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UNESCO World Heritage Centre
7, Place de Fontenoy
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France

Dear Mr Debonnet,
dear Mr. Eloundou-Assomo,

we would like to address the UNESCO World Heritage Committee in regard to the World Heritage site Selous Game Reserve, Tanzania, and the planned uranium mining project, Mkuju River Uranium Project.

We are a small NGO working on the issue of uranium mining since a number of years, the undersigned working on this issue since approx. 30 years. We work with NGOs on a worldwide basis and have contacts and information about uranium mining all over the world, also in Tanzania. We work closely with WISE Uranium Project which operates an encyclopedic website on uranium mining issues (<http://www.wise-uranium.org/>) .

We have been following the development of uranium exploration in Tanzania and specifically in the Selous area for several years now, with growing concerns.

We would like to outline our main concerns briefly:

1. Uranium and its decay products

Although uranium is a naturally occurring element, it has a number of dangerous features:

First of all, whenever we speak of uranium, it has to be taken into consideration that in reality we are talking about uranium PLUS its 13 decay products (from the U-2238 decay series, there are more from the U-235 decay series); thus, just by the nature of its physical properties as an unstable, decaying i.e. radioactive element, we are always dealing with a 'cocktail' of some 30+ radioactive elements (see attachment 1).

Uranium and its decay products release radiation - α -, β - and γ -radiation. ALL kinds of radiation are detrimental to all forms of life. There are many detailed studies about the extent of the effects of radiation on human health, discussion about acceptable dose limits, however, there is no doubt that radiation is detrimental to all forms of life.

Uranium is also chemically toxic, it effects for example the kidneys and other organs in humans, and some of the decay products are also known to be toxic.

Uranium is known to be also reprotoxic - harmful in regard to reproduction: it may cause sterility in h females as well as in males; this has been established in experiments with animals.

A brief overview of health impacts of uranium is given, for ex., by the US Government's ATSDR - Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine (<http://www.atsdr.cdc.gov/phs/phs.asp?id=438&tid=77>)

"Current evidence from animal studies suggests that the toxicity of uranium is mainly due to its chemical damage to kidney tubular cells, leading to nephritis. Other sensitive targets of toxicity include the respiratory tract (inhalation only), neurological system, reproductive system, and the developing organism.

(Source: "Toxicological Profile for Uranium", by: US Agency for Toxic Substances and Disease Registry (ATSDR). September 1999. CAS# 7440-61-1)

A review of the effects of uranium and depleted uranium exposure on reproduction and fetal development, by Darryl P. Arfsten, Kenneth R. Still, Glenn D. Ritchie, Geo-Centers, Inc., (<http://tih.sagepub.com/content/17/5-10/180>)

In addition, radioactivity of uranium and its decay products may cause genetic effects; the impact of these effects may show up only generations later.

2. Uranium Mining

When uranium ore is mined, the ore is dug up, mechanically crushed to sand and treated with chemicals in a uranium mill, mostly using acid sulfur, in order to precipitate uranium from the ore.

Thus, the radiological situation is irreversibly changed.

Uranium and its decay products, so far contained more or less safely in the ore underground, are now mobilized physically as well as chemically (contact with air).

General Environmental Impacts

The process of precipitation of uranium from the ore needs huge amounts of water which has to be disposed afterwards, as well as lots of energy, causing further problems.

In the case of Mkuju River Uranium Project, this means for example:

- Since sulfur is not naturally occurring on site, sulfur will have to be trucked in on a daily basis; acid sulfur will be produced on site. This implies traffic of several truckloads per day, and dangers from the acid sulfur production plant.

- Since power / electricity is not available in the Mkuju River Project area, the company plans to generate electricity by diesel engines and generators. Diesel fuel will also have to be trucked in, this leads to further dangerous traffic, implies the danger of spills etc. with diesel fuel as well as exhaust fumes from the engines.
- Since traffic will increase massively, infrastructure i.e. roads will have to be improved and / or newly built; in another context, the WHC has expressed concerns that improved access to an area leads to more poaching.

