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Uranium Mining in Niger; Status and Perspectives of a Top Five Producing Country

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Abstract

- Currently ranking as number three amongst uranium producing countries, Niger is a major contributor to world uranium.
- Poorly endowed with other natural resources, Niger gets an essential contribution to its export income from its significant uranium exports.
- Enjoying more than thirty years of safe, efficient and smooth operations, Niger production appears as an essential component for a suitable stability of world uranium supply, particularly for the European Union.
- Production comes from two companies, Somair and Cominak, operated by COGEMA, an AREVA Group company.
- Uranium concentrates are sold respectively to COGEMA (about two-thirds) and the other foreign partners, ENUSA of Spain and OURD of Japan.
- The remaining reserves and resources are sufficient to sustain a stable production far into the coming decades. While being of lower grades than those mined in Canada, Niger's ore-bodies are by far the richest on the African Continent, and are comparable or higher than those mined in Australia, not even mentioning other producing countries, all having lower grades.
- To some extent, these facts are not sufficiently known, and therefore Niger uranium production is often underscored.

This Paper aims at mitigating this perception and furthermore at showing the role Niger can play in world future uranium production for the continuing benefit of both world power production and local population income.

As a conclusion, we believe that uranium production in Niger has the potential of being a real sustainable mining case study.

Introduction: Niger – an important uranium producing country

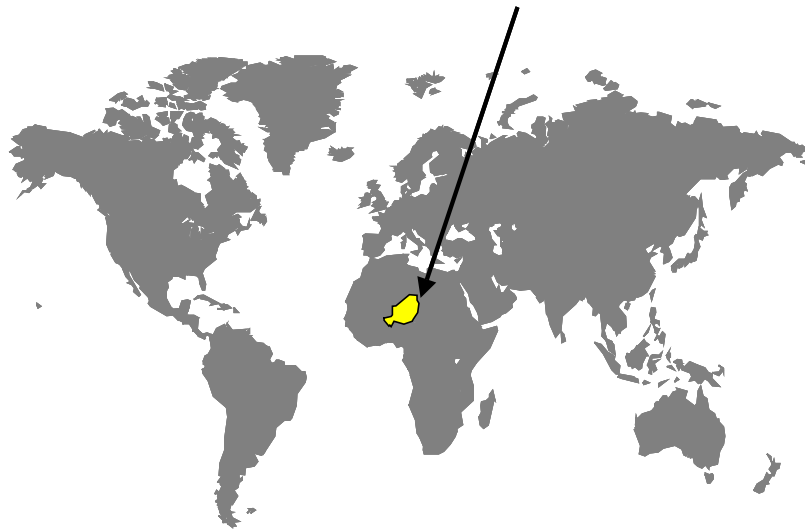
In 1995, an analyst's Paper emphasized the fact that "Africa has big uranium production, [and] gets little recognition" (Jay McMurray, NAC Intl. Focus April 1995). Our perception is that this remains generally true and is fully applicable to Niger. Perhaps this perception is the combined result of uranium buyers focusing on the very high grade mines of the Canadian Athabasca Basin or on uranium

resources of Central Asia which are very large and relatively new for Western customers. Another point is that Africa's geography (*see Figure 1*) is not always well known (and mistakes between Niger and its neighbouring country, Nigeria, are rather frequent).

The fact is that, as number three amongst uranium producing countries, Niger is a major contributor to world uranium supply. This must be made sufficiently known, as it is important for the overall appraisal of world uranium supplies, and for local economic development as well.

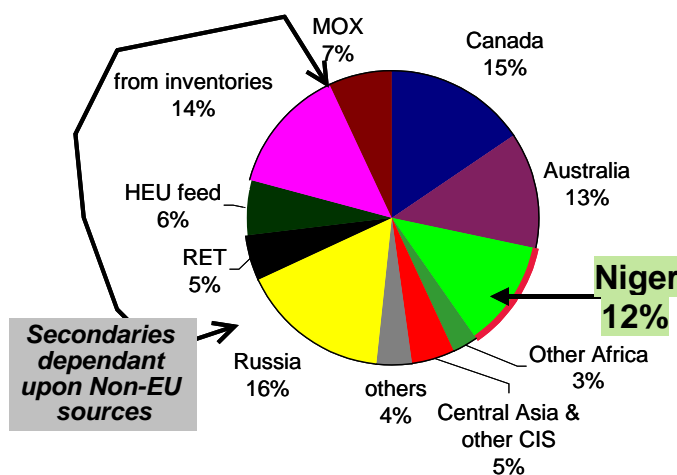
Fig. 1: Niger; a Rather Vast Country at the Core of Africa

