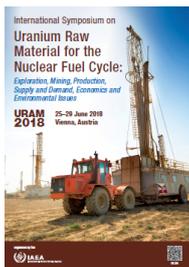


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ENVIRONMENTAL FACTORS CONTROL AT SIERRA PINTADA, ARGENTINA: WATER QUALITY

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INTRODUCTION

The Sierra Pintada uranium mine is located in Mendoza Province, Argentine, 38 km. west from San Rafael and 240 km. south from Mendoza city. It was in production from 1975 to 1995 when the operations were stopped owing to economic reasons. Under the open-pit extraction system, 1,600 tons of uranium ore were extracted and treated by acid leaching and ion exchange columns with a nominal capacity of 120 tU / year, and more than 6.000 tons of uranium remain to be extracted. The CMFSR (San Rafael Manufacturing Mining Complex, according to its initials in Spanish) supplied for 22 years the whole uranium required by power plants for nuclear power production and research reactors and production of radioisotopes in Argentina.

Currently, the activities carried out at the site are maintenance, monitoring and environmental management. At this moment, the treatment of pit water and the management of solid waste disposed in the complex is in the stage of environmental impact assessment.

Soon it will begin to define the closure of the El Gaucho open pit, one of the four pit in which the mining operation was completed and still remains open pending the restoration

The area where most of the facilities of the CMFSR are located is in the basin of the El Tigre brook, which crosses the mineralized zone and flows into the Diamante River, the main water course that feeds the irrigation network of the San Rafael Department. Due to the El Tigre stream originally passed directly over the mineralized zone, a deviation of its natural course was made previously to the mining operation stage, preventing the water from entering one of the open pits with a high uranium content.

The importance of the Diamante River as a water resource in the south of the Mendoza province is given by being the main supplier of water for irrigation in the city of San Rafael and its surroundings, where economic activities related to agriculture are carried out, with special emphasis on the fruit and viticulture production [1]. This area is characterized by being a semi-desert zone, which thanks to the irrigation supplied by this river, is transformed into a productive agricultural area.

CNEA's (Atomic Energy National Commission, by its initials in Spanish) commitment to maintain and constantly improve its relationship with the environment according its environmental policy, ensuring that environmental factors, specially water courses are not affected by the activities developed in the mining complex, has led to the development of an extensive monitoring plan to evaluate the quality of the water resource.

In the same way, the concern of the population near the site turns into strict controls of the water factor by the control organisms: the DGI (Irrigation General Department, by its initials in Spanish) and the ARN (Nuclear Regulatory Authority, by its initials in Spanish), the former provincial and the latter national.

MONITORING PLANS

From the very beginning of the activities developed in the Sierra Pintada uranium deposit, the controls of the different environmental variables were carried out, with special emphasis on the water resource. CNEA has a wide network of water monitoring, internal and external to the mining complex. The quality of this resource is verified in the environmental laboratory located in the CMFSR, wich is certified by the Argentine

Accreditation Organism for the technique of uranium determination in samples of surface and underground water.

The main objective of the water monitoring plan is to analyze the temporal and spatial evolution of the parameters and to have data available to detect possible anomalies or incidents and, where appropriate, evaluate them and make evolutionary predictions.

The current network includes 45 points for groundwater, of which 29 are internal wells to the deposit area, and 32 points for surface water, of which 17 are internal, the rest are outside the boundaries of the Complex in areas of interest for nearby populations.

The regularity of the sampling in each of these points, (monthly, bimonthly, quarterly or biannually) according to the needs of the site, was defined from the analysis of the seasonal variation, or not, of the normal behavior, after more than 40 years of compilation of data and experiences.

On average about fifty different samples are analyzed monthly, which are studied for determination of physicochemical parameters (electrical conductivity, total dissolved solids, acidity, temperature), anions (chlorides, nitrates, sulfates, carbonates, bicarbonate, hydroxide), cations (ammonium, sodium, potassium, calcium, magnesium, lead, chromium, arsenic, mercury) and radiological parameters (uranium and radio-222).

Special emphasis is placed on 8 control points measured monthly, 4 of surface water and 4 of groundwater, which can give an environmental diagnosis of the situation of water quality in the area. These points are strategically located upstream and downstream of the Complex, and allow to correlate the contribution of the deposit to the values of uranium, since the water courses pass through a highly mineralized zone.

Regarding to surface water, the most significant control points are upstream and downstream of the CMFSR in both El Tigre and Diamante streams. This allows to know, if exists, the variation in uranium values with that the mineralized zone contributes to the modification of water quality.

Both the Mining Code (National Law 24.585) and the Provincial Law 5961, Decree 820/2006 establish a limit of 100 µgU/l as the permitted limit in water for human consumption. The same maximum limit is allowed for the discharge of liquids to receiving bodies according to Resolution number 647/00 of the General Irrigation Department.

In the case of El Tigre brook, which has an average flow of 0.16 m³/s, before entering the mineralized zone, the current brings on average 3.94 µgU/l and leaves it with an average of 12.31 µgU/l, this means an increase of more than 200%.

As to the Diamante River, which has an average flow of 28.25 m³/s, upstream of the mouth of the El Tigre stream, it brings on average 1.57 µgU/l and waters below it with an average of 2.028 µgU/l, this means an increase of 30%, which is contributed by the brook.

Regarding to groundwater, the most significant control points are two upstream and two downstream of the CMFSR, strategically located according to the direction of groundwater flow. The average values are around 15 µgU/l.

The analyses are carried out in the environmental laboratory of the Complex, since it has technology to fulfill studies. It is equipped with an atomic absorption spectrophotometer for the determination of metallic elements and an ion chromatograph for the determination of anions. The laboratory can provide the analytical service for environmental samples, not only of ground and surface water, but also of sediments.

In the year 2014 the laboratory was able to accredit the laser fluorimetric determination of uranium in water technique, through the OAA (Argentine Accreditation Organization, according to its initials in Spanish), since it meets high quality standards. It is important to mention that there are no others laboratories with this high degree of quality in the nearby, including the laboratories from the control organisms.

With respect to the air factor, radon levels are monitored periodically in both the CMFSR area and nearby populations. A study is currently underway to model the transport of particulate matter in the atmosphere to implement a new air quality monitoring plan.

CONTROL ORGANISMS

Due to the concern of the population of the area adjacent to the Mining Complex, and the importance of the Diamante River for the area of influence of the CNEA facilities, the control authorities carries out periodic checks on the activities developed in the facilities and their impact on the environment.

On the one hand, the General Department of Irrigation (DGI), through the Sub Delegation of the Diamante River, takes samples of water, which are analyzed by the National University of Cuyo.

The DGI takes the samples at the exit of the industrialized zone for the El Tigre brook and downstream from the mouth of the same in the Diamante River. The average values of uranium content are 16.62 µgU/l and 1.74 µgU/l respectively, which are concordant with those measured by CNEA. In all the measurements made by this control body, the measured values are lower than the limits allowed by Resolution number 647/00.

At a national level, the control is carried out by the ARN (Nuclear Regulatory Authority, according to its initials in Spanish), taking samples of both air (to control the levels of Radon gas) and surface water with an annual periodicity. The ARN has approved the water and sediment monitoring plans and analyzes both the results of its monitoring and those reported monthly by CNEA, submitting quarterly reports that conclude, until now, that the levels of uranium in the water courses surrounding the deposit are at normal levels, and below the allowed limits. This corroborates CNEA's commitment to the environmental policy on the site.

The results of the analyzes implemented by the ARN on the channel of the El Tigre brook give average values of 3.9 µgU/l waters below the mineralized zone and 13.3 µgU/l upstream of the same, with registered maximum values of 6.3 ± 0.3 µgU/l and 29.0 ± 3.5 µgU/l respectively. While in the Diamante River the average values measured by this control organism are 1.2 µgU/l upstream from the mouth of the El Tigre stream and 1.4 µgU/l downstream, with historical maximums of 3.0 ± 0.7 µgU/l 2.9 ± 0.5 µgU/l respectively [2].

The ARN concludes in its reports that the values reported by the CNEA are compatible with the results of the routine monitoring carried out by the control organism and that, on the other hand, they are lower than the guideline established by the World Health Organization for drinking water of 30 µgU/l.

CONCLUSIONS

During the productive and the subsequent stages, no values were recorded above those allowed in the water courses of the El Tigre stream and the Diamante River, demonstrated not only by the own monitoring, but also by those carried out by the Irrigation General Department and the Nuclear Regulatory Authority.

Over 40 years of CNEA activities in the area, with almost 20 years using sulfuric acid for the process of treating the minerals, there has been no alteration in the quality of the surface or underground water, since the beginning of the production activities of uranium concentrates in 1979, suitable methodologies were used for handling of acid solutions and for the management of process effluents.

In all these time, CNEA maintains its commitment to the care of the environment, through the implementation of its environmental policy and putting into practice the concept of continuous improvement to ensure sustainable environmental management.

REFERENCES

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- [2] NUCLEAR REGULATORY AUTHORITY –SCA N°09/17. Evaluation of the monthly reports of control points of surface and groundwater of the CMFSR, corresponding to the third quarter of 2016.

Country or International Organization

Argentina

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