Impacts from Tailings ...

Whereas most of the uranium (U-238, U-235) is extracted from the ore, basically all of the decay products remain in the 'tailings'; approx. 80% of the original radioactivity of the ore remains in the 'tailings'.

Due to the longevity of the radioactive elements, these tailings will remain radioactive for a very long period of time - in human terms: forever - and they will remain toxic.

Currently, uranium is mined at percentages of far less than 0,1% uranium in the ore. For Mkuju River Uranium Project, Mantra Resources, the original owner, announced a percentage of 0.037% uranium in the ore; they claim the deposit holds 59.6 million tons of uranium (UraniumOne has lately increased these figures, we use the figures formerly published by Mantra Resources).

At the said percentage, approx. 59.5 million tons of radioactive and toxic waste ('tailings') will be created, most of it in form of slush and sand.

In case the reserves should amount to 139.6 million tons, as claimed by the now owner-operator Uranium One, Canada, the amount of tailings would amount to 139.5 million tons of radioactive and toxic waste.

Tailings need to be contained safely and apart from the environment due to their dangerousness for an extremely long period of time (as said above, in human terms: forever).

This poses obviously a serious challenge which is very hard to meet. Industrialized countries are struggling seriously with this challenge - scientifically, financially and practically.

It is also obvious that developing countries such as Tanzania will have even more difficulties in dealing with the aftermath of uranium mining.

3. Dangers from Tailings

Tailings from uranium mining are very hazardous, and their impact is by no means limited to a small area of the mine and its surroundings, as the industry sometimes tries to make belief.

For an overview of hazards from tailings, also see: WISE Uranium Project, slide talk: <http://www.wise-uranium.org/stk.html?src=stkd01e&show=m>

3.2. Rupture of Tailings dam

Tailings dams may break; this has repeatedly happened.

WISE Uranium Project lists tailings dams failures worldwide regardless of country and time, in industrialized countries as well as in others, in the more distant past as well as lately.

(<http://www.wise-uranium.org/mdafu.html> and <http://www.wise-uranium.org/mdaf.html>)

Radioactive and toxic mud and liquid contents are spilled into the environment, 'cleaning up' is an extremely difficult task, if possible at all; in some cases, tailings were washed into creeks and contaminate them for major distances downstream (for ex. Churchrock Tailings dam failure 1976)

3.3. Seepage

Radioactive material dumped in a tailings dam / into tailings ponds may seep into groundwater aquifers and contaminate them in case there is no proper impermeable layer; in some cases, plastic foils are used as an "impermeable layer". Most definitely, these foils will not stay impermeable 'forever', but allow sooner or later radioactive materials to seep into the underground aquifers: thus, they may easily find their way into the waters of the Selous Game Reserve and contaminate wildlife.

Examples for seepage are manifold:

United States

"Every uranium mill has extensive, localized groundwater contaminant plumes that are still years, if not decades, from being fully remediated."

(Source: STATEMENT OF CHRIS SHUEY before the Subcommittee on National Parks, Forests, and Public Lands; Natural Resources Committee; U.S. House of Representatives; March 28, 2008.

http://www.downtheyellowcakeroad.org/userfiles/file/Health%20Attachments/SRIC_ShueyStmt2008USHOR-NavajoUHIthEffects.pdf)

Niger

"The global alpha activity measured for the 2 samples is high – respectively 1.0 Bq/l (ZU water) and 11 Bq/l (ZI water). This means that the values are 10 times and 110 times exceeding the 0.1 Bq/l limit recommended by the World Health Organization (and adopted by the French authorities)."

(Source: "The Impact of the Uranium Exploitation by the Nigerien Subsidiaries of COGEMA-AREVA - Review of the analyses carried out by the CRIIRAD laboratories in 2004 and in the beginning of 2005, Reference: CRIIRAD 0517 / 20th April 2005)

Namibia

"The high uranium concentration in underground water collected downstream Rössing uranium mine in the Khan river and Swakop river alluvium raises the question of the origin of this uranium. (...) In the Khan river alluvium immediately downstream Dome Gorge waste rocks dump the uranium concentration is 430 µg/l. This may be due to the fact that a fraction of the uranium contained in the waste rocks is dissolved by rain water and eventually reaches the groundwater."

