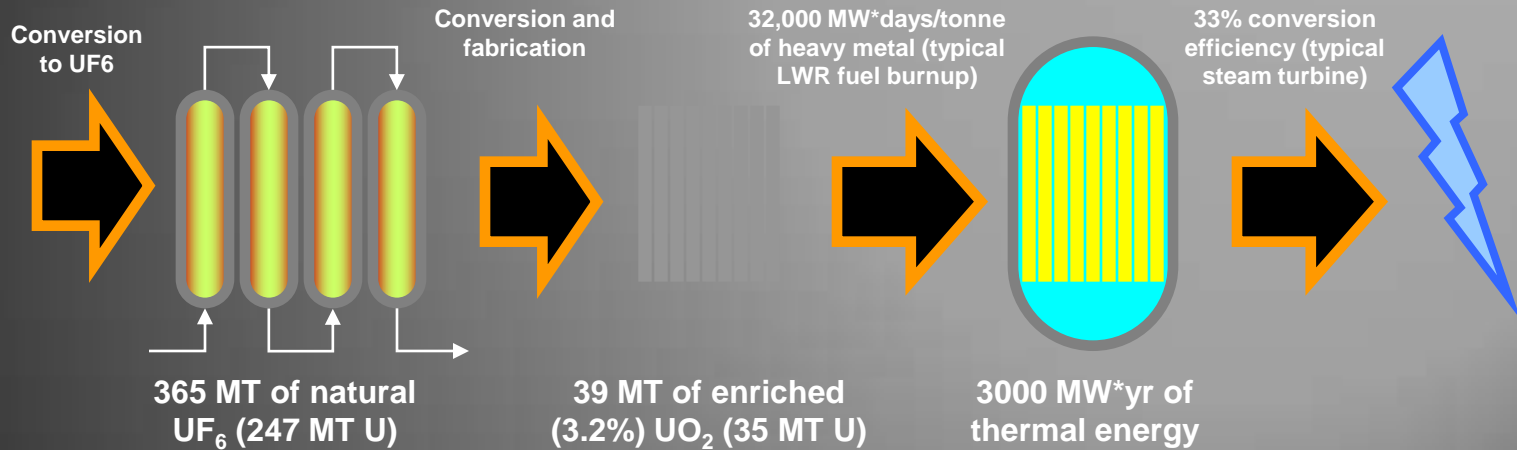


- ▶ Nuclear power is set to make a comeback
- ▶ Huge potential for new technologies and approaches
- ▶ Can easily mine thorium instead or as well as uranium
- ▶ A **greener** alternative to traditional nuclear fuel promising alternative energy source that is safe and sustainable
- ▶ Could generate low cost power
- ▶ Substantial long term investment upside
- ▶ Thorium as an additional **Greener** investment potential to an investors nuclear portfolio along with uranium and nuclear technology
- ▶ **1 Kg Th = 1 MWe**

