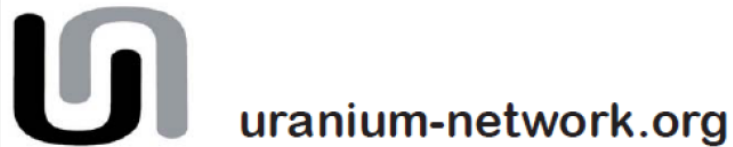


Uranium Mining, Health Impacts, Compensation and Rehabilitation of Uranium Tailings



in cooperation with



Costs

Monetary Costs (financial costs)

for example

- **Costs of mine closure**
- **Costs of Tailings Management**
- **Costs of monitoring of the environment after mine closure**

etc.

Non-monetary costs, → ‚Social Costs‘

for example

- **Health problems of miners and people in the vicinity**
- **Premature deaths**
- **Loss of land as means of subsistence and livelihood**
- **Social and political conflicts, eating up resources**

etc.

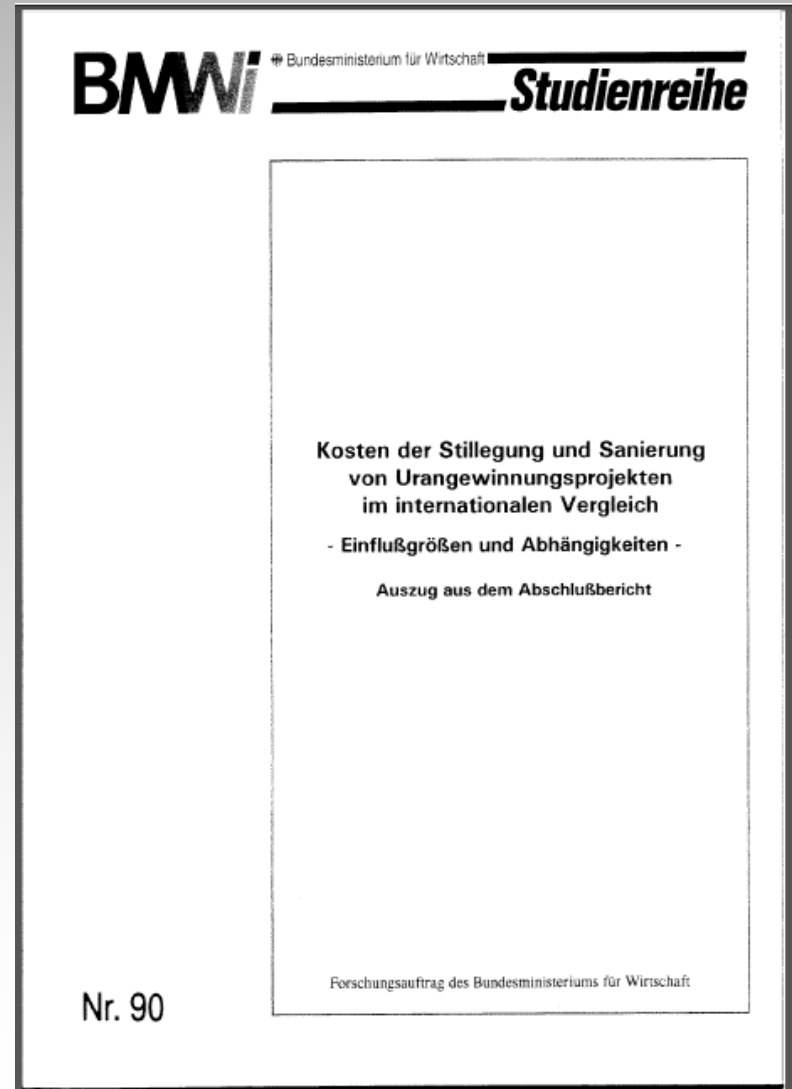
**Reclamation
of
Uranium Mine Tailings
and its Costs**