(Source: CRIIRAD - Preliminary results of CRIIRAD radiation monitoring near uranium mines in Namibia / Press Release April 11th 2012

<http://www.criirad.org/actualites/dossier2012/namibie/CRIIRAD-namibia-press.pdf>)

These few examples show clearly that it is impossible to contain the dangerous wastes safely.

3.3. Tailings dams overflow

Due to heavy seasonal rainfalls, tailings dams may overflow; this, radioactive materials spills into the environment; it is next to impossible to recover that material.

Examples: Australia - Kakadu National Park, a World Heritage site:

"Ranger is an open pit-mine in the middle of the World Heritage Kakadu National Park. Its radioactive leaks and spills have contaminated the Kakadu wetlands ..."

(Source: <http://www.ippnw-students.org/Japan/Ranger.pdf>)

"Polluted water leaking into Kakadu from uranium mine

The Ranger uranium mine inside the World Heritage-listed Kakadu National Park is leaking 100,000 litres of contaminated water into the ground beneath the park every day, a Government appointed scientist has revealed.

Alan Hughes, the Commonwealth supervising scientist appointed to monitor the mine's environmental impact, confirmed at a Senate committee hearing that about 100 cubic metres a day — the equivalent of 100,000 litres or three petrol tankers — of contaminant were leaking from the mine's tailings dam into rock fissures beneath Kakadu.

There have been more than 150 leaks, spills and licence breaches at the Ranger uranium mine since it opened in 1981."

(Source: Lindsay Murdock, The Age March 13, 2009

<http://www.abc.net.au/news/2010-05-24/fears-over-kakadu-uranium-mine-pollution/838488> and

<http://www.treatyrepublic.net/content/uranium-mine-spillage-kakadu>)

Currently, uranium mining companies are sometimes arguing they should not be judged by the mistakes of the past, and that they will perform better in the future. The 2011 events in Australia around Ranger uranium mine in Kakadu National park do not show changes:

2011, April 16

"Radioactive water threatens Kakadu

Radioactive water is in danger of spilling into an Aboriginal community and Kakadu's World Heritage-listed wetlands if record rainfalls continue to deluge the vast Ranger uranium mine."

(Source: Lindsay Murdoch. April 16, 2011,

<http://www.theage.com.au/national/radioactive-water-threatens-kakadu-20110415-1dhzu.html>)

3.4. Tailings: Radon Gas Exhalation, Dust

One of the decay products of uranium is radon gas - the only gaseous element in the decay chain. Although radon gas has only a relatively short half life of 3.8 days, it may spread with the wind within this time across major distances. Radon then decays in a series of other radioactive elements.

The wind will also carry dust - radioactive dust - from the mine into the Game reserve; dust may include uranium as well as any of the radioactive decay products of uranium, most probably a mixture of these elements.

In the case of Selous Game Reserve, there is danger that radon gas will be blown with the wind into the park and later on decay into other radioactive elements with a longer life such as Lead-210 with a half life of 22 years. These radioactive elements can be ingested by animals, accumulate in their tissue, bones or organs and lead to the health damages, premature death, reproductive problems or genetic defects passed on from generation to generation.

Changing the boundary of the Park will do nothing to stop radon gas and dust from the mine entering the park.

Radon gas exhalation from tailings can be reduced by (a) a layer of water on the tailings (b) a layer of impermeable material, for example clay or bentonite.

In the dry season, providing enough water to cover the tailings properly may be difficult.
In the rainy season, too much water on the tailings may lead to overflow or tailings dam ruptures.

Covering tailings with impermeable layers if applicable only after the tailings dam or a certain part of it has been closed or after mines closure; costs are considerable, the layer needs to be at least 50cm up to 1m to be effective re: radon gas exhalation. This containment needs to remain stable for several thousand years.