Surface: 1 267 000 km² (about 2.3 times France or 5 times Wyoming)



Its share in European Union uranium supplies (about 15% of uranium purchases and 13% of total supplies in 2003, *see Figure 2*) is particularly prominent and deserves a special focus, particularly under the limelight of source diversification and security of supply, and also in the appraisal of EU economic relationships with the African continent.

Fig. 2: Niger in EU Utilities Total Uranium Supply by Origin (y2003)



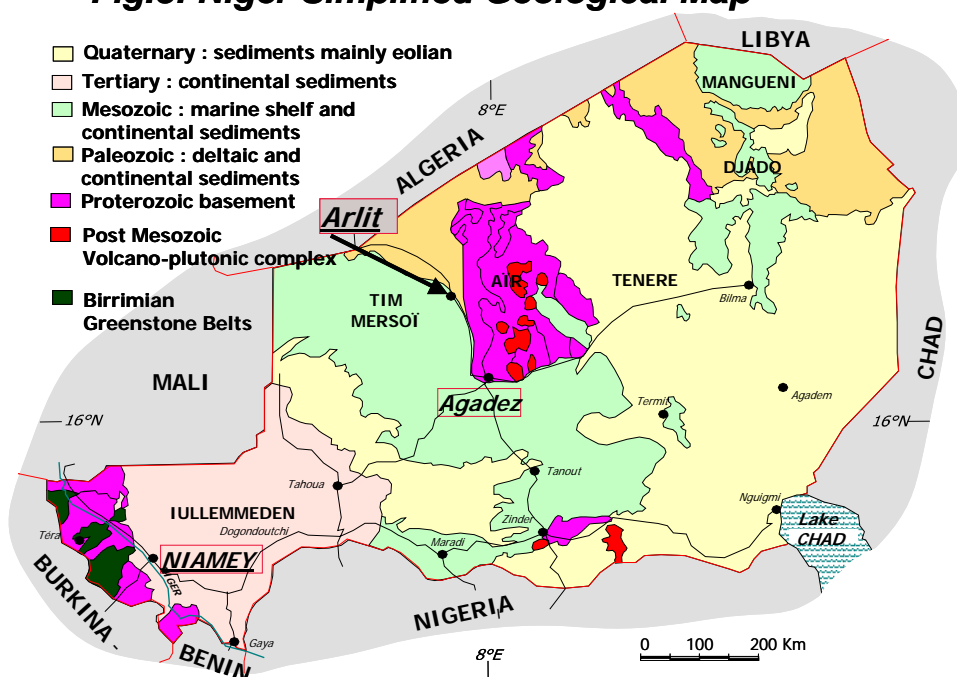
Source : adapted from ESA AR 2003

Geological background (*see map Figure 3*)

Niger's main uranium resources are all contained in the sediments of the Tim Mersoï sub-basin which is mainly the continental part of the sedimentary layers of the Iullemeden sedimentary basin. The large deposits currently mined by Cominak and Somaïr are located respectively in the Guezouman conglomeratic formation, supposedly of a Visean age, and in the Tarat sandstone formation which is younger and supposedly of a Namurian age.

Upward in the sedimentary pile, other mineralizations and deposits have been identified, the most important one being the Imouraren deposit located in the Tchirezrine sandstone of a Jurassic age. To describe the deposits in a very simple way, one can characterize them as belonging to the "sandstone type" uranium deposits. Not surprisingly, it has been found that the Imouraren orebody is probably amenable to In Situ Leaching mining methods, like many sandstone types analogs. For various reasons (relatively high grade, targeted recovery rate, lower permeability, historical reasons, economics...), the currently mined deposits are recovered through conventional mining methods.