Reclamation Costs of Uranium Tailings

**Study of German Ministry
for Economic Affairs
(BMWi) 1995**

**„Costs of Mine Closure
and Reclamation of
Uranium Exploitation
Projects - an International
Comparison“**

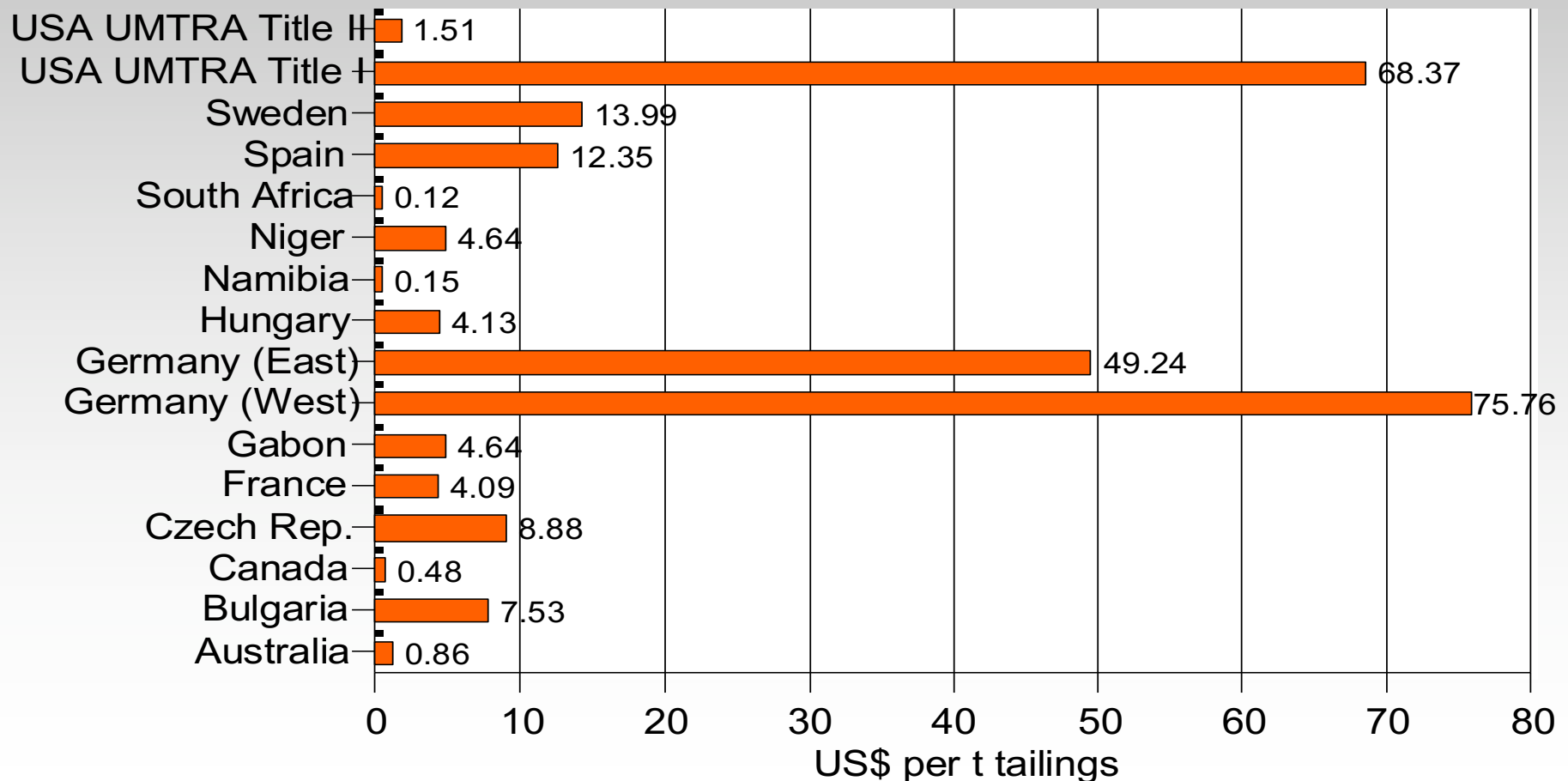
**conducted by
Uranerzbergbau GmbH**



Reclamation Costs of Uranium Tailings

Study by German Ministry for Economic Affairs

Reclamation Cost per t tailings



Reclamation Costs of Uranium Tailings

Study by German Ministry for Economic Affairs

Tailings Management Costs

pro ton tailings

	<u>1993 costs (+)</u>	<u>2013 costs (*)</u>
Scenario 1: Uranium Exploitation as side product	US \$ 2,20	US \$ 2,68
Scenario 2: Uranium Mining (,only‘)	US \$ 4.-	US \$ 4,88
Scenario 3a: Average of all available data	US \$ 15,76	US \$ 19,23
Szenario 3b: Average of Minimum and Maximum (US\$ 0,12/t , South Africa and US\$ 75,76/t tailings, WestGermany)	US \$ 37.97	US \$ 46,33

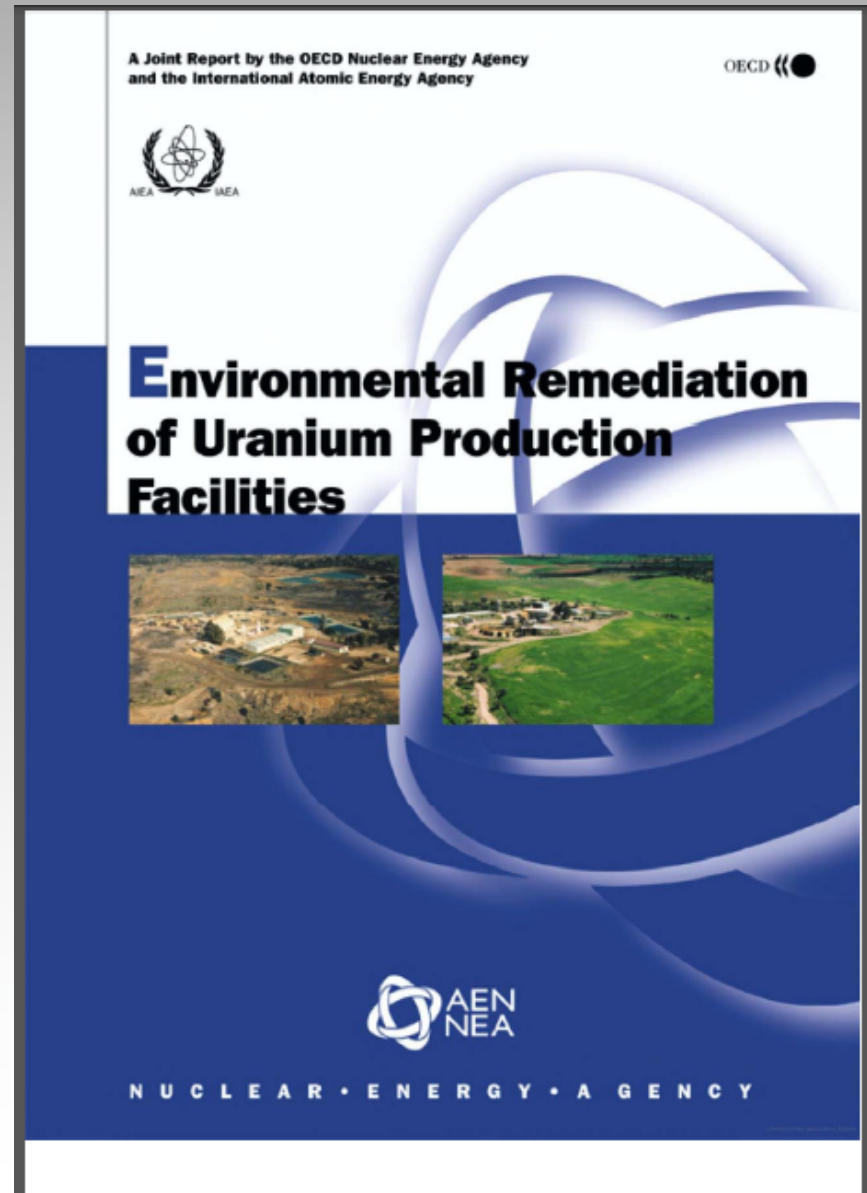
(+) original BMWi-Study of 1993

(*) calculated at 1% inflation / year

Reclamation Costs of Uranium Tailings

Study by OECD and IAEA, „Environmental Remediation of Uranium Production Facilities“

