

History and consequences of uranium mining in Niger from 1969 to 2017

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Geographical context

The region of Agadez is one of the eight regions of Niger, which are Niamey, Tillabery, Dosso, Tahoua, Maradi, Zinder, Diffa and Agadez. Agadez is in the heart of the Aïr massif on the southern edge of the Sahara, at an equal distance from the Mediterranean and the Gulf of Benin. Arlit, the center of mining activities in Niger, a town with a few thousand inhabitants lies about 240 km North of Agadez. In the 1970ties, Arlit depended on Iferouane, a town with 18'000 inhabitants at about 100 km northeast of Arlit. It was a pastoral region on the edge of the desert, where wild animals such as ostriches and gazelles lived and camels and other domestic animals grazed in a pasture environment rich in firewood. In those years, no artificial mountains were visible within a radius of 50 km; the mountains of the Aïr massif, Bagzan (2200m altitude) and Tamgak (1800m altitude) are further away.

Historical context

In the late 1950ties, prospecting activities for uranium and other minerals were initiated in Niger and, of course, elsewhere, in particular in Africa [1]. About ten years later, the search led to the discovery of large uranium deposits in the area of Arlit. Because of earlier ties with France, much of the activities associated with uranium in Niger were - and still are - controlled by the French company AREVA (now named ORANO). In the year 2015, Niger produced about 8% of the world's uranium [1]. Since Niger is one of the poorest countries in the world, uranium mining is a major contributor to its economy and is therefore supported by the government.

In the following, a brief chronological description of the events is given.

- On February 2, 1969, Diori Hamani, the first president of the Republic of Niger, which had been independent since 1960, traveled to Arlit to lay the foundation stone for the first uranium mine in Niger named SOMAIR (for “Société des Mines de l’Aïr”). This mine is operated at a level of 63% by the French Atomic Energy Commission and the “Compagnie Générale des Matières Nucléaires” (COGEMA), founded in 1976. In September 2001, AREVA was formed as a merger between COGEMA and FRAMATOME, the builder of French nuclear power stations.
- Two years later, on February 2, 1971, Diori Hamani returned to Arlit to inaugurate the SOMAIR mine.
- Also in 1971, the first ton of Nigerian uranium was shipped to France to fuel its nuclear power plants.
- In this year, the chief of the department of Arlit, Elhadji Ibrahim, was 30 years old and was about to replace his father, who died a few years later. Elhadji Ibrahim remembers

that they were promised prosperity from the uranium and the birth of a second "Paris". However, this promise was never fulfilled.

SOMAIR currently produces 2800 tons of uranium per year.

- On July 24, 1975, a second mine named COMINAK at about 12 km from SOMAIR opened; it was still dominated by the French giant AREVA (34%). COMINAK currently produces 1500 tons of uranium annually.
- As well in 1975, the SONICHAIR mine in the Agadez region opened, where coal is mined to heat the thermal power plant for AREVA's uranium mining sites.
- During the period from 2000 to 2007, the State of Niger awarded more than 200 mining permits, particularly those for uranium, half of which were in the department of Arlit.
- In 2007, another mine opened in Ingall, 160 km West of Agadez. This mine is called SOMINA for "Société des Mines d'Azelik" and is owned mainly by a Chinese company. It produces 700 tons of uranium per year.
- On May 4, 2009, the first stone of the IMOURAREN industrial complex was laid and operations began for the largest open pit mine in Africa, which is the second largest in the world after the McArthur River mine in Canada. IMOURAREN SA is mainly owned by AREVA and is located 80 km southwest of Arlit in the commune of Dannat. IMOURARENS annual production forecasts are 5000 tons of uranium. Note that the McArthur River mine produced 7500 tons of uranium in 2012.

Political and social context

The political and social context has had an important impact on the development of mining in Niger. During the civil regime of Diori Hamani (1960-1974), Nigerians considered the exploitation of uranium as an affair of "whites", whereas during the military regimes of Seyni Kountché and Ali Seybou (1974-1991), it was almost forbidden to ask questions and any challenge was considered a national crime, punishable by death penalty. The national conference of July 1991 ignored the mining sector because the Nigerians had acquired by fear the reflex of silence.