Fig.3: Niger Simplified Geological Map



The two uranium producing corporations in Niger: history and current status

A brief history of uranium in Niger

The starting point of uranium history in Niger can be set in year 1957, with the discovery of uranium showings at Azelik by the "Bureau Minier de la France d'Outre-mer". Made aware of the discovery at a moment when uranium was actively being sought, the French "Commissariat à l'Energie Atomique" almost

immediately started a detailed study of the showings and launched an airborne and field survey.

As a consequence, in 1959, the discovery of Azelik and Abakorum deposits took place.

Then, a succession of discoveries followed: Madaouela in 1963; Arlette, Ariège, Artois, Taza, Tamou and Takriza in 1965; Imouraren in 1966; Akouta in 1967.

At the same time, Niger experienced several major milestones in its history as a country. In December 1958 the creation of the Republic of Niger occurred, followed by its independence on 3 August 1960.

To some extent, one can say that the history of modern Niger coincides well with the history of its uranium industry.

Somaïr

Based upon orebodies discovered in 1965 (Ariège, Artois, Arlette) and subsequently developed, the Société des Mines de l'Air (SOMAIR) was the first one to be incorporated on 1 February 1968. Its headquarters are located in Niamey, the capital of Niger.

Somaïr has its own mill, the Arlit mill, started in December 1970. Since 1980, it has included two production lines with a total capacity of 2300 tU per year. Due to depressed market conditions, the first line was shut down in 1982. It remains partially operable. The Arlit mill has its own sulphuric acid production plant, using imported sulphur.

Production is from several open pits of about 70m deep.

- Arlette Open-pit opened in 1968
- Ariège in 1976 (now exhausted)
- Taza in 1986 (southern part already exhausted)
- Takriza in 1996
- Tamou in 1998

Other open pits are projected to mine the Artois and Tamgak deposits.

Current shareholding is described in Appendix 2 describing Somaïr. At the very beginning, other foreign shareholders participated, but, for various reasons, they sold their shares in the Company.

Cominak

Cominak was set up as a company on 12 June 1974. This was decided quite shortly after the discovery in 1967 of the Akouta orebody and Akola. Somaïr's, headquarters are located in Niamey.

Cominak is an underground mine, whose entrance (a 20% twinned decline, one for engine circulation, one for a belt-conveyor for the ore) is situated at Akouta. It provides access to the producing stopes about 250m deep underground. The mill is also next to the mine (the Akouta mill). It was started in late 1978. Its current production capacity is about 2500 tU per year.

The Akouta mill has its own sulphuric acid production plant, using imported sulphur.

Besides ONAREM and COGEMA, Cominak includes two other important shareholders, OURD of Japan and ENUSA of Spain. At a moment when uranium prices are moving up sharply, the value of being a partner in such ventures is no longer open to question.

Uranium Mining in Niger Economy with a special focus on Sustainable Development aspects

Niger Key Figures

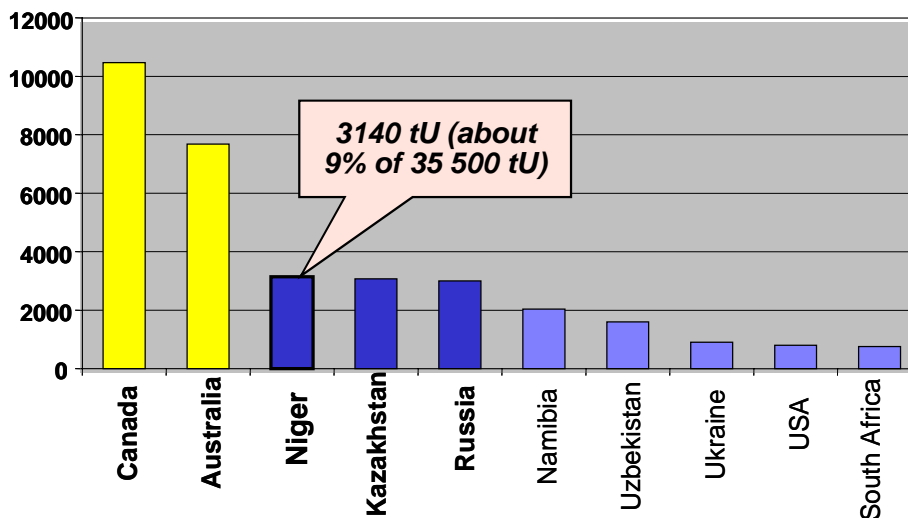
Located at the center of north-central Africa, on the southern rim of the Sahara desert (*see Figure 1&3*), Niger is a rather vast country, covering 1 267 000 square kilometers. Total population is about 10.79 million (2001), of which about 16% live in towns.