*"The finest fraction of the radioactive **tailings** dumped on Rössing tailings dam is **blown away** by the wind and contaminates the surrounding environment. The contamination of top soil with radium 226 ranges between 960 Bq/kg and 7 400 Bq/kg in samples collected up to 2 km away from the tailings dam fence."*

(Source: CRIIRAD - Preliminary results of CRIIRAD radiation monitoring near uranium mines in Namibia / Press Release April 11th 2012

<http://www.criirad.org/actualites/dossier2012/namibie/CRIIRAD-namibia-press.pdf>)

Conclusion

From the paragraphs above, it is shown that the impact of a project such as a uranium mine is by no means limited to its site, nor its impact, by the nature of the uranium extraction process, be limited to a small area of the mine, as the mining companies often try to make belief.

Radioactive and toxic materials will inevitably spread via air, ground and surface waters, with dust blown etc., and they will one way or another, effect the wildlife in the Selous Game Reserve, sooner or later.

3.5. Longevity of the radioactive elements in the tailings

Small quantities of uranium and all of the other decay products will stay within the tailings, all of the decay products will continue to be produced in perpetuity - for hundreds of thousands of years.

The longevity of the uranium decay products requires the containment to last also for hundreds of thousands of years; this technological challenge has still to be met.

Tailings rehabilitation of existing or abandoned mines shows that tailings containments may become dysfunctional after a few years already.

The issue of how to warn future generations not to dig in these areas is also still unresolved.

3.6. Mined out open pit / mined out tunnels and shafts

Once the mine is exhausted, there will remain either one or several pits (open pit mine) or tunnels and shafts of an underground mine. Both need to be decommissioned.

In many cases, mining companies go bankrupt or simply leave the country (for ex. AREVA in Gabon) without decommissioning the former mines.

In Namibia, management of Rössing Uranium Ltd. explained to the author that - for closure - the road to the mine will be cut - and the open pit and the tailings will be left to themselves; or, added another management person, the mine might be integrated into a museum area with other abandoned mines of the area.

Please note that Rössing mine is located inside the Namib-Naukluft National Park.

In France, former Cogema, now Areva, has left dozens, if not hundreds of sites, barely rehabilitated. This has been exposed in documentary "L'Uranium - Le Scandale de la France contaminée", produced by France3, series "Pièces à Conviction", broadcasted on 13. February 2009, (available on dailymotion http://www.dailymotion.com/video/xamwg9_uranium-le-scandale-de-la-france-co_news or <http://videos.sortirdunucleaire.org/Uranium-le-scandale-de-la-France>)

4. Track Record of the Uranium Industry

The uranium industry has a track record of not cleaning up or rehabilitating the sites of its mines and tailings; this bad performance may partially go back to the fact that the industry was producing a material considered to be of strategic importance for the production of nuclear arms; thus, the industry was in the beginning basically exempt from taking (full) responsibility for its actions and its wastes. This attitude prevails to the day.

The track record is disastrous, no matter what country, political system or region; the following examples are just a few and could be continued "ad infinitum":

In France, as mentioned in paragraph 3.6., Cogema / Areva have left 210 uranium mines with 300 Mio tons of wastes, many of them inefficiently reclaimed, with radioactive materials spilling into aquifers and surface waters etc.
(see documentary "L'Uranium - Le Scandale de la France contaminée", France3, 13. February 2009).

In the United States, hundreds of uranium mines, operating from the 1950ies to the 1980ies have not been rehabilitated and continue to contaminate the environment: "Abandoned Uranium Mines: An Overwhelming Problem" in the Navajo Nation" says "The Scientific American"
(<http://www.scientificamerican.com/article.cfm?id=abandoned-uranium-mines-a>)

In Gabon, Areva has left its former uranium mining sites with minimum decommissioning, the wastes continue to contaminate the environment, mainly nearby creeks and rivers.