A second, politically unstable, period followed with a multiparty system, but the democratic elections of Mahamane Ousmane in 1993 were a real learning experience for freedom. However, the years of freedom were soon over because of the coup d'Etat - said to be the fruit of chronic political instability - led by General Ibrahim Baré Maïnassara and Major Daouda Malam Wanké in 1996.

A third period began with the democratic election of Tanja Mamadou (2000-2010). During these years, the Nigerians began to question the usefulness of uranium mining and about its consequences. It is in this context that the civil society organizations, now termed NGO, that are active in the area of mining, were born.

The agreements between the government of Niger and the AREVA group

Throughout 2014, negotiations had taken place between the two partners, namely the government of Niger and the AREVA group, representing the French State. The result of these negotiations was the signing of the Mining Convention of 16 July 2015. Unfortunately, this Convention is based largely on the one of 17 January 1969, which extends until 2043. The 2015 Convention does not take into account the legal and fiscal developments of Niger and of ECOWAS and UEMOA and even says that in the event of dispute between the two parties, the provisions of the 1969 Convention will apply. Thus, the sovereignty of the State was severely hurt by the convention of 2015. The State of Niger found itself in a position of weakness because of the consequences of the Libyan crisis, the fall of Gaddafi, the crises in Mali and Nigeria linked to the actions of the terrorist sect of Boko Haram.

The actions of civil society organizations in Niamey had no influence on the ability of AREVA and France to carve out the lion's share in the negotiations, as has been customary since 1969.

Methods of mining and processing

Open pit mines: uranium mining is carried out in open pits at 40 to 130 meters below the surface; this is the case of the SOMAIR and Imouraren mines. It consists of a prospecting phase and a mining phase. Processing of the ore is done either by crushing of uranium-rich ore, or - for uranium-poor ore - by grinding, treatment with sulfuric and nitric acids, solid-liquid separation on band filters, extraction of uranium by solvents, re-extraction with sodium carbonate, precipitation and production of yellowcake that contains more than 70% uranium. This method leads to deformation of the landscape with a rise of mountains termed “tailings” consisting of mining waste.

Underground mines: mining takes place at about 250 m below ground. The access to the mine is provided via a path with a slope of 20% over a distance of 1300 meters. Conveyor belts lift up the extracted ore to the factory located just above the mine. Processing of the ore comprises mechanical grinding and dissolution by sulfuric and nitric acids, purification and concentration in basic solvents, precipitation by neutralization with magnesium hydroxide and drying. The final product is called magnesium uranate and contains more than 70% uranium. This method has the advantage of not creating deformation of the landscape by mountains of mining waste.

In both cases, the product is packaged into 200 liter containers and shipped to the various customers, who are AREVA, SOPAMIN, OURD and ENUSA.

Both mining methods produce various types of waste after processing the ore in factories or by leaching. Liquid waste is discharged into special tanks, whereas solid waste, such as rocks and sand, but also sludge, is disposed off as tailings. Apart of the uranium extracted to be further

processed, about 85% of the uranium-associated radioactivity as well as the decay products remain in the waste. The latter includes, for example, very long half-life products such as thorium-230 and radium-226. In addition, the chemicals used in the leaching process as well as other pollutants, such as arsenic and heavy metals - copper, manganese, etc. - are also left behind in the tailings.

Waste products from uranium mining

This waste consists of:

- a. Rocks that result from the lands above the uranium containing layers. In the case of the open pit mine of SOMAIR, this waste forms enormous mountains that can be seen from 30 km and which have the disadvantage of drastically modifying the landscape.
- b. Residues of the remainder of the ore; these are deposited on 50 ha of land and today reach a height of 30 m near the factories. The quantity of these residues is estimated at 40 million tons, of which 14 million tons for COMINAK, 16 million tons for SOMAIR and 11 million tons of leach residues from SOMAIR. As mentioned, these tailings contain 85% of the original radioactivity and are stored in the open air. There are several risks associated with these, namely radioactive contamination of the ground water, propagation of radon radioactivity via the air and dispersal into the environment by wind or rain. AREVA and its subsidiaries in Niger report annually that there is no risk - without providing irrefutable proof.
- c. Other solid waste: paper and cardboard, plastic, rags, scrap, glass, tubes, vegetable waste, waste oils, batteries and wood. The mining companies declared a total of 400 tons, whereas the reality is quite different because only the contaminated scrap that we discovered during August 2012 measured about 1600 tons of which 1000 t came from the COMINAK and 600 t from the SOMAIR mine.
- d. Liquid waste: effluent from mills and wastewater from maintenance activities. These liquids usually contain low levels of uranium and other metals. They are collected and the water is evaporated in large basins that are tight - according to the mining operators. These basins are bordered by 4 to 7 m high dikes constructed of mineral waste rock with a central clay core. The external sealing is ensured by welded polyethylene sheeting.
- e. Atmospheric releases consist primarily of the radioactive gas radon. In addition, there is dust, vehicle exhaust and volatile vapors, such as carbon dioxide, nitrogen dioxide, sulfur dioxide and other volatile compounds.
Radon originates from the the decay of uranium. Nitrogen dioxide is produced by leach treatment of uranium ore in the mill. Sulfur dioxide is produced during the combustion of coal or mineral oil.

f. Chemicals used in the processing of uranium ore consist of sodium carbonate, sulfur-containing compounds, magnesium oxide, various nitrates and pyralene. These products are sometimes stored in houses in the town of Arlit or other towns in Niger, e.g. in Tahoua and Zinder. They are also dumped onto the streets of cities, on roads and on the outskirts of industrial installations. Animals in search of pasture around the factories are the major victims of this negative environmental impact. It is described in the minutes of a meeting: "The consequences of this exploitation for half a century."

In conclusion, it is obvious that the exploitation of uranium in Niger for half a century, mostly by AREVA, has had serious consequences for the environment and for human health.

Consequences on the environment

- Exhaustion of fossil aquifers
- Disappearance of the plant cover
- Disruption of wildlife
- Deformation of the landscape due to formation of tailings from the extracted material
- Deposition of radioactive scrap and other radioactive material in the town of Arlit and in the rest of the country.

Consequences for human health

- Onset of diseases in workers and some of the population, often only after 20 years of exposure to mining material
- Tumorous malformations and gynecological problems
- Severe diseases or suspicious deaths of several workers, including those who worked in places at risk of ionizing radiation.

Evolution of the situation

During the early years, from 1969 to 1999, active mining of uranium in Niger was carried out by AREVA in a "very wild" (i.e. uncontrolled) manner. The workers were not aware of the risks of ionizing radiation and the surrounding population were not informed. This changed with the mobilization of environmental protection organizations, in particular after the publication of reports after the visits to Niger by CRIIRAD, SHERPA and Greenpeace in 2003, 2005 and 2009, invited by the Nigerian NGO Aghirin'man.

Since then the following measures have been taken:

- Implementation of timely awareness raising programs

- Implementation of radioactivity control measures
- Installation of a radioactivity surveillance system in Arlit
- Establishment of a health test site in the region of Agadez
- Establishment of a sustainable development fund for municipalities impacted by mining
- Suspension of work in the Imouraren mine
- Opening of another uranium mine in Arlit by a Canadian company.

The restoration of sites

The redevelopment of the sites implies that it is necessary to backfill the countless pits that have been dug since 1969, eliminate about 100 million tons of radioactive waste and restore the environment, especially the wildlife and the flora.

No concrete measures have been taken so far to ensure such a redevelopment of the used sites. However, according to some sources, AREVA's subsidiary mining companies set aside since 2014 funds consisting of a percentage of their uranium sales - corresponding to 100 tons per year - for site restoration.

Reference

[1] Winde F, Brugge D, Nidecker A, Ruegg U: Uranium from Africa - An overview on past and current mining activities: Re-appraising associated risks and chances in a global context. *J. African Earth Sciences* 128: 759-778 (2017).