As is the case for the member countries of the “Banque Centrale des Etats d’Afrique de l’Ouest”, the local currency is the “Franc de l’Afrique de l’Ouest” or CFA. It has had a fixed rate with the French Franc (FF) of 100 CFA per FF since January 1994. When the French Franc joined the EURO system, the CFA was automatically linked to the EURO with the rate of 655.957 CFA per €

Niger’s 2002 GDP was about €1.1 billion in total and €190 per capita. In this total GDP, mining activities represent about €50 million (about 2.4%), of which uranium is the dominant share with more than 70%. The mining share of GDP is accounted for the added value, not the sale value.

Total exports are about €300 million, with uranium concentrates exports representing 31% of that total. In 2003, Niger uranium production reached 3143 tU. This figure makes Niger the third largest uranium producer in the world, slightly ahead of Kazakhstan and Russian Federation in terms of output. (*see Figure 4*)

Fig. 4: Top 10 Uranium Producing Countries (2003)



Uranium as a source of revenues for the Niger Economy

Niger is poorly endowed in other natural resources. Even though gold exploration and production in the Liptako area (western part of Niger) is being stimulated by the current level of the gold market, its contribution remains limited. Production of a few other minerals, including coal mined primarily for local power production, accounts for scarcely 30% of mining revenue. In fact, Niger gets an essential contribution to its export income from its significant uranium exports.

It is of interest to note that current value of uranium exports covers roughly the value of imports of petroleum products needed by the official Niger economy (source IMF Country Report 02/34 and “Consultations annuelles 2004 au Titre de l’Article IV avec le FMI – Mars 2004”).

It is also important to stress that tax revenues from uranium mining activities represent more than 5% of Niger’s total revenue.

Uranium mining and local development

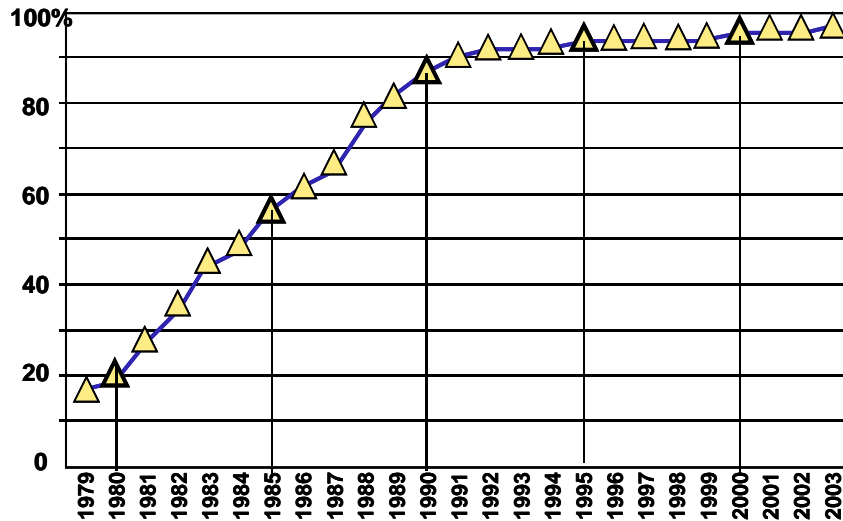
Local employment and the “Nigerisation” of the management

Uranium mining is the largest Niger industrial employment provider. Direct employment reached 4400 workers before the market became depressed. At the end of 2003, the Somair and Cominak payrolls still exceeded 1700 workers.

Indirect employment through sub-contractors followed the same trend. More than 500 workers can be accounted in 2003. When including those related to Arlit and Akokan cities, where more than 100 000 people live, it appears that the uranium mining sites are one of the largest business centers in Niger.