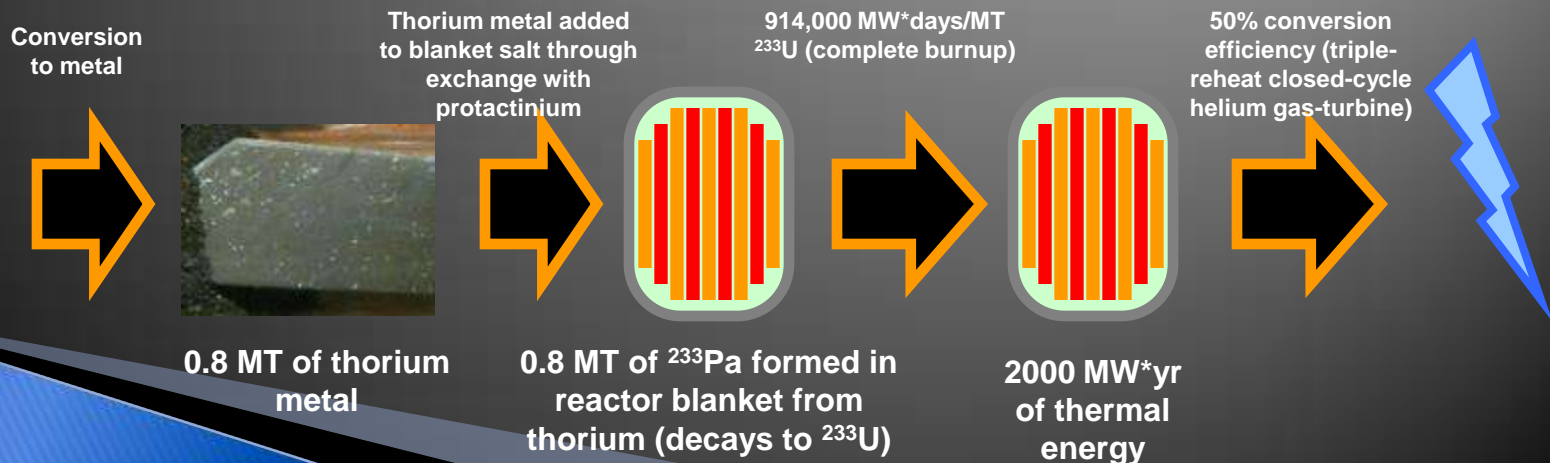


Energy Extraction Comparison

Uranium-fueled light-water reactor: 35 GW*hr/MT of natural uranium



Thorium-fueled liquid-fluoride reactor: 11,000 GW*hr/MT of natural thorium



Uranium Fuel Waste Generation

Waste generation from 1000 MW*yr uranium-fueled light-water reactor



Mining 800,000 MT of ore containing 0.2% uranium (260 MT U)

Generates ~600,000 MT of waste rock



Milling and processing to yellowcake—natural U_3O_8 (248 MT U)

Generates 130,000 MT of mill tailings

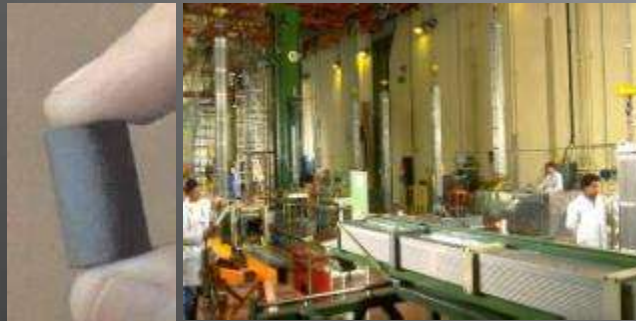


Conversion to natural UF_6 (247 MT U)



Enrichment of 52 MT of (3.2%) UF_6 (35 MT U)

Generates 314 MT of depleted uranium hexafluoride (DU); consumes 300 GW*hr of electricity



Fabrication of 39 MT of enriched (3.2%) UO_2 (35 MT U)

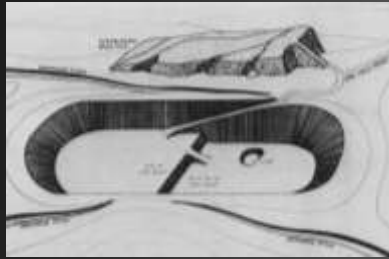
Generates 17 m³ of solid waste and 310 m³ of liquid waste



Irradiation and disposal of 39 MT of spent fuel consisting of unburned uranium, transuranics, and fission products.

Thorium Fuel Waste Generation

Waste generation from 1000 MW*yr thorium-fueled liquid-fluoride reactor

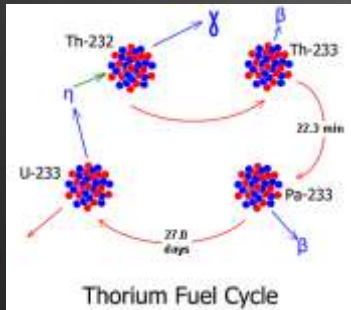


Mining 200 MT of ore containing 0.5% thorium (1 MT Th)

Generates ~199 MT of waste rock



Milling and processing to thorium nitrate ThNO_3 (1 MT Th)
Generates 0.1 MT of mill tailings and 50 kg of aqueous wastes