We would like to draw your attention to another site and event:

The High-Level International Forum "Uranium Tailings: Local Problems, Regional Consequences, Global Solution", Geneva, 29 June 2009

(<http://www.un.org/kg/en/news-center/news-releases/article/65-news-center/3556-the-high-level-international-forum-uranium-tailings-local-problems-regional-consequences-global-solution-took-place-in-geneva-on-29-june-2009>)

The UN Forum shows very clearly that the problems of uranium mining tailings are not something advocated only the environmental movement or anti-nuclear groups, but that uranium mining and its tailings are a major problem, requiring international attention at highest, i.e. UN level to solve it.

Obviously, if there is a chance to avoid these problems, it should be used.

5. Economic Issues

5.1. Costs of 'rehabilitation'

At first glance, economic issues are not in the scope of decision making of the World Heritage Committee.

However, economic issues effecting the mining company or the state may have an impact on the ability of state or mining company to take care of decommissioning a mine and contain its tailings.

Since Tanzania regulations - as far as we know, access to the regulations is difficult - do not foresee the setting aside of funds for the rehabilitation of the mine site after operation, the risk is very high that the mining company will leave country and / or declare bankruptcy after the deposit is mined out. The aftermath of mining will be left without any proper decommissioning and / or rehabilitation.

It is more than questionable whether the state of Tanzania will then have the financial means to rehabilitate the mine site and contain the tailings safely.

In another paper, we calculated the costs of such rehabilitation.

Estimated costs of Rehabilitation for Mkuju River Project, Tanzania			
		"Small" version	"Extended" version
tons of tailings:		59.500.000	139.500.000
<u>Costs</u>	<u>US \$ / t</u>	<u>US \$ Total</u>	<u>US \$ Total</u>
<u>Scenario 2 (*)</u>	7,01	417.095.000	977.895.000
(Uranium mining only)			
<u>Szenario 3a</u>	27,64	1.644.580.000	3.855.780.000
(Arithmetic average of all costs)			
<u>Szenario 3b</u>	66,58	3.961.510.000	9.287.910.000
(Mean average of minimum and maximum costs)			
(*) Scenario 1 referred to a copper-/gold-uranium mines and is not of importance here.			

The costs are based on the results of a study commissioned by the Bundeswirtschaftsministerium (German Minister for Economic Affairs) and published in 1995.

(Source: Kosten der Stilllegung und Sanierung von Urangewinnungsprojekten im internationalen Vergleich - Einflußgrößen und Abhängigkeiten - Auszug aus dem Abschlußbericht zum Forschungs-auftrag Nr. 37/93 im Auftrag des Bundesministers für Wirtschaft durchgeführt von URANERZBERGBAU-GmbH, März 1995)

The application of the results of the lowest costs for rehabilitation of uranium mine tailings leads to an amount of costs of approx. 417 Mio US \$ (based on 2012 costs).

Conclusion

These figures show that economic aspects very well have an impact; it is Questionable that Tanzania will have US \$ 417 Mio US \$ at hand for rehabilitation of remnants of Mkuju River uranium mine.

Chances are that the tailings and mine will not be decommissioned and will continue to contaminate the environment, including World Heritage site Selous Game Reserve.

5.2. The New "Uranium Rush" ...

A raise of the prize of uranium / "yellowcake" to approx US \$ 50 / pound has sparked a "uranium rush" across the world, junior exploration and mining companies are looking for uranium wherever possible.

This rush comprises the risk that it may collapse in case the price of uranium will drop in the future. Such a collapse has happened twice in the past, and left for ex. the Canadian uranium mining region at the Northern rim of Lake Athabasca (Uranium City) a ghost town - with dozens of mine sites abandoned, contaminating the environment to the day.

Given the insecure future of nuclear industry in general, a drop in the price of uranium cannot be excluded.

Mkuju River Uranium Project will operate with a very low percentage of uranium in the ore, thus, production costs are comparatively high; **a small drop of the price of uranium might put the company out of business quickly.**

Most probably, the mine and its tailings would be abandoned without any rehabilitation, or with minimum precautions, posing a massive danger for the environment.