2002



Reclamation Costs of Uranium Tailings

Joint Study by OECD and IAEA

OCE-02/ quotes unit costs (without water treatment) for the decommissioning and remediation of uranium mines in a range from US\$0.76 to US\$16.9 per ton of mined uranium ore or of US\$0.55 to US\$13.62 per kg of uranium produced, respectively.

Costs of decommissioning and remediation of mill plants (again without water treatment) are in the range from US\$3.1 to US\$32.9 per kg of uranium.

Inclusion of water treatment will push up costs between 10 and 50 %.

from: Environmental Remediation of Uranium Production Facilities, OECD, International Atomic Energy Agency (IAEA).
Published by: OECD 2002

Reclamation Costs of Uranium Tailings



Bahi / Manyoni Area – Reclamation Costs

URANEX plans to mine 92 Mio t Uranium ORE

Concentration of uranium in the ore: 0,01%

99,99% of the ore mined will be → **Tailings: 91 Mio tons**

Estimated Costs of Tailings Reclamation in Bahi area, Tanzania			
<u>Tons Tailings (rounded):</u>			91.000.000
<u>Costs</u>		<u>US\$ /t</u>	<u>US\$</u>
<u>Scenario 2 (Uranium mining ONLY)</u>		4,88	444.080.000
<u>Scenario 3a (Arithmetic average Value)</u>		19,23	1.749.930.000
<u>Scenario 3b (Average between min and max value)</u>		46,33	4.216.030.000

Reclamation Costs of Uranium Tailings



Mkuju River Uranium Project - Reclamation Costs

Estimated Costs for Mine Reclamation at Mkuju River Uranium Project, Tanzania

			<u>"Small" Version</u>	<u>"Extended" Version</u>
<u>Tons of Tailings:</u>			59.500.000	139.500.000
<u>Costs</u>		<u>US\$ /t</u>	<u>US\$</u>	<u>US\$</u>
<u>Scenario 1 (U exploitation with Gold-/Copper M</u>		2,68	159.460.000	373.860.000
<u>Scenario 2</u>	(Uranium Mining ONLY)	4,88	290.360.000	680.760.000
<u>Scenario 3a</u>	(Arithmetic Average)	19,23	1.144.185.000	2.682.585.000
<u>Scenario 3b</u>	(Average of Min / Max Values)	46,33	2.756.635.000	6.463.035.000

Reclamation Costs of Uranium Tailings

Example: UNITED STATES



Budget of Company for Reclamation: US \$ 10 Mio.

Estimated costs for reclamation on site: US \$ 19 Mio.

Estimated costs for reclamation „off-site“: US \$ 155 Mio.

Up-to-date Cost Estimation: US \$ 1.000 Mio. (1billion)

Reclamation of Uranium Tailings

for example: UNITED STATES

“More than 10,000 abandoned uranium mines have been identified across the United States, primarily in the West, and more than 10 million people live within a 50-mile radius of one, they said.

According to the draft report to the U.S. Congress, the six states that have the most abandoned uranium mines within their boundaries are Arizona (416), Colorado (1,347), New Mexico (249), South Dakota (155), Utah (1,376), and Wyoming (319).”

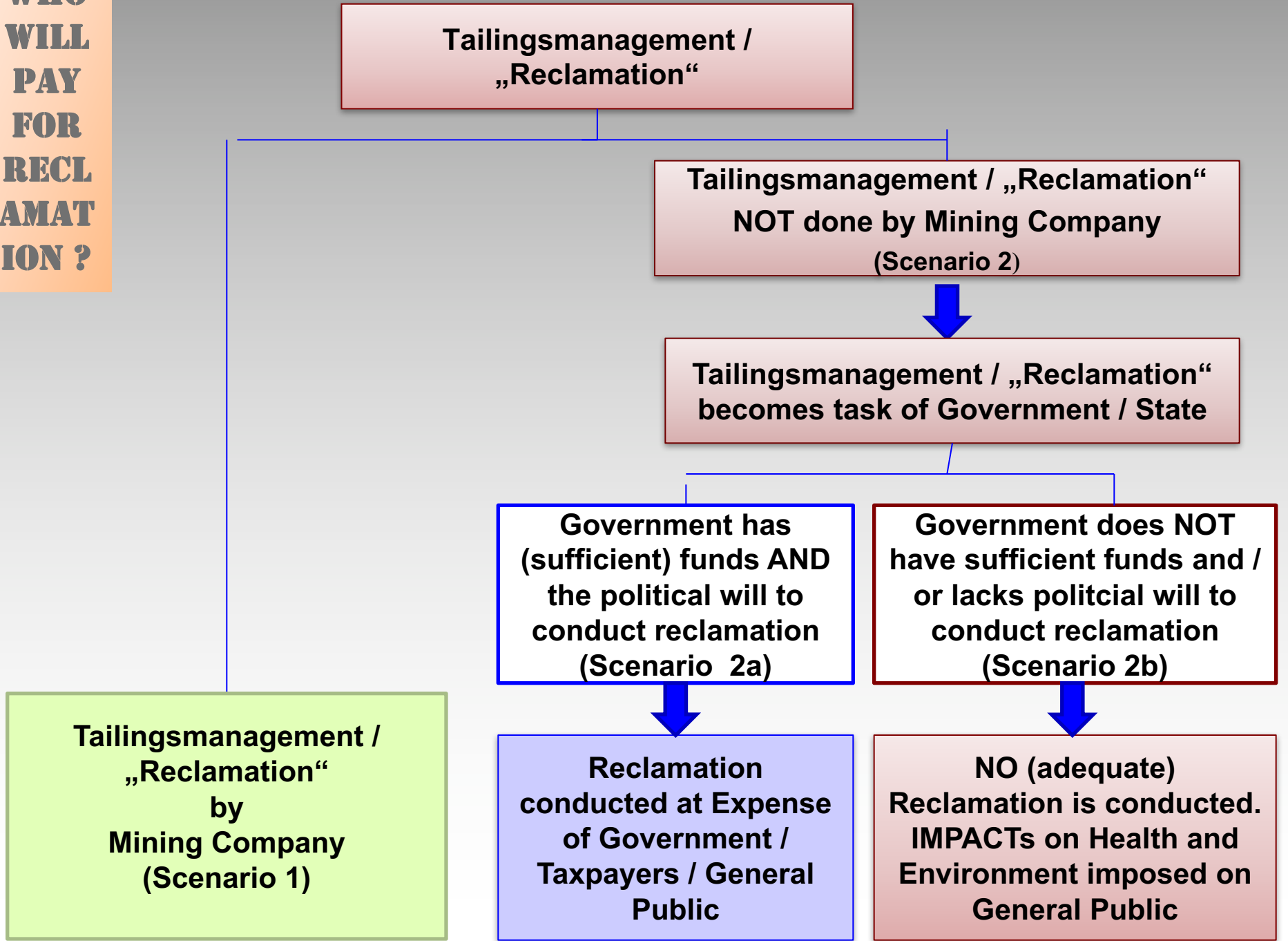
[from: http://www.cipamericas.org/archives/12256](http://www.cipamericas.org/archives/12256)