Conversion to metal and introduction into reactor blanket



Breeding to U233 and complete fission

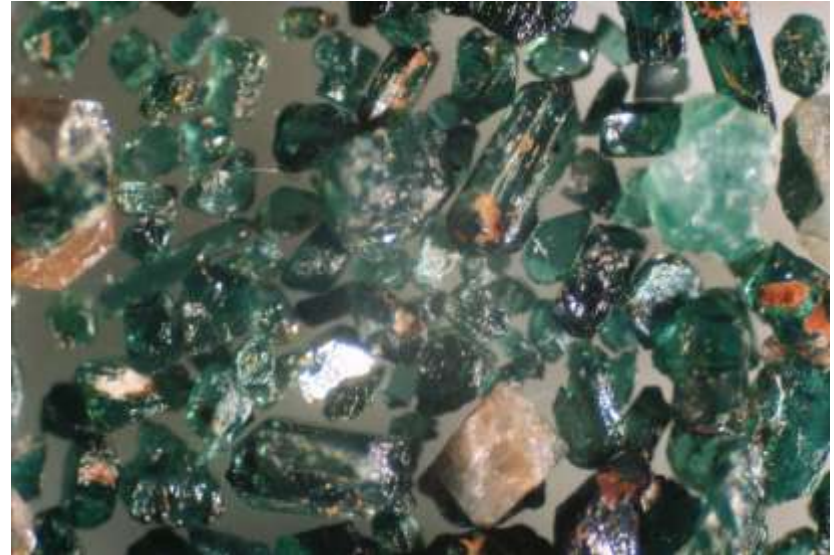


Disposal of 0.8 MT of spent fuel consisting only of fission product fluorides

Thorium Mineralisation

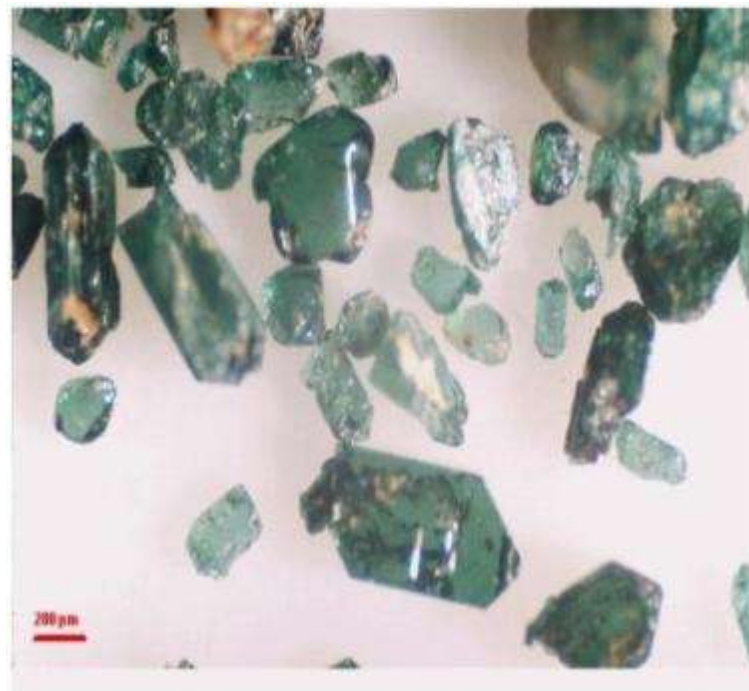
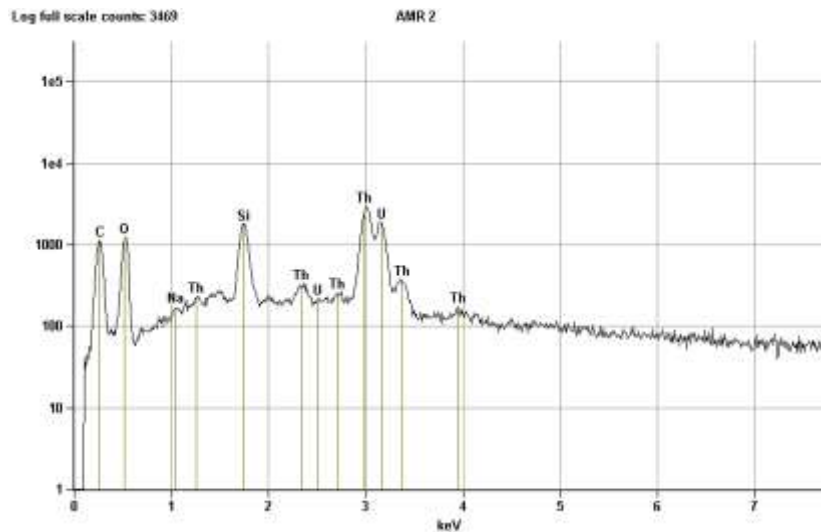
TETRAGONAL AMR THORITE GRAINS

The tetragonal nature of the thorite crystals which were obtained during processing of samples from the recent drilling at Çanaklı



Thorium in our Thorite

SEM - EDS Analysis Results



Quantitative Results AMR 2					
Element	Net Counts	Weight %	Atom %	Formula	Compnd %
O	8092	19.31S	66.52		---
Na	115	0.12	0.29	Na ₂ O	0.16
Si	16403	8.17	16.02	SiO ₂	17.47
Th	54838	67.92	16.13	ThO ₂	77.29
U	2742	4.48	1.04	UO ₂	5.08
Total		100.00	100.00		100.00

Our Resources

ORE TYPE

Mantle Origin, Heavy Mineral Sand like, Liberated, Pyroclastic Tuff

MINING METHOD

- ▶ **Quarry:** Hydromining - Dredge
- ▶ **Concentrator:** Hydrocyclone + Spiral + Magnetic Separator

TOTAL RESOURCE : Up to 2 Billion Ton

RECOVERABLE RESOURCE BY CONVENTIONAL METHODS

- ▶ Up to 700 Million Ton (35%) (-0,70mm+0,015mm Fractions)

AVERAGE GRADE :

- ▶ 1 Kg / Ton TREO 0,1 Kg / Ton Nb₂O₅
- ▶ 5 Kg / Ton TiO₂ 60 Gr / Ton ThO₂
- ▶ 1 Kg / Ton ZrO₂ 30 Kg / Ton Fe₃O₄ (Micronized Magnetite)

Top News

- [Thorium Energy in American Scientist](#)
The how and why's of thorium's benefits. Aim high!
- [Former Greenpeace Director Contributes](#)
He is noted for his u-turn.
- [Congressman Calls for Thorium Energy](#)
In his quest for...
- [Bill Gates Invest in Thorium Capable Reactor Venture](#)
Bill Gates received a standing ovation...
- [Google Hosted the Thorium Energy Conference at Headquarter](#)
The second TEA Conference on thorium energy...
- [Thorium Energy Conference 2010, London on October 17 - 20](#)
It's Time To Talk!