6. Political Issues / Issues of Administration and Regulatory Bodies

Lack of regulations or lack of state power, weakness of administration to rehabilitate a mine site will influence the degree and quality of the rehabilitation of a mine site.

In our dealings with Tanzanian administration, ministries, and NGOs, it became obvious that

- a) the Minister of Mines is pushing forward with the uranium mine project at Mkuju River, regardless of concerns of the World Heritage Committee,
- b) a regulatory framework has been worked out within a very short time under pressure (approx. one year), any concerns in order to have more detailed and considerate regulations were shoved aside,
- c) the regulatory bodies such as Tanzania Atomic Energy Commission have no experience at all with uranium mining or controlling nuclear materials at a larger extent,
- d) the regulatory bodies lack equipment and funding and, at this stage, are not even able to monitor the exploration activities independently.

This leads to major concerns as to how these regulatory bodies will be able to enforce even minimum environmental standards on site, guarantee an environmentally acceptable operation of the mine during its proposed 10-year life time, and make sure of a long term safe containment of tailings and decommissioned mine site later on.

7. More Uranium Mining activities ... and the Selous-Niassa Wildlife Protection Corridor

An additional danger poses the fact that in the area of Mkuju River Uranium Project at the south border of Selous Game Reserve, other companies are also actively exploring for uranium.

Thus, there is also a risk that at the border of the World Heritage site Selous Game Reserve a mining and industrial complex might develop which undoubtedly will influence the Reserve adversely in the long run.

These exploration and mining activities may lead to an industrialization of the area which would also endanger the Selous - Niassa Wildlife Protection Corridor which is vital for both wildlife protection areas.

Therefore, we believe any mining activities in the area should be discouraged in order to guarantee for the long run the safety of the Selous Game Reserve, the Niassa National Park in Mozambique and the Niassa-Selous Wildlife Protection Corridor.

8. Recommendation

The planned Mkuju River uranium mine is a project very hazardous to the World Heritage site Selous Game Reserve, Tanzania; it has the potential to endanger the Park massively, and contamination will last for a very long time, in human terms forever.

Changing the boundary of the World Heritage site Selous Game Reserve in order to have the planned Mkuju River Uranium mine located outside the Reserve and thus make it acceptable for licensing, will not prevent radioactive contamination and toxic materials from entering the Park via surface waters, aquifers, and air etc., and endangering wildlife in the end.

The longevity of the radioactive elements poses a danger far beyond the time of operation of the mine, and will endanger the World Heritage site for many generations to come who will have to deal with the problems - or leave the site to serious environmental degradation.

We therefore suggest to keep the boundaries unchanged and discourage the Government of Tanzania to license the Mkuju River Uranium mine.

In case the Government. of Tanzania decides to go ahead with the mining project, we strongly recommend to change the status of Selous Game Reserve to "endangered World Heritage site".

In case you have any questions and for any further information, please do not hesitate to contact us.
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Freiburg, Germany, 19 May 2012

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Attachment 1 - Radioactive Decay . Uranium-238 series

Radionuclide		Mode of decay	Half-life
Uranium-238	²³⁸ U	α	4.5 billion years
Thorium-234	²³⁴ Th	β	24 days
Protactinium-234	²³⁴ Pa	β	6.7 hours
Uranium-234	²³⁴ U	α	245.500 years
Thorium-230	²³⁰ Th	α	77.000 years
Radium-226	²²⁶ Ra	α	1.600 years
Radon-222	²²² Rn	α	3.85 days
Polonium-218	²¹⁸ Po	α	3 minutes
Lead-214	²¹⁴ Pb	β	27 minutes
Bismuth-214	²¹⁴ Bi	β	20 minutes
Polonium-214	²¹⁴ Po	α	164 micro-seconds
Lead-210	²¹⁰ Pb	β	22 years
Bismuth-210	²¹⁰ Bi	β	5 days
Polonium-210	²¹⁰ Po	α	238 days
Lead-206	²⁰⁶ Pb		stable