**10 MILLION
PEOPLE ARE
ESTIMATED TO LIVE WITHIN
50 MILES
OF A RECORDED MINE.**

<http://www.cleanuptheminers.org/resources/>



**WHO
WILL
PAY
FOR
RECLAMATION ?**



'Social Costs' of Uranium Mining

Social Costs

- **Health care costs to treat diseases**
- **Compensations to be paid (for example: US, Germany)**
- **Loss of income for sick workers**
- **Loss of livelihood for workers' families**
- **Premature deaths of workers,**
 - **leading to impoverishment of families**
- **Possibility of genetic damages which may carry on for many generations to come**

URANIUM MINING IN EAST GERMANY

THE AFTERMATH / DEATHS AND SICKNESSES



1946 – 1990

7.163 Uranium miners died from lung cancer

For 5.237 of them, occupational exposure was recognized as cause

1991 – 2012 and onwards

3.700 cases of lung cancer recognized as occup. disease

100 workers larynx cancer, 2.800 quartz pneumoconosis

Presently, approx. 200 cases of lung cancer of former U miners
per year are recognized as occupational disease

Other diseases mostly not recognized as consequence of
occupational radiation exposure of former U miners

**Recognition and compensation process seen as restrictive and not
transparent by critics, health data not accessible to ex-miners etc.**

THE AFTERMATH SICKNESSES, DEATHS AND COMPENSATION



Berufsgenossenschaften / Employers' Liability Insurance 2012

- Of 500.000 individuals working for WISMUT at one point in time, only 165.000 could still be tracked after 1990
- until 1990
31.000 cases of occupational diseases recognized (in GDR), approx. half of it silicosis
- 1990 – 2012:
additional 7.800 cases of occupational diseases recognized (FRG)
- Total expenses 1990 – 2012
950 million € for diagnostics, therapy and compensations paid

(on top of the 7 billion € spent for reclamation of the tailings)

Impacts on Health of Workers / Miners

for example: NAMIBIA

**from 1976 on: Uranium Mining by Rössing U Company,
looked upon as illegal, under UN Security
Council Resolution 435 and UNCN Decree No. 1**

**1992: Serious concerns re: health and social situation of workers,
Study „Past Exposure ...“**

by Greg Dropkin and David Clark

**late 1990ies: A court case is launched
against Rio Tinto, majority owner of Rössing,
unsuccessful**

PAST EXPOSURE

Revealing health and environmental risks of
Rössing Uranium

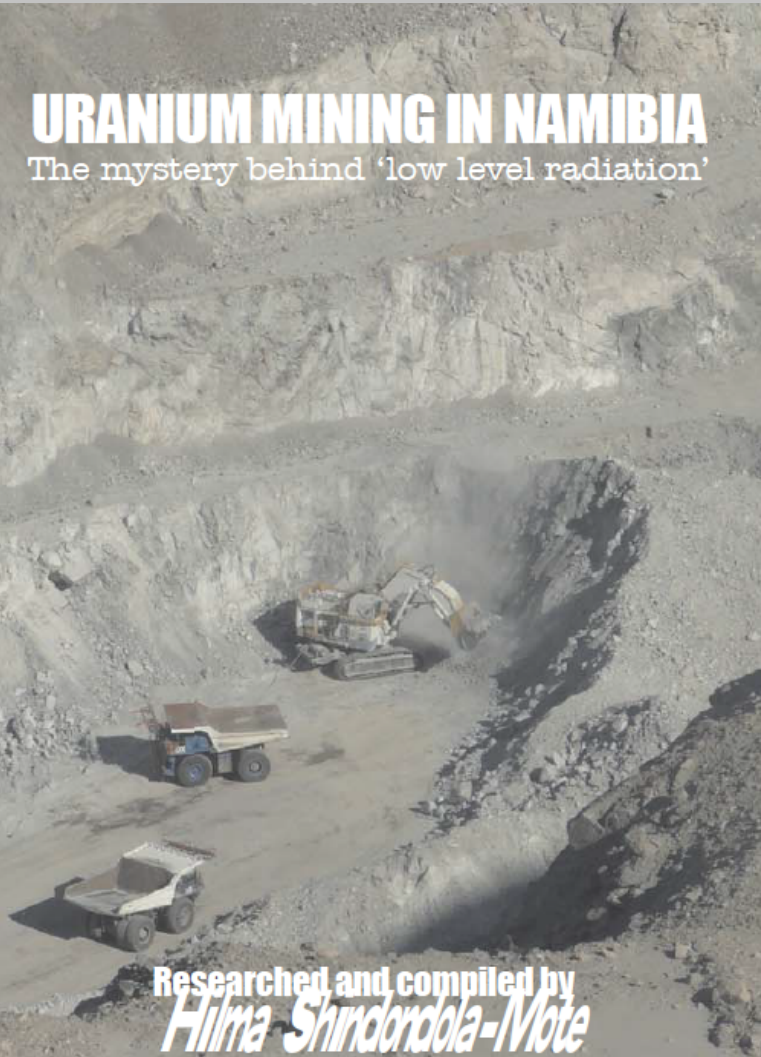


Impacts on Health of Workers / Miners

**for example:
NAMIBIA**

URANIUM MINING IN NAMIBIA

The mystery behind 'low level radiation'



Researched and compiled by
Hilma Shindondola-Mote

**2009: LaRRI Labour
Research and Resource
Institute, Windhoek,
Namibia:**

**„Uranium Mining in
Namibia
The mystery behind Low-
level radiation“**



Impacts on Health of Workers / Miners

*for example:
Niger*

Tanko Anafi declares, "I know I am affected like nearly everyone who worked and those currently in the villages..."

We are more than 1,200 people that have left all across the country. Some have died elsewhere.

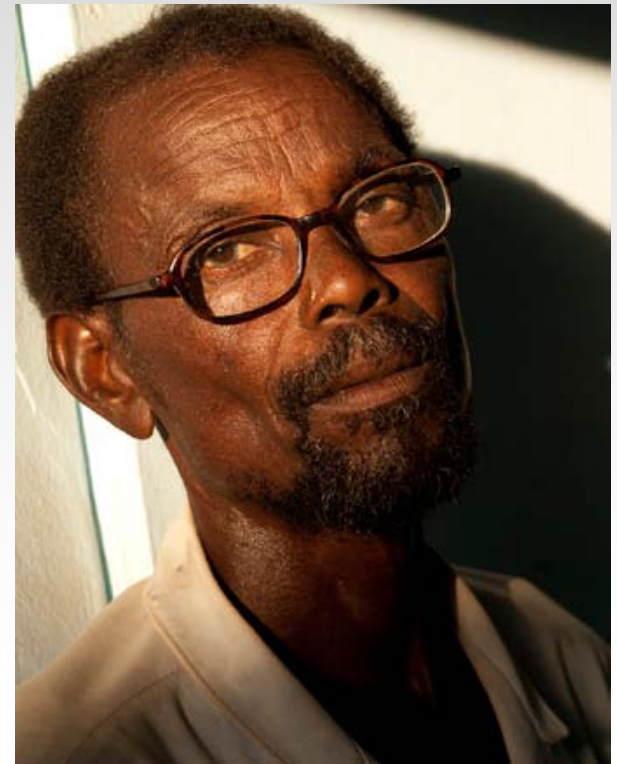
Some of these deaths are linked to uranium."

One ex-worker, Kiro Marafa, 58, was dying, according to his family. His wife, Saoudé Idi, was extremely distraught and tried to explain his situation.

"There is no point asking the doctors [what's wrong]... They would not tell us. They only say he is suffering from blood pressure."

We are waiting from the mine company to take action, she said, because we have no power.

"We know there are indeed many, many diseases and risks linked with this work. (...)"



Impacts on Health of Workers / Miners



Serge VENEL
Ancien chef mécanicien – COMINAK – Arlit

***Beispiel:
... NIGER / FRANCE***

**Serge Venel
starb am
31 Juli 2009
an Lungenkrebs**

„I have been able to track down 110 persons [former uranium miners / workers]. Among them, 70 have died from cancers, especially in the respiratory tract.“ (Peggy Venel, daughter of Serge Venel, 1978–1985, Engineer with COMINAK)

Impacts on Health of Workers / Miners

Asked whether she knew of similar disease cases among Nigerian workers at the mines, she (Peggy Venel) said:

"Hundreds of Nigerian people have died of all types of cancer, but their cases are extremely difficult to document."

Venel said that whenever consulted by the ill uranium mine workers, Areva doctors would always diagnose AIDS-related causes or other diseases but never cancer.

"Until today, Areva doctors deny any causal link between the working conditions in the mines, the radioactivity, and the numerous cases of cancer among the workers."

aus: Lack of Data on Causes of Death Buffers French Company, IPS, 122. April 2010
by Julio Godoy (<http://ipsnews.net/news.asp?idnews=51149>)

**Compensation
for Uranium Miners
and Mill workers**

Compensation for Negative Health Impacts of Uranium Mining

United States

RECA - Radiation Exposure Compensation Act

adopted as law after extensive lobbying work
for „downwinders“ i.e. people impacted by nuclear
weapons tests
for uranium miners and millworkers

Federal Republic of Germany

Compensation system according to German social insurance, according
to estimated doses
(Costs near € 1 billion)

France

The case of Serge Venel: Family took AREVA to court,
won first instance, lost in second instance

Compensation for Negative Health Impacts of Uranium Mining

France

The case of Serge Venel: Family took AREVA to court, won first instance, lost in second instance

Namibia

In 1990ies, Namibians took Rio Tinto / Rössing Uranium to court over negative health impacts, case was thrown out of court in UK.

...thanks for your attention !
... and LEAVE URANIUM in the GROUND!

**WHO WILL PAY
FOR RECLAMATION
COSTS ?**

WHO WILL PAY FOR RECLAMATION ?

Examples for Scenario 2a

Reclamation conducted at Expense of Government /
Taxpayers / General Public

Examples:

Germany

United States of America

France

WHO WILL PAY FOR RECLAMATION ?

Examples for Scenario 2b

NO (adequate) reclamation is conducted.
IMPACTs on Health and Environment imposed on
General Public

Examples

Niger

Gabun

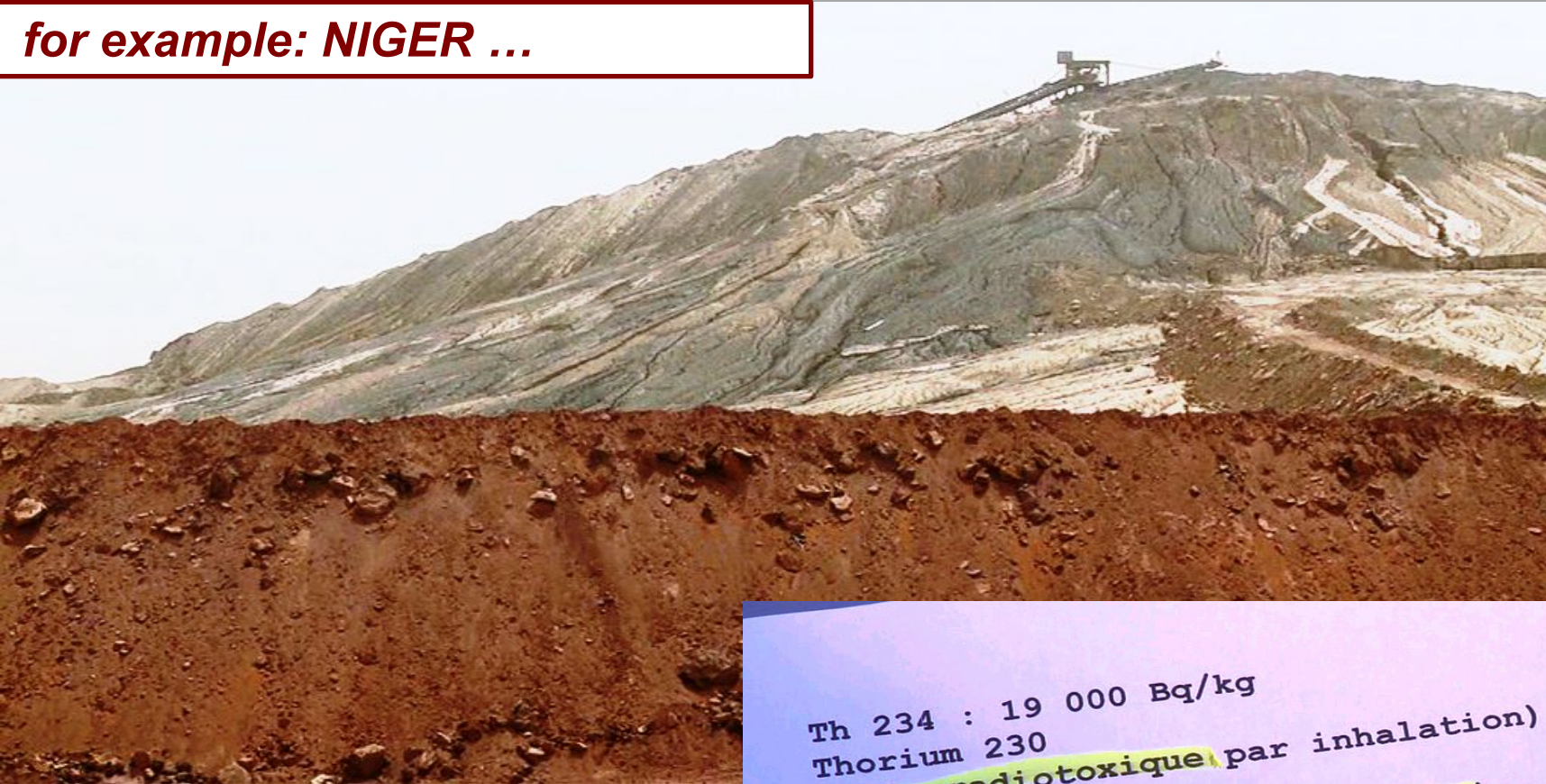
Namibia

South Africa

etc.

WHO WILL PAY FOR RECLAMATION ?

for example: NIGER ...



**Uranium mining since 1968:
35 millions tons of
radioactive waste (tailings)
uncovered, untreated**

Th 234 : 19 000 Bq/kg
Thorium 230
(très radiotoxique, par inhalation) :
33 000 Bq/kg
(période physique = 75 000 ans)
Radium 226 (père du radon) : 36 200
Bq/kg
Plomb 210 = 50 000 Bq/kg
(très radiotoxique par ingestion, avec
le polonium 210 qui lui est associé)
Ce sont des déchets radioactifs à très
longue période et très radiotoxiques

WHO WILL PAY FOR RECLAMATION ?

for example: Gabon ...



Gabon 1971 – 1975:

COMUF dumped 2 Mio t radioactive tailings into a local creek.

NO reclamation at all



WHO WILL PAY FOR RECLAMATION ?

Gabon and Niger :

Study by the European Union 2010

The assessment indicates that substantial problems and negligence exist in both countries with respect to the operation of the uranium mines, the safety of mines and local citizens.

It also criticises a lack of transparency regarding company's data on radioactive pollution and, in one case, claims that radioactive materials have been used for construction and that water sources and soil around the mining villages have been affected.



aus:

DIRECTORATE-GENERAL FOR EXTERNAL POLICIES OF THE UNION
DIRECTORATE B, POLICY DEPARTMENT, STUDY:
POTENTIAL USE OF RADIOACTIVELY CONTAMINATED MINING MATERIALS
IN THE CONSTRUCTION OF RESIDENTIAL HOMES FROM OPEN PIT URANIUM
MINES IN GABON AND NIGER
EXPO/B/DEVE/FWC/2009-01/Lot05-07 November/ 2010, PE 433.662 EN

WHO WILL PAY FOR RECLAMATION ?

for example: NAMIBIA ...



Rössing uranium mill tailings deposit, and Seepage Plume



Rössing Uranium Limited

Extent of Seepage

Costs

Monetary Costs (financial costs)

for example

- **Costs of mine closure**
- **Costs of Tailings Management**
- **Costs of monitoring of the environment after mine closure**

etc.

Non-monetary costs, →,Social Costs‘

for example

- **Health problems of miners and people in the vicinity**
- **Premature deaths**
- **Loss of land as means of subsistence and livelihood**
- **Social and political conflicts, eating up resources**

etc.

ADDITIONAL HAZARDS:
ACCIDENTS
SEEPAGES
HEALTH IMPACTS
SOCIAL IMPACT

Health Impact of Uranium / U mining (2)

Not well researched

- ❖ Changes in the DNA, will be passed on from generation to generation and may lead to malformations etc.
- ❖ Synergetic effects of the impact of several decay products on humans, synergetic effect or toxicity and radioactivity

People living in the vicinity of mines / tailings have multiple exposures to radiation via air, food, drinking water, probably γ -radiation

Impacts on General Public – long-term

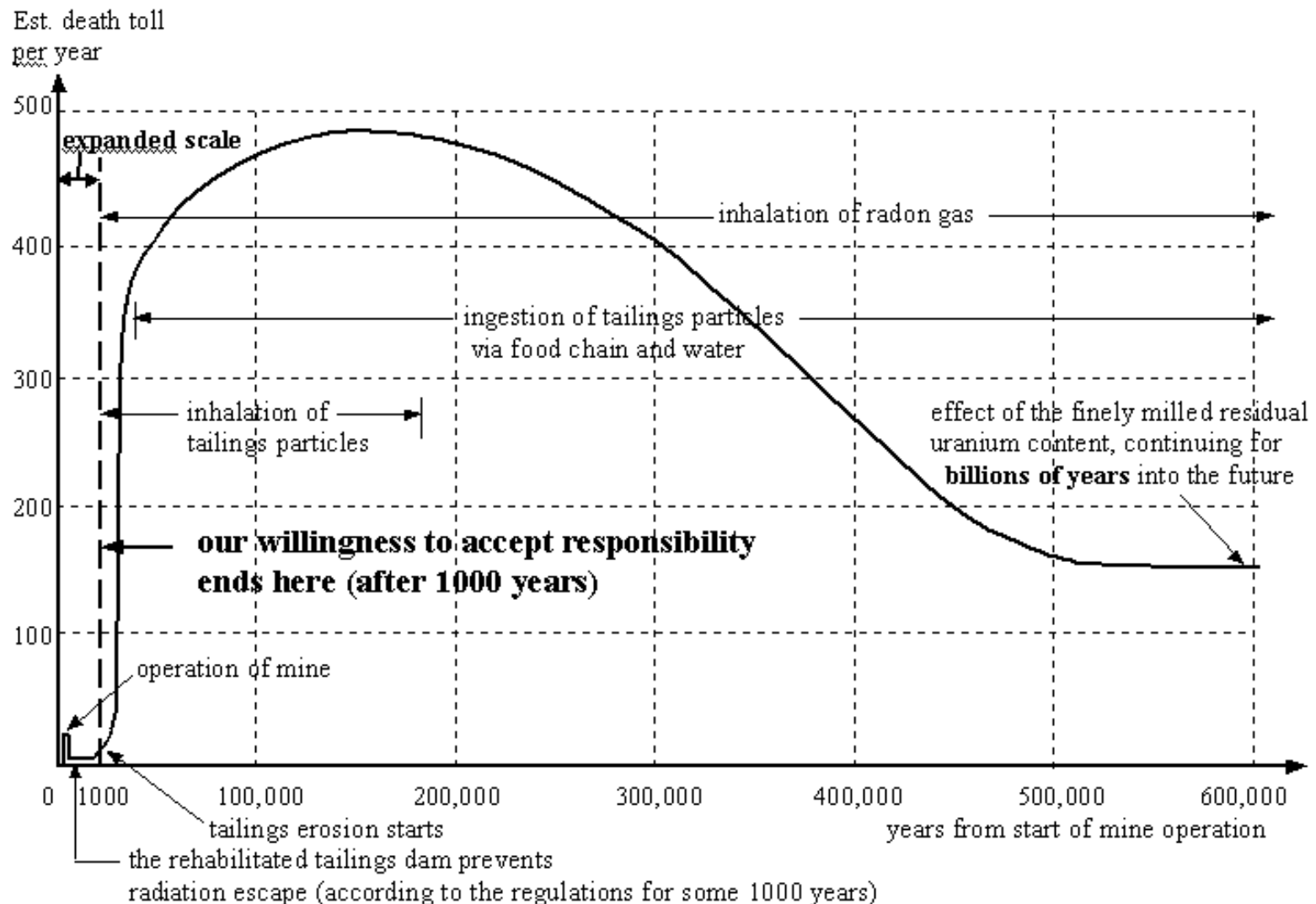


Fig 1: Estimated annual death toll from Roxby Downs uranium tailings (see section 1.3). The total for the next 500,000 years is **130 million deaths** from radiation cancer.

