

# HEALTH CONCERNS IN REGARDS TO LAMP

MALAYSIAN MEDICAL ASSOCIATION

## What is rare earth ?

- 17 elements on periodic table

But the ore ALSO contains :

+ radioactive Thorium, Uranium

+ Heavy metals – lead, cadmium, chromium...

In natural state, they are confined in compounds.

Once processed, they are released...

# Thorium decay series



# How does Thorium gets into the environment?

- The waste products from the processing plant :
  - \* liquids – even though treated, suspended and dissolved Thorium can not be removed
  - \* gas – Radon gas released during crushing and from continuous decay in waste dump site
  - \* solids – the mill tailings are in the form of fine powder which may be carried through wind, rain and underground water into wider environment

# How does Thorium get into the body?

1. inhale contaminated dust
2. swallow contaminated food or water

- \*Lung levels of Th 230,232 higher in miller, miners
  - from review of epidemiological evidence ( Wrenn et al 1981 )  
the major route of exposure was inhalation among workers
- \*absorption through lungs accounts for 2/3 of ultimate uptake in the body
- \*absorption depends on solubility of different chemical forms and particle size
- \*Distribution in body from inhalation exposure: tracheobronchial lymph node, bone, lung, liver, kidney in decreasing order
- \*about 0.02-0.05% of ingested Thorium is absorbed into blood stream and deposited in:
  - Bone (70%) *biological half life 22years*
  - Liver (4%) *biological half life 700 days*
  - other organs & tissues(16%) *biological half life 700 days*
  - 10% *excreted*
- \* Excretion is primary in faeces

# What are the primary health effects ?

- Thorium dioxide is classified by the U.S. Agency for Toxic Substances and Disease Registry as a "**known carcinogen.**"
- Animal studies suggest that thorium may be absorbed through skin, but thorium poses little health hazard outside of the body.
- Workers who are exposed to thorium have been shown to have an increased chance of **lung disease, lung cancer, and pancreatic cancer.**
- Thorium has also been shown to cause **liver disease, blood disorders, and changes to genetic material.**
- Large acute (one time) doses have been shown to lead to metal poisoning in animals.
- **Birth defects** have been observed in animals exposed to thorium.

# Epidemiology studies

1. Bayan Obo rare-earth and iron mine in China
  - Compared between miners who had inhaled ore dust containing thorium (2903) with miners who had inhaled dust-free air (4655),  
(From 1977-December 1993)
  - The SMR from lung cancer for group 1 was 5.15 (95%CI 3.36-7.89), Group 2 - 2.30 (95% CI 1.17-4.51).
  - Both groups also had higher SMR compared to Chinese population; it was due to high rate of smoking.

# Epidemiology studies

- The study showed that significant increased lung cancer mortality in both exposed miners and unexposed workers when compared with the Chinese population and the level in exposed miners was significantly higher than in unexposed workers.
- Due to inhalation of silica- and thorium-bearing dusts and thoron progeny.



# Epidemiology studies

## 2. Bayan Obo rare-earth and iron mine in China

- The total person-years of observation of the dust exposed miners and the unexposed miners were 62712 and 34672 respectively.

(From 1977-March 2001)

- The SMR from lung cancer for group 1 was 6.13(95%CI 4.2-8.94), Group 2 – 1.9 (95% CI 0.95-3.81).
- The difference between the 2 SMR is very significant (Chi square = 9.488;  $p < 0.005$ )
- No difference of smoking habits between the 2 groups
- Carcinogenicity after long-term inhalation of thorium-containing dusts and thoron progeny is confirmed.

# Epidemiology studies - US

A case study of 112 New Jersey households in the vicinity of a thorium waste disposal site found a higher prevalence of birth defects (relative risk 2.1) and liver disease (relative risk 2.3) among the exposed population than the unexposed group.

Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley & Sons Inc., 1993-1994., p. 2257

Environmental effects



Health Issues

Institute for the Analysis of Global Security (IAGS)  
China's Rare Earth Elements Industry:  
What Can the West Learn? By Cindy Hurst

- Page 16: Severe environmental damage (2nd Paragraph)

*According to an article published by the Chinese Society of Rare Earths, "Every ton of rare earth produced, generates approximately 8.5 kilograms (18.7lbs) of fluorine and 13 kilograms (28.7 lbs) of dust; and using concentrated sulfuric acid high temperature calcination techniques to produce approximately one ton of calcined rare earth ore generates 9,600 to 12,000 cubic meters (339,021 to 423,776 cubic feet) of waste gas containing dust concentrate, hydrofluoric acid, sulfur dioxide, and sulfuric acid, approximately 75 cubic meters (2,649 cubic feet) of acidic wastewater, and about one ton of radioactive waste residue (containing water)"*

Investigating rare earth element mine development in environmental protection agency region 8 and potential environment impacts by justin paul  
august 15, 2011

- Rare earth element production could contaminate the environment if best management practices are not used and the operation is not closely monitored.
- The possible contaminants include, but *not limited to radionuclide*, rare earth elements, metals such as **barium, beryllium, copper, lead, managanese, and zinc, sulfide minerals, carbonate** could be a concern with rare earth element

# China Baotou – Inner Mongolia

- Baotou is the biggest rare earth production area in China which supplies about 60% of rare earth of the world.
- China, Baotou was blamed to caused high level of radioactive in the soil and water around the area (reported by The Star 2nd May 2011 page W32)

# Baotou

- Baotou was blamed for producing approximately ten million tons of all varieties of wastewater every year and most of that waste water is discharged without being effectively treated,
- which not only contaminates potable water for daily living, but also contaminates the surrounding water environment and irrigated farmlands.