At the mines, a strong “Nigerisation” management program started in 1979 (see Figure 5). The program aimed at transferring knowledge, expertise and responsibility to national graduate personnel. This program has been successfully implemented, and, as a result, from an initial situation of about 16%, currently about 97% (and up to 99% overall, including operators) of all managers were born in Niger.

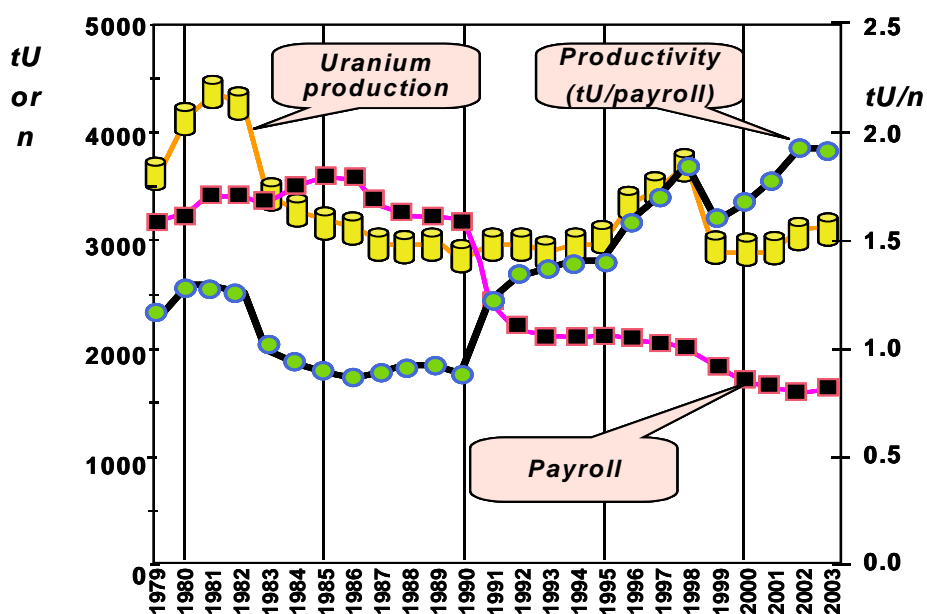
Fig. 5: Cominak + Somair Employees « Nigerisation » rate



In addition, in last few years, Areva has developed a program, which aims at fostering expertise and experience sharing between all of its mining sites worldwide. This involves sending Niger origin managers to other countries like France or Canada.

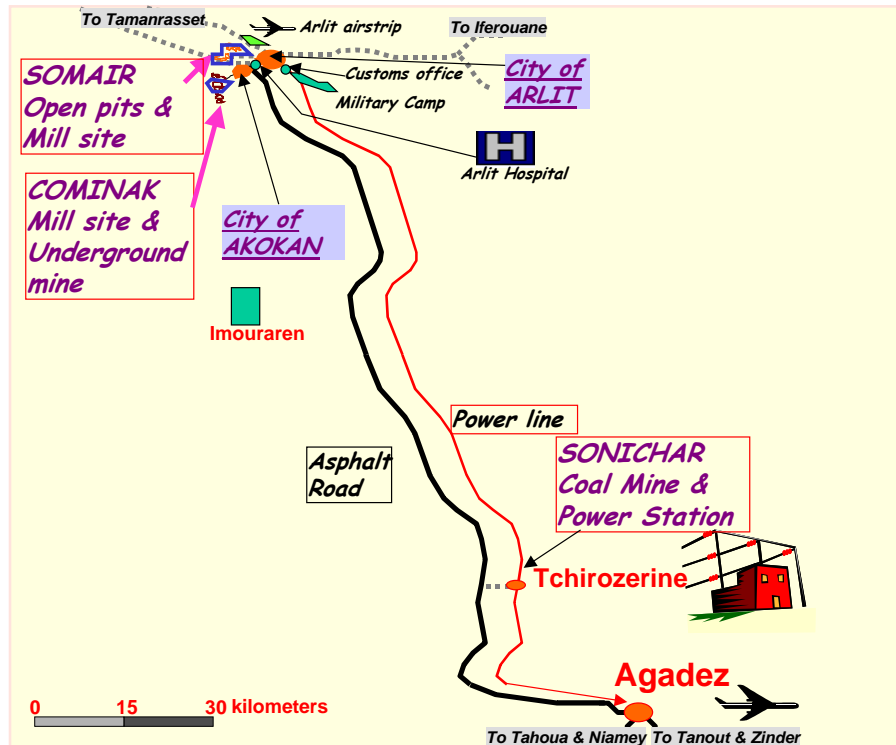
Another point to highlight is that this “Nigerisation” program was accompanied by productivity improvements, a very valuable trend, especially at times when the uranium market was depressed (see Figure 6).