Result

Cost-Benefit Analysis of Uranium Mining operations need to include

➤ **Costs of Tailings Management**

High costs of mine reclamation and tailings management currently not taken into account

Currently, only benefits from taxes, royalties and job creation are taken into account

➤ **Social Costs**

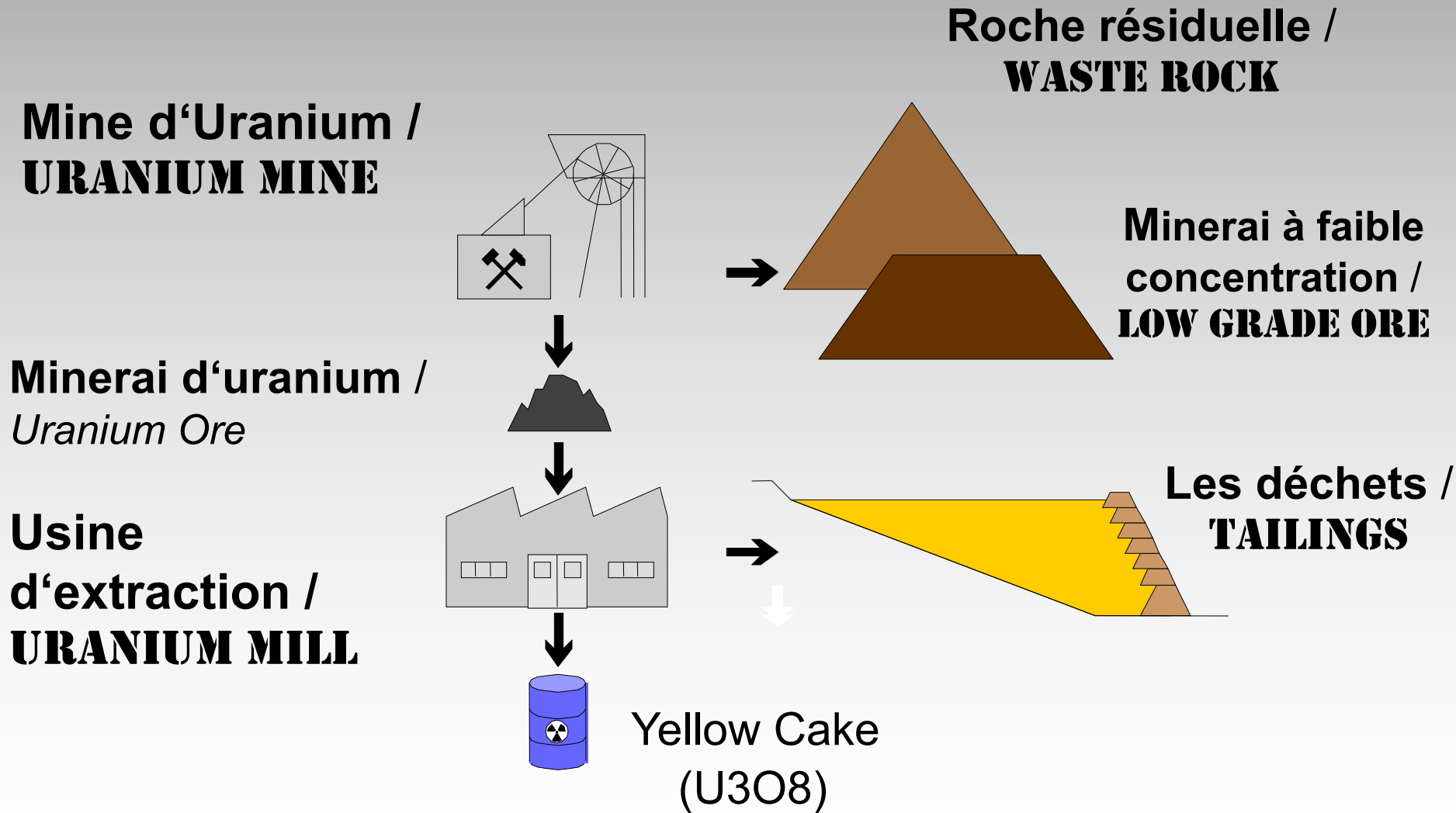
... need to be taken into account

Currently completely ignored

➤ ***Balanced view of U mining activities needed***

... thank you for your attention!

Uranium Production: Mining and „Milling“



Tailings – Specific Problems

- **Radioactivity**

Tailings contain approx. 80% of the original radioactivity of the ore
(due to the decay products of uranium)

- **Longevity**

Some decay products have very long half lives, tailings will stay radioactive „forever“ (hundreds of thousands of years)

- **‘Cocktail’ of approx. 25 decay products**

All of them are radioactive, some of them are also toxic (poisonous)

- **Mass of Tailings**

Tailings will be 100 to 10.000 times the amount of the uranium extracted

- **Toxicity of other substances**

Tailings also contain other poisonous substances (for ex. heavy metals)

Reclamation Costs of Uranium Tailings



Mkuju River Uranium Project

Mantra plans to mine 59.6 million tons of Uranium ORE

Concentration of Uranium in the ore: 0,037%

99,963% of the ore will be → **Tailings: 59,5 Million tons**

Extended Version of Mkuju River

Plans to mine 139.6 million tons of Uranium ORE

(same concentration)

99.963% of the ore will be → **Tailings: 139.5 million tons**

Reclamation of Uranium Tailings

➤ Reclamation – is it possible at all?

Natural radiological situation **CANNOT** be restored.

Reclamation is an attempt to control damage.

➤ Reclamation – what does it cost?

Due to problems of enormous quantities, longevity, consistency of tailings etc. ...

→ very expensive to store tailings „safely“.

WHO WILL PAY FOR RECLAMATION ?

example: GERMANY

Uranium Mining in former East Germany

At reunification in 1990, West Germany (FRG) ,inherited‘ mines and tailings of (former) East German SDAG Wismut“

- **Approx. 7.100 miners have died from lung cancer**
- **Reclamation costs: 7 billion €**
- **Reclamation took at least 20 years**
not yet finished 25 years later (2017)
- Continuation of water treatment for time unknown
- Today, 20 yrs. after end of mining, 200 new cases of lung cancer/year

(Study by BfS – Bundesamt für Strahlenschutz, German Federal Agency for Radiation Protection)