- Bradsher, Keith (October 29, 2010). "After China's Rare Earth Embargo, a New Calculus". *The New York Times*. <http://www.nytimes.com/2010/10/30/business/global/30rare.html>. Retrieved October 30, 2010.
- Cindy Hurst. 15 November 2010. Cutting Edge News

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# In united states

- 1. West Chicago: Kerr-McGee Chemical Corporation –1932-1973**
- 2. California: Molycorp. Inc. 1974-2002**

# West Chicago, US

- In the early years, people from the surrounding community used the mill tailings as fill dirt in various properties, such as their yards and gardens.
- For more than 25 years starting in the 1930s, residents unwittingly spread low-level radioactive waste throughout the suburb of West Chicago, using the byproducts of a local factory as landfill.

# West Chicago, us

- The Kress Creek/West Branch DuPage River site includes almost 7 miles of creek and river sediment, banks and floodplain soils contaminated with thorium.
- In 1991 the Illionois Department of Public Health found elevated cancer rates in the community

# Chicago

- A study by the Illinois Department of Public Health in 1991 found a greater than expected incidence of some cancers among West Chicago residents. From 1985 to 1988, the study found three times as many cases of melanoma, a type of skin cancer, among men than expected in a similar population. The incidence among women for lung cancer and among men for colorectal cancer were almost double the rates expected, the study found.

Los Angeles Times March 21, 1993

- After 40 years later, toxic waste still haunts pockets of DuPage County. Thorium cleanup nears finish line, but federal funds are in doubt.

Chicago Tribune January 21, 2012

# Molycorp. Inc. – California



- The Molycorp complex at Mountain Pass, Calif., was at one time the world's leading producer.
- Hundreds of thousands of gallons of water carrying radioactive waste spilled into and around Ivanpah Dry Lake.

# California



- The New York Times 29<sup>th</sup> October 2010 has reported that the only American rare earths mine, there was radioactive fluid leaked into the nearby desert in the late 1990s, causing a costly cleanup that contributed to the mine's closing in 2002.

# What are the health concerns in regards to LAMP?

- **PUBLIC HEALTH**

## 1.METHOD OF STORAGE OF SOLID WASTES

above ground , open air storage sites lined by clay and 1mm HDPE at bottom  
need to keep the wastes moist at all times to minimise dust  
Radon and Thoron is continuously emitted from WLP in the open RSF  
at Mount Weld 1.5mm thick HDPE

risk of spillage and dissemination when need to transport to PDF or to be recycled later

## 2.THE LIQUID EFFLUENT

daily about 5 olympic sized swimming pools of raw water will be used and discharged after treatment. The present industrial effluent regulations Std B is used to monitor the quality, which does not include heavy metals and radioactive components.

New international std GB 26451-2011 tailored for RE industry

The required management of liquid waste is by evaporation at Molycorp and mount Weld

## 3.THE GASEOUS EFFLUENT

the sulfuric fumes maybe retained in the scrubber system but the Radon and Thoron can escape into the atmosphere

### 3. RECYCLE THE SOLID WASTES – NUF, FGD

the estimated radioactivity of FGD=0.47Bq/g , NUF=0.52Bq/g

to recycle as fertiliser /soil conditioner for plantation ---enter food chain ?

### 4. RECYCLE THE SOLID WASTES – WLP

WLP can be made into WLP concrete for construction, road base aggregate for road construction, and paver blocks for pavement

	WLP	WLP concrete	Blank concrete
Gross alpha	3.40 Bq/g	0.27 Bq/g	undetectable
Gross beta	16.0 Bq/g	1.13 Bq/g	undetectable
Th 232	5.44 Bq/g	0.61 Bq/g	0.06 Bq/g

is it safe to live in “minimally “ increased background radiation ?

**Recycling of these wastes is no longer practised in China !!**



## 5. PERMANENT WASTE DISPOSAL ?

Todate, there is no definitive plans for long term disposal if the wastes were not recycled despite recommendation from IAEA to do so !

estimated total quantity of wastes generated in 20 yrs : (dry weight)

FGD = 1,148,940 t   NUF = 3,467,300 t   WLP = 1,248,000 t   grand total= 5,864,240 t

# OCCUPATIONAL HEALTH

- EXPOSURE TO EXTERNAL AND INTERNAL RADIATION

SOURCE : Lanthanide dust, wastes, Radon,Thoron emission from processing and storage site

CRITICAL GROUP : truck drivers, ore handlers, process operators, RSF operators

ASSESSMENT OF EXPOSURE : radiation detector for external radiation only

ESTIMATION OF EXPOSURE DOSAGE : calculation modules are debatable

- INADEQUATE PROTECTION

mask not specific, only to certain groups

need goggles?

no compulsory shower, change of clothing

- HEALTH MONITORING PROGRAMME

present occupational accident reporting form not tailored for overall health

long term comprehensive monitoring needed

## What the Experts say

- Nuclear industry proponents often assert that **low doses** of radiation (eg below 20mSV) produce no ill effects and are therefore *safe*.
- But , as the US National Academy of Sciences BEIR VII report has concluded, no dose of radiation is safe, however small, including background radiation; effect of exposure is **cumulative** and **adds** to an individual's **risk** of developing cancer.

# Conclusion

- China, United States even Malaysia had solid evidences that rare earth processing mine or plant has indeed caused harm to the environment and people's health.
- WHEN CONTAMINATION IS PROVEN IT IS TOO LATE AS IT IS NOT REVERSIBLE
- The future of our descendants cannot be compromised in the name of development.