Figure 6: Employment & Productivity (Cominak + Somair)



Energy, Infrastructures and Long term Evolution (see Figure 7)

Fig. 7: Mining Sites & Regional Infrastructures in the South of the Sahara Desert



During the early stages of mine setup, it was necessary to build everything from scratch in this desert area belonging to a region with no industrial tradition. The responsibility of building, financing and operating such equipment was carefully shared in full cooperation with the local authorities.

The electricity needs of the mine sites are covered by the production of a power plant including two 16 MW units located on a coal mine about 40 km to the North of the Agadez city. This power plant is operated by the Société Nigérienne de Charbon d'Anou Araren (SONICHAR), next to the small city of Tchirozerine. A 200 km transmission line brings the power to the mines. The excess power is brought to the Agadez city and its neighbouring areas.

Another important infrastructure specially built for servicing the mining sites is the 800 kilometers long asphalted road from Tahoua to Arlit via Agadez, the construction of which was 100% financed by the two mining companies. Also constructed on site were an airstrip and various lodging facilities for visitors, subcontractors and the staff.

A special effort was also made in the health field: two hospitals were built. They provide the best health care available in the area and are open not only to the workers and their families, but also to the local people.

Special attention has been paid to the problems raised by the evolution of mine sites' population. Current staff levels for both companies are now stabilized at about 1700 direct employees. It is estimated that, all in all, their families total about 20 000 persons, including retired employees, most of them still living in the area. Initially, the Arlit City was built to accommodate 5000 people. The Akokan city was established a few years later on a similar basis. Today the two cities have more than 100 000 people, more than those related only to uranium mining and dedicated ancillary services. Several important consequences must be addressed.

In the short term, one of the most important of these issues is water supply, and there is an ongoing program to address the problem. In the long run one also has to think well in advance about the unavoidable "after-mining" period. In both situations, we are and will be applying our Sustainable Development philosophy in a very practical way.

Education and training

In order to reach the goals established at the startup of an industrial activity never previously experienced, and thereafter by the "Nigerisation" program, several tracks were established.

- EMAÏR (Ecole des Mines de l'Aïr) started in 1975 in Agadez and provided full geological, mining and maintenance programs at supervision level. More than 60% of supervisors at Somaïr and Cominak graduated from that school.
- Cominak set up its own workers training center at the very beginning. This center is still active.
- External specialized courses were also established with other entities (Turin, Ensut-Dakar, Cogema).

Overall, these efforts represent sizeable amounts of staff expenses. However, as already mentioned, the results proved to be very positive.

Radioprotection and Environmental aspects

Somaïr and Cominak have set clear programs to manage radiological impacts on workers and the environment:

- Workers are submitted to individual dose tracking and annual medical checks.
- Current radioprotection limits are set by Niger National Regulation Acts. In addition to these, a project has been launched to limit the workers' dose levels under international standards (CIPR 60). As a result, no worker had been exposed to a dose exceeding 18 mSv at the end of 2003.
- As shown on aerial survey maps, the radiological impact on the surrounding areas is under control, as these impacts are monitored and tracked. In particular, no measurable airborne contamination from rock piles can be detected, despite the dry and windy climate of this desert area.
- The two companies are ISO 14001 certified.
- A water management program is underway, including programs aimed at diminishing industrial water consumption.

- Decommissioning programs are set up and financial provisions have accordingly been budgeted for.

Potential and future trends for uranium mining in Niger

The question of competitiveness

In the international market place, Niger uranium had and to some extent still has the reputation of being relatively high cost or even of being “subsidized” by the French industry. The first comment we must make is that there is no subsidization at all, no “matched sales system” or equivalent direct or indirect help. The “Niger uranium export price” is negotiated on a yearly basis between the companies and their shareholders with the consent of the Niger government. Such clients will resell the material to their customers. The price is set according to prevailing world market conditions, previous year pricing and financial ratios of the two mining companies; there is nothing exceptional there.

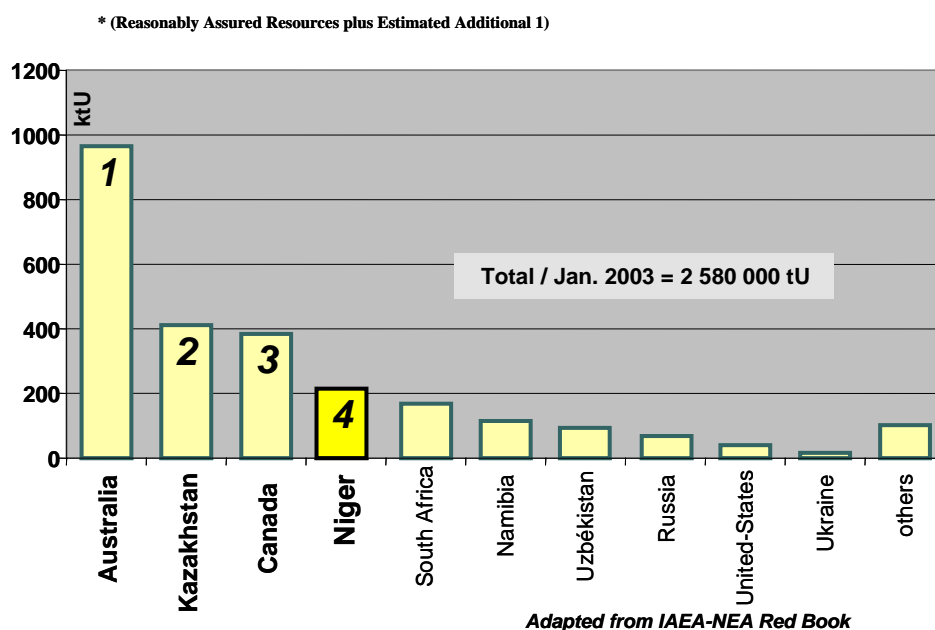
For several reasons, primarily the very nature of the orebodies and the remoteness of the mine sites, Niger uranium is obviously not the cheapest to produce in the world. Nevertheless, the grades and their continuity are quite fair, and productivity improvements are permanently sought. As a result, Niger uranium, while not falling within the first quartile of the current world production cost curve, is not at the top of this curve and remains a sound and stable supply. Furthermore, according to recent market changes, the reality is now that we need not only the full spectrum of the current curve, but, in addition, we already need more costly productions to cover the global demand. In the future, there is little doubt we will have to rely durably upon significantly more costly sources.

The question of known resources availability

Reported Resources: enough uranium for a sustained production

Niger is one of the most important uranium bearing provinces of the world. Its contribution to past uranium production has already been mentioned as one of the few showing a cumulative production in the range of 100 000 tU and more. But, more importantly, its remaining reserves and resources are quite large (*see Figure 8*)

Fig. 8: Known Uranium Resources* (recoverable at less than 15 US\$/lbU₃O₈)



According to the most recently published figures by Niger Ministry of Mines for the NEA-IAEA “Red-Book”, its resources base is as follows:

RAR <US\$40/kg	EAR 1 <US\$40/kgU	RAR <US\$80/kg	EAR 1 <US\$80/kgU	Total known
90 ktU	125 ktU	102 ktU	125 ktU	227 ktU

In addition to these “Known Resources”, only a very small amount of “Estimated Additional” is reported, and no Speculative Resources at all. To say the least, one can say there is room for additional exploration in Niger, and Areva is again active in “true exploration”, under the so-called “Tagora project”, launched in 2002 after a period of focus on mining reserves development work.

Reserves: A closer look at the near future

Reserve figures correspond to the part of the known resources that are fully evaluated according to a well defined mining project and are ready for production. They are expressed in the Table below as “recoverable concentrates” (taking into account all mining and milling losses).

Regarding the two producing companies, these figures indicate that about ten years of forward production are already delineated. Further development work, and related expenses, will be required to maintain this horizon of visibility.

In addition to this, another mine project is currently under a feasibility study. It is the Imouraren project which includes amongst several technical choices an ISL project.

Mine/Project	Total Reserves (tU recoverable as concentrates) as of Jan. 04	average grade (kgU/t)
COMINAK	29 050	5
SOMAIR	14 160	3
IMOURAREN*	about 80 000 tU	1.1

*Assuming an ISL mining method and a recovery rate of 70%

Conclusion

Enjoying more than thirty years of safe, efficient and smooth operations, Niger production appears as an essential component for a suitable stability of world uranium supply, particularly for the European Union.

The uranium reserves indicate that mining operations can continue to operate at current output for more than a decade.

The resources base already identified means that several more decades of production are very likely, and the geological appraisal of the overall potential provides an even more optimistic view.

Combined with safe, environmentally friendly operations, such a potential will ensure Niger a long term income from its uranium exports, and the customer countries a secure and long term supply.

APPENDIX 1

History of Uranium Industry in Niger: born and grown with the country

1957: Discovery of uranium showings at Azelik by the “Bureau Minier de la France d'Outre-mer”

1958: Detailed study of the showings and airborne & field surveys by the French “Commissariat à l’Energie Atomique”

December 1958: Creation of the Republic of Niger

1959: Discovery of Azelik and Abakorum deposits

August 3, 1960: Niger Independance

1963: Discovery of the Madaouela deposit

1965: Discovery of Arlette, then Ariège, Artois, Taza, Tamou and Takriza

1966: Discovery of Imouraren

1967: Discovery of Akouta

1968: Setup of the Société des Mines de l’Aïr (SOMAIR)

1971: First commercial production in Arlit (SOMAIR)

1972: Discovery of Ebala

1974: Incorporation of the “Compagnie Minière d’Akouta” (COMINAK)

1974: Imouraren Joint Venture Agreement

1978: First commercial production in Akouta (COMINAK)

1979: Incorporation of the “Société Minière de Tassa N’Taghague” (SMTT)

1996: SOMAIR purchases SMTT assets

2002: Re-activation of exploration and development programs (TAGORA project)

2006: Expected milestone; 100 000 tU of cumulated commercial uranium production in Niger

APPENDIX 2

ID Card of the two Uranium Producers in Niger

SOMAIR:

Current Ownership: COGEMA-France & affiliates (63.4%), ONAREM-Niger (36.6%)

Mill characteristics:

Name/location: Arlit Mill / Arlit
Startup date: 1971
Process: Acid Dynamic Leaching/Solvent Extraction
Capacity: 2000 t/day
Product: Sodium Di-Uranate (68 to 71w% of U)

Related Mines: Ariège, Artois, Arlette (initial Somaïr lease) and Tamou, Taza, Takriza, Tamgak (SMTT lease)

Mining Method: Open Pits
Reserves: about 14 000 tU
Average grade: 0.3 % U

Environmental Management: Certified ISO 14001 since November 2002

Key figures:

2003 output: 1126 tU
number of employees at year end: 565

Typical Mining figures:

Yearly barren rocks stripping: 10 Mt
Yearly mined tonnage from mineralized zones: 1.5 Mt

COMINAK:

Current Ownership: COGEMA-France & affiliates (34%), ONAREM-Niger (31%), OURD-Japan (25%), ENUSA-Spain (10%)

Mill characteristics:

Name/location: Akouta Mill / Akokan

Startup date: 1978

Process: Acid Dynamic Leaching/Solvent Extraction

Capacity: 1800 t/day

Product: Magnesium Uranate

Related Mines: the Akouta mine provides access to several adjacent orebodies (Akola, Akouta, and coming Afasto with Ebba North and South)

Mining Method: Underground – mainly room & pillars

Reserves: about 29 000 tU

Average grade: 0.40 to 0.50 % U₃O₈

Environmental Management: Certified ISO 14001 since January 2003

Key figures:

2003 output: 2017 tU

number of employees at year end: 1070