Articles

- [Liquid Fluoride Thorium Reactors](#)

Meet the Attractive Thorium at ThEC2010

15 October, 2010

Thorium is naturally found in various forms, one is Thorite. It's a rare nesosilicate but the most common mineral of thorium. Specimens of thorite is generally found in special geological formations. The crystals are rare, but when found they produce nicely shaped short prismatic crystals.

Other varieties of thorite include "orangite", an orange variety, and "calciorthorite", an impure variety with trace amounts of calcium.

The color is normally black, but also brownish black, orange, yellowish-orange and dark green as seen in the image.



AMR Minerals will bring Thorium samples for everyone to see at ThEC2010.

Ahmet, Director of AMR Minerals, says "Our thorium is unique as it is not in monazite but in a liberated form in thorite, hence without the need for cracking."

The crystals range from a near 40 micrometers up to 1mm in size with a beautiful shade of green.

[AMR Minerals](#), owner of Thorium mining rights in Turkey.



It's Time To Talk

IThEO held ThEC 2010 in London on October 17-20 at the prestigious Royal Institution.

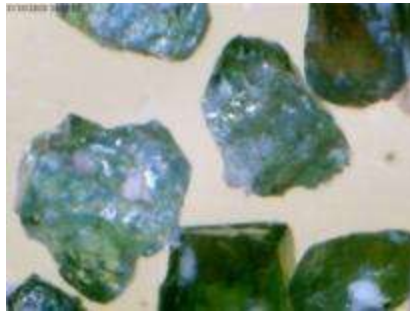
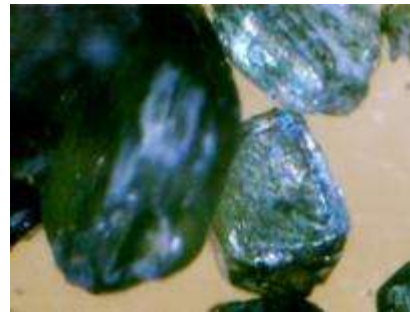
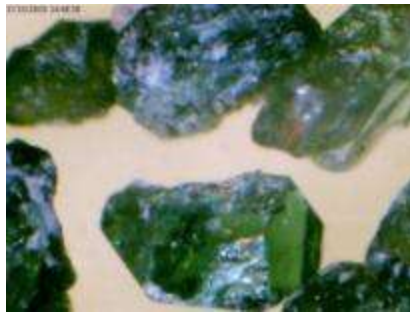
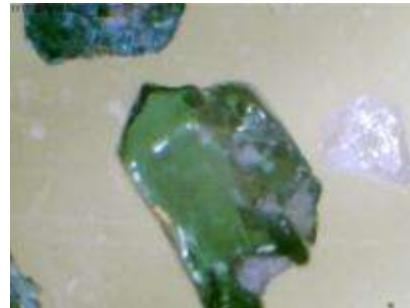
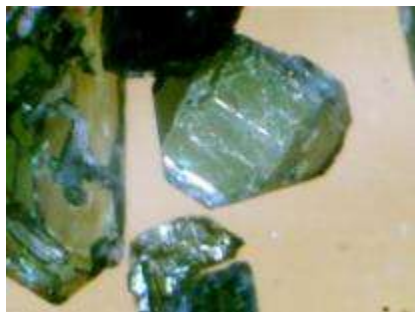
- [Program - ThEC2010](#)
- [Click here for further information](#)

Become a Member

If you would like to support IThEO and our efforts to make Thorium part of a sustainable energy future, or just



Our Thorite (75% Thorium)



AMR RESOURCES



www.amrminerals.co.uk

AMR Madencilik İşletmeleri San. ve Tic. A.Ş.

ABC Yolu, ABC Plaza Kat:4

34460 Istinye, Istanbul

Tel: +90 212 323 3435

Fax: + 90 212 229 5463

amr@amrmadencilik.com.tr

AMR Resources Ltd

Alliance House

12 Caxton Street

London SW1H 0QS

Tel: +44 20 7799 1000

Fax: +44 20 7799 1020

ahmet.arda@amrminerals.co.uk



We are members of:

