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STATE EXPERTISE CONCLUSION

ON THE ENVIRONMENTAL IMPACT EXPERTISE

BP 35

Initiated by *Geoteam CJSC*
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Activity: *Report on the environmental impact assessment of the amended project for Amulsar gold-bearing quartzite deposit mining complex RA Vayots Dzor and Syunik Regions*

"Environmental Impact Expertise Center" SNCO
Director: */signed and sealed/* V. Sahakyan

Enclosed the conclusion of 9 pages

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Report on the environmental impact assessment of the amended project for Amulsar gold-bearing quartzite deposit mining complex submitted by Geoteam CJSC

Client: "Geoteam" CJSC

Projectors: "RAKE" LLC, "Eco Audit" LLC

Submitted materials: Working project, Assessment report

Location: RA Vayots Dzor and Syunik Regions, administrative territories of Gorayk, Saravan, Gndevaz communities

Activity category: Category /A/

Amulsar mining complex is located within the administrative borders of Gorayk, Saravan, Gndevaz communities of the RA Vayots Dzor and Syunik Regions.
The villages of Saravan and Gndevaz are located 5km south-west of the projected mine and 7 km to the West correspondingly, while the village of Gorayk is 5km to the south-east. The nearest town center is Jermuk which is 10km to the north- west and 7 km away from the nearest point of infrastructures. The community of Kechut that is part of Jermuk is 7 km to the north of the mine.
Amulsar gold-bearing quartzite deposit resources were approved in C_1+C_2 categories by the RA Ministry of Energy and Nature Resources Staff Mineral Resources Agency's two decisions
For Tigranes and Artavazdes sites they comprise:
Ore: 56434.5 thousand t. (23812 thousand m^3)
Gold: 52664 kg
Silver: 210.51 t
For Erato site:
Ore: 32941.8 thousand t. (13899.5 thousand m^3)
Gold: 21069 kg
Silver: 83.86 t
In 2015 technical and economic optimization works aimed at reducing the project development costs were performed.
The main amendments to the project are:
-overburden rock volume has increased by 14281.26 thousand m^3; it has become 106490.056 thousand m^3 from 92202.78 thousand m^3;
- maximum annual productivity of the open pit was accepted to be 10,0 mln./t of merchantable ore
- production capacity and brands, etc. of mountain transportation equipment were changed;

- locations of the roads connecting to the crushing facility, the barren rock storage facility and roads of other significance were changed;
- location of the overland conveyor was changed;
-instead of the primary, secondary and third crushing facilities primary and secondary crushing facilities were located in one place.
-instead of the camp located at Vorotan river valley the employees involved in the construction and operation works will be accommodated in the local guest houses that are outside the direct site;
-the fuel storage facility and fuelling station are relocated to the south-west of the barren rock storage facility. Storage container was not changed;
-cone crusher was replaced with one toothed crusher;
- crushed ore pile was removed and replaced by feeder with modified sizes inside the crusher facility for the secondary crushers;
-in the ore sorting point the increased volumes of crushing enable to launch 3 sorters. The facility sizes were reduced in connection with the removal of the third crusher;
-the number of conveyors was reduced from two to one; one transporting tower and one accumulator were removed;
-heap leach facility (HLF) (leach pad, collection ponds and diversion facilities), the area occupied by the leach facility was reviewed so as to perform more superficial digging works of diversion waterpipe located in the northwestern part. The 3 leach phases were changed into four and the scope of the first phase was reduced.
-taking into consideration the volumes of barren leach solution new flow estimated based on the HLF water balance and the requirements to the storage of residual water treatment pond sizes were increased;
-the storm water ponds sizes were increased;
-the workshop for trucks maintenance and the washing site were relocated to the north-west of Erato;
- sodium cyanide consumption rate was reviewed and underwent double reduction;
- gold retreatment technology was reviewed and changed: instead of electrolysis zinc dust deposition will be applied (Merril-Crowe).

Amulsar gold-bearing quartzite deposit shall be exploited with two open pits

- Artavazdes and Tigranes sites are exploited by open pit N 1
- Erato site is exploited by open pit N 2.

In their final position the projected open pits have the following parameters:
-Open pit N1: maximum length is 1665m, maximum width: 980m, maximum depth is 270m, the bench height is 10m, safety berm width is 4m.
-Open pit N2 maximum length is 855m, maximum width: 760m, maximum depth is 225m, the bench height is 10m, safety berm width is 4m.
The exploitation of open pit N 2 (Erato site) shall be in two stages.
The second stage will be projected based on the results of the currently ongoing additional prospection of the site.
The open pits will be exploited according to the following timetable.
Open pit N 1: years 1-7
Open pit N 2: I stage: years 5-8, II stage: years 8-9.

Pursuant to the draft proposal the annual productivity of the open pit is 10000 thousand t. (4205.0 thousand m^3) as per merchantable ore.
The average annual productivity of the open pit as per the overburden rocks is estimated to be 20000.0 thousand m^3 (46756.08 thousand tons).
The time period for the mine exploitation is 19,5 years taking into consideration the preparation and pit closure works.
For the open pit processing the system with bilateral longtitudinal motion layers is adopted, by transporting the overburden rocks to the external and starting from the 5th year- partially to internal stockpiles. The selected processing system has the following parameters:
-height of the bench is 10m
-the bench inclination angle:
in working state is 65-70^0
in its final position once turned off-50-60^0
-The inclination angle of the open pit edges is 33^0-46^{0}35';
-The minimum width of the working site is 30-40m;
-The annual descend of the mineral products works is 40m in open pit N1 and 50m in the open pit N2.
The following works should be performed for opening the open pit N1 and reaching a production capacity:
-constructing an industrial site S=1,0 ha, V=30400m^3;
-constructing a road of 5495m from 2970m altitude mark layer of the open pit up to the crushing facility, stockpile and parking lot for the trucks, V=280000 m^3;
-removal of overburden rocks from the layers with 2970m altitude mark V=426150m^3-340000 m^3;
-removal of overburden rocks from the layers with 2960m altitude mark V= 340000 m^3, accompanying mineral product-20000 m^3 (47400 t);
-bench with an altitude mark of 2950m-removal of overburden rocks-86600 m^3
-storage facility: construction of unloading site S=430m^2 V=2150m^3;
-storage facility: construction of water drainage canal.
The construction duration of the open pit is estimated to be 2,0 years.
The overburden rocks are represented by siltstones and barren rocks. The removal of siltstones is without preliminary ripping while the overburden rocks are removed by bulldozers, excavators, dumpers mountain transportation means after preliminary ripping. The overburden rocks will be stored in the external storage facility located to the north of the open pit and starting from the 4th year partially in the 1st internal storage facility of the open pit.
The preliminary ripping of the rocks is planned to be done by drilling and blasting using borehole charges.
As an explosive the locally produced ANFO (for dry areas) and geonit for waterful areas are usually used.
Mineral product loading works of the mountain mass shall be performed with CAT-6050 excavators having a direct shovel and 26m^3 capacity bucket and CAT-789 dumpers having 190 load bearing capacity (body load capacity is up to 110 m^2) are used for transportation.
The overburden rocks with the total volume of 140.65 mln. m^3 are represented by orehosting rocky overburden rocks of about 137.88 mln. m^3 and by 2.77 mln. m^3 siltstones.

Up to the 5th year of the open pit exploitation the overburden rocks of 87.9mln. m^3 in volume are stored in the external storage facility located to the northwest of the open pits and 6.1 mln.m^3 -in the developed space above the bench with the altitude mark 2780 m of the open pit.
Later on parallel to deepening of the open pit N 1 the remaining overburden rocks of 37861.65 thousand m^3 in volume are stored in the developed space of open pit N1 and in the external storage facility.
The area occupied by the external storage facility is 140.69 ha, the total altitude is 250m, the edge inclination angle is 18^0, the upper plateau mark is the layer of 2710 m altitude mark, the surface is 12.3 ha, capacity is 113784.153 thousand m^3.
The volume of the internal storage facility is 40 936,080 thousand m^3, the area occupied is 57 ha.
The upper layer of soil in open pit N1 area which is 138.27 thousand m^3 in volume is stored to the north of the open pit N1, in its immediate vicinity. The occupied area is 5.0 ha. The upper layer of soil in open pit N2 area which is 130.08 thousand m^3 in volume is transported and stored in the northern part of the open pit N2, the area occupied is 5.06 ha.
The upper layer of the soil in the external storage facility area which is 148.9 thousand m^3 in volume is removed and transported beforehand and separately stored to the east of the storage facility.
The rocks with low quantity of metals will be placed in the southwestern part of the storage facility; their volume comprises 9968373m^3.
The electric power of the open pits shall be supplied through 15 diesel generators with the power capacity of 100kW and 24 diesel generators and a compressor will be used during the construction of the communication channels.
In order to get doré the ore is processed in two grinding stages; thus in 80% providing for the established size of 18mm (P100=19mm). The crushing facility actions include primary grinding with a jaw crusher and later- secondary grinding with a closed circuit cone crusher with triple deck screen. The primary grinding site is equipped with dust-arresting system that enables to bring the dust accumulation to the minimum in all the transporting points. In the secondary crushing site dust accumulation is regulated through the dust control system of the primary grinding site.
The crushed ore is transported via the overland conveyor to the crushed ore storage facility located in 5.3 km distance. The overland conveyor will be equipped with regenerative transferring system which will produce about 3Mw energy and will again be returned to the energy system.
The conveyor will be equipped with intermediate overland and three underground passes.
The crushed ore available in the crushed ore storage facility with the net volume of 5000t is reclaimed underneath the stockpile by three feeders that are transferred to the feeding conveyor of the load out bin. During the transfer to the load out bin coarse lime will be added to the ore from the 200 tons capacity lime bunker. In order to ensure the established pH level the added lime will be measured.
The crushed product mixed with the lime by the feeding conveyor is transferred to the load out bin with a capacity of 100 tons. Once the bin is full the feeders and the unloading feeder conveyor are stopped. The ore is loaded from the load out bin to the truck. Later on the crushed ore is transferred to the heap leach facility for stacking and leaching.
The heap leach facility is located in the 28th area which is a flat area and has a undulating land is some areas.
The leach facility will be built in four stages; the total surface will be 1,153,900 m^2.

The leach facility will have a composite liner system which will consist of low-density polyethylene (LLDPE) geomembrane intralayer under which pressed slightly water-permeable soil intralayer of at least 0,3 m thickness or in case of big inclination-geosynthetic clay liner (GCL) will be placed.
The drainage pipeline will be constructed above the intralayer of the facility and granular drainage landfill cover layer with at least 0,6m thickness will be placed which will consist of easily drying, coarse, granular material. The accumulated solutions, storm/snowmelt water leakages and the infiltration flows will independently flow to the pond.
Heap leaching process includes stacking of crushed ore in layers on the leach facility and individual leaching of each layer for recovering gold and silver. The barren leach solution (BS) which contains rarified sodium cyanides will be added to the ore stockpile surface by droppers or sprinklers at a projected volume of 6l/hour/m^3. The project cycle of ore stockpile leaching is 60 days.
The solution will be absorbed through the ore up the drainage system that is above the liner where it will be collected in the drainage pipe network, inside the granular drainage layer with the minimum thickness of 0.6 m above the liner. The solution will automatically flow to the pregnant solution process pond. The enriched solution collected in the process pond is pumped to the process facility for recovering gold and silver.
In order to prevent the access of animals to the site a mesh fence with closing gates will be built alongside the leach facility perimeter.
The ore stockpile on the leach facility shall be stacked in four stages: with horizontal layers of 8m thickness. The maximum nominal height of the stockpile is 120m above the protection intralayer.
HLF collection ponds will include the 1st, 2nd and 3rd storm water collection ponds. The collection pond sizes were projected according to the projection standards using the HLF water balance estimation data. The 1st cleaning and storm water collection pond will be constructed during the construction of the 1st phase facility and the 2nd pond- during the construction of the 3rd phase facility, the flood pond will be constructed during the construction of the 4th phase facility.
Within the territory of leach facility cleaning solutions and storm/snowmelt water flows will automatically flow and accumulate in the lowest point of the facility and will flow to the cleaning pond through the gutter.
Processing plant consists of absorption-desorption-recovery (ADR) plant, filtration and reagents replenishing and supply systems. The ADR plant will be located to the south- west of HLF collection ponds. The entire territory of ADR plant shall be isolated; in order to exclude the leakages and any kind of flooding generated from the plant it shall be connected to the process pond.
Precious metals are extracted in the plant in the coconut charcoal activated by saturated leaching solution (LS) by using coaling towers in the opposite flow. Once loaded with precious metals the coal moves from the towers to the elutriation tower where under high temperature and pressure metal elutriation (desorption) is done inside layering containers in coal solution. Later the eluate is mixed with zinc dust and in the result of that gold and silver are separated from that solution. When the precious metals are separated in the solution layering containers in a form of sediment, the solution is filtrated, the residue is dried, retorted for getting mercury, mixed with (furnace) charge and melted in induction furnace for getting doré bullions. Later the doré bullions are transported to smelting-house for further filtration. The ADR cycle reactivates coal and regenerative furnace through acid washing technique for preserving the coal ability to absorb the metals. After regeneration the coal is returned to coaling tower as fresh coal.

The main points and equipment of the heap leaching and ADR scheme are the receiving hopper, wheeled vibratory feeder, jaw crusher, feeder conveyor of crushed ore and hopper, crushed ore hopper, three-layer vibrating screen, coarse vibrating screen conveyor, secondary crushing hopper, secondary cone crushers, overland conveyor, crushed ore storage facility, feeders, load out bin, heap leach facility, process pond, rarefied solution pond, storm waters collection pond, coaling towers (5), elutriation tower, solution layering container, retort, induction furnace, smelting-house.

"Geoteam" CJ Company and local and international specialized organizations have conducted corresponding studies for assessing the possible impact on the air basin, water bodies, biodiversity and soils during the mining complex exploitation. Studies on the possible impact of explosions, radiation and noise were conducted, too.

During the production processes there will be harmful substances emissions during the mine exploitation, ore transportation, crushing (grinding), lime receiving and filling it into the conveyor processes from the solution preparation and ADR points.

The total number of emissions from controlled immovable sources is estimated to be 338.39 t. per year and from mobile sources: 737.5 t. per year.

In the result of dust dispersion study it was asserted that the majority of outcast PM_{10} particles, i.e more than 95% will sit within 1km distance from the site, and more than 90%- within 500 m distance from the emissions source. The PM_{10} and $PM_{2.5}$ concentrates will be within the standards based on the distances from the project implementation places.

Cyanic acid, hydrochloric acid vapors and the expected close to the ground concentrates of natrium dioxide, carbon monoxide are within the limits defined for populated areas although the production site is located outside the populated areas.

The water is used in Amulsar mine, heap leach and gold production areas for technologic purposes and for the drinking- economic needs of the employees, as well as for creating firefighting reserves. The general purpose is separating contact and non-contact waters so as to reduce the necessity for their storage. As much as it is practically possible, the contact waters will be used in HLF processes and the residual waters will be cleaned in the biological filtration system (BFS) before flowing to the River Arpa (below the point for taking water from Arpa). The proposed system will consist of a number of ponds, bioreactors and humid areas through which pH level will be increased and nitrates, sulphates and metals will be removed.

Three main water storage points will be available during the exploitation stage:

-clean water pond (with 20,450m^3 capacity) where the outflows of the mine leading and deferent roads, as well as of conveyor corridor will be collected;

-HLF contact waters collection pond (maximum capacity is about 1,280,000 m^3) where outflows of ADR perimeter pond and sedimentation tank-pits and trucks maintenance workshop pond waters will be collected;

-the rainwater collection three ponds (maximum capacity is about 630,000m^3) located downstream the HLF will be used during the exploitation for the active collection of treatment waters, they also have rainwater collection container.

During the closure period the waters discharges to the environment include the flows from HLF, ADR and the recovered areas.

During the post-closure period in order to discharge the residual waters of ADR their quality will be brought in conformity to the RA II category concentrates for which biological water filtration system located in the HLF vicinity will be used.

The filtrated leachates will be discharged into a group of infiltration chambers located at the HLF water collector or into the tributary of Arpa. The ADR perimeter pond will be used for seasonal flows storage and management by controlling their discharge to the biological filtration system.
During the drainage of HLF before being discharged to the environment the waters will be filtered in the active filtration system. The biological filtration system will be launched in the post-closure stage in the same way as during the exploitation stage.
During closure the outflows from HLF system will correspond to the 2nd category and/or initial standards.
The comprehensive analysis on the ecosystems and biodiversity, as well as the possible impact were assessed by specialized organizations (RA NAS Institute of Botany, RA Scientific Center of Zoology and Hydroecology, Armenian Society for the Protection of Birds, Treweek Environmental Consultants (TEC). The project aims at avoiding any loss of biodiversity and guaranteeing that in the result of the project works there will not be any systemized degradation or loss in biodiversity and ecosystem functions. This means that the species available within the area affected by the project shall have the same long-term existence possibilities during the project implementation as they would have had in case the project did not exist and similar scope of corresponding bioenvironment as in the initial situation will be available for the species. According to the studies, in certain areas of the subsoil to be exploited and in the adjacent areas Potentilla porphyrantha species of plant which is included in the RA Red Book were found. Their protection and reproduction will be carried out in accordance with the RA Government Decree N 781-N of July 31, 2014. Amulsar provides for first category importance (critical) bioenvironment for this species which will be affected by the Project operations. For that purpose a reserved area (hereinafter Arshak reserved area) in the south of Arshak mountain peak was separated for preserving the viable population of the plant. In other places individuals of the plant were found and during the geological prospection works the approaching paths were designed in a way to bypass them.
In the report on the biodiversity compensation strategy an action plan aimed at compensation and protection, as well as estimated costs summery were developed.
According to the RA Nuclear Power Plant and State Nuclear Safety Regulatory Committee at the RA Government the radiation background of the area is within the standards and the radiology report results presented by Radman Associates confirm that the doses of possible radiation caused by radioactive substances of natural origin during the performance of professional duties are within the international standards and the natural radiation background in the area is lower than the average background level of the soils in the Republic of Armenia.
Noise and vibration impact assessment estimations that were made in accordance with the International Finance Corporation (IFC) “Environmental Health and Safety Guidelines” standards developed based on World Health Organization (WHO) “Noise in the Populated Areas” guidelines standards and in accordance with the N2-III-11.3 sanitary standards requirements of the RA “Noise in the Workplaces, Residential and Public Buildings and Residential Development Areas” showed that the levels measured in the nearby populated areas are within the standards.
According to the estimations, the air pressure in the blast wave front and the ground vibration, as well as sound pressure levels of penetrating noise will not exceed the effective IFC and RA standards.
According to the submitted project a 1000m sanitary protection zone (SPZ) from all the production facilities is preserved.

The economic damage on the atmosphere in the result of Amulsar mining complex exploitation is estimated to be AMD 165005252.
The economic damage caused to the soil resources is estimated to be AMD 4985695500,0.
In the mine recultivation, closure and reclamation plan, as well as in the assessment reports the characteristics of the soils, fertile layer protection and recultivation and closure monitoring expenses that are estimated to be AMD 254000000 are presented. Considering that all the reclaimed land parcels will undergo active care after closure the residual impact is evaluated as small and insignificant.
In order to prevent and mitigate the negative impact on the environment during the mine exploitation, ore heap leaching and gold extraction technological processes, an impact mitigation action plan and a plan for their monitoring were developed.

Expertise requirements

1. to be consistently guided by the legislative standards requirements enumerated in the protocol N 7/14 of the RA National Academy of Science Sevan Lake Protection Expertise Committee as of 24.02.2014 during the mine and leach facility stockpile construction, exploitation and closure
2. to carry out the protection and reproduction of Potentilla porphyrantha species of plant included in the RA Red Book in accordance with the agreement on "Transportation of New Population Individuals of the Plant Species Registered in the Red Book of Plants of the Republic of Armenia" signed by and between the RA Ministry of Nature Protection and Geoteam CJSC.
3. Two years before the mine closure to submit to the RA Ministry of Nature Protection the final plan for an environmental impact expertise in the established manner.

CONCLUSION

A positive conclusion is given on the report on the environmental impact assessment of the amended project for Amulsar gold-bearing quartzite deposit mining complex under the condition of mandatory fulfillment of the above stated expertise requirements.

Expert: */signed and sealed/* A. Minasyan