T I M E S L I M I T E D
TERRY I. MUDDER ENVIRONMENTAL SERVICES, LTD.

TECHNICAL STATEMENT REGARDING CYANIDE

RESPECTIVELY SUBMITTED BY :

Dr. Terry I. Mudder

RESPECTFULLY SUBMITTED TO :

Prime Minister Calin Popescu Tariceanu

Mr. Nicolaw Vacaroiu
President of the Senate

Mr. Bogdan Olteanu
President of the Deputies Chamber

and

The Government, Parliament, and People of Romania

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I. PROFESSIONAL QUALIFICATIONS

Thank you for affording an opportunity to express some personal and professional reflections surrounding the global use of cyanide in the recovery of precious metals. It is a privilege to submit these remarks to the Ministries, Government, and People of Romania in support of the use of the cyanide process for the recovery of precious metals.

I am Dr. Terry I. Mudder co-owner TIMES Limited, an environmental science and engineering firm located in Sheridan, Wyoming in the United States. I was formally a partner, office manager, and corporate consultant for Steffen, Robertson, and Kirsten, a respected international mining consulting firm. Prior to consulting, I served as Chief Environmental Engineer and Chief Research Chemist at the Homestake Mine in Lead, South Dakota, where I developed the first full-scale process for the microbial degradation of cyanide in mining wastewater. The full-scale process, which operated for nearly twenty years was featured in a biotechnology feature article in *National Geographic*.

I hold a Bachelor of Science degree in Chemistry from the South Dakota School of Mines and Technology, and a Master of Science degree in Organic and Analytical Chemistry and a Doctorate degree in Environmental Science and Engineering from the University of Iowa both located in the United States. I have over twenty-five years experience in the investigation of the analysis, chemistry, fate, monitoring, toxicity, and treatment of cyanide containing wastes and considered one of leading experts in the world.

I have served as adjunct professor, graduate student and thesis advisor, and quest lecturer at several colleges and universities in Australia, Canada, and the United States in the Departments of Biology, Chemistry, Civil Engineering, Environmental Engineering, Geology, Metallurgy, Soil Science and Reclamation. I have received the prestigious Guy March Medal from my Alma Mata, the South Dakota School of Mines and Technology, as an outstanding alumnus. I have also served on two university advisory boards including the Mine Life Cycle Center at the University of Nevada.

I have worked on over 200 mining and industrial projects on six continents and in several countries including Australia, Bulgaria, Canada, Chile, China, France, Ghana, Greece, Indonesia, Mali, Mexico, New Zealand, Peru, Romania, Russia, South Africa, Turkey, and the United States. Clients have included aboriginal peoples, citizen groups, mining companies, non-governmental organizations, and regulatory agencies.

I have had considerable experience in the public forum, including testimony at hearings, lectures to non-governmental organizations, keynote addresses at workshops and symposia, presentations at professional meetings, and as an expert witness in litigation.

I have written over eighty papers and given numerous technical presentations and lectures, many pertaining to the use of cyanide in mining. I have been involved with many short courses and workshops on cyanide, acid mine drainage, and reclamation held throughout the world.

I have co-authored over fifteen manuals, pamphlets, and books, including *The Chemistry and Treatment of Cyanidation Wastes*, *The Cyanide Monograph*, and the new CD entitled the *Cyanide Compendium*, all published by Mining Journal Books in England. These publications are considered standard reference texts used throughout the international mining industry on cyanide.

I have been instrumental in the development and application of many novel chemical, physical, and biological treatment processes for cyanide and metals, for which I have received both national and international awards, including the prestigious Philip Morgan Medal of the Water Environment Federation. I have received several worldwide patents for these processes as well. These processes include among others the original biological treatment process developed for Homestake Mining Company, the *Cyanisorb* Process for cyanide recovery from metallurgical circuits, and the *Biopass* System for passive in-situ treatment of spent heap leach pad solutions, waste rock drainage, and tailings impoundment seepage.

I am and have been the member of many national and international scientific organizations and associated professional committees including the American Chemical Society, Standard Methods for the Examination of Water and Wastewater, the American Water Works Association, the Water Environment Federation, and the American Society for Testing of Materials. I have served as a peer reviewer of manuscripts submitted for publication in professional journals including *The AIME/SME Mining Journal* and the ACS publication *Environmental Science and Technology*. I am a frequent editorial contributor and Technical Advisor to *Mining Environmental Management* and a member of the Editorial Board of the new *Journal of European Mineral Processing and Environmental Protection.* I co-created and maintain the only free Internet website dedicated to providing technical information on cyanide located at www.cyantists.com.

I also created and co-sponsored the *Dr. Adrian Smith International Environmental Stewardship Award* given to outstanding individuals for lifetime achievement in the area of environmental stewardship in the mining industry. I have provided expert advice to the International Council on Metals and the Environment (ICME) and The Gold and Silver Institutes. I have been a technical advisor and consultant to not only to industry and academia, but also to the International Cyanide Management Institute, British Columbia Ministry of Environment, Canadian Public Works, the Canadian Department of Indian Affairs and Northern Development, Environment Australia, the Peruvian Environmental Protection Service, the United States Environmental Protection Agency, the United States Forest Service, various State and Provincial regulatory agencies, the United Nations Environmental Program, and the World Bank Group and International Finance Corporation on issues related to global cyanide management.

I also co-sponsored a cyanide workshop for the prestigious scientific delegation responsible for preparation of the TUBITAK report to the Turkish government regarding the use of cyanide in mining in the country and at the Ovacik mining operation.

II. AN INTERNATIONAL PERSPECTIVE OF CYANIDE

With world population growing and nations developing rapidly, the risk of environmental mishaps increases as industry supplies the needs of expanding economies. The issues and concerns raised by the public regarding impacts of this risk are real and justified. Nonetheless, the forces of nature coupled with the imperfections of humans do not allow us to live on a risk free planet, and we must learn to balance benefits and impacts.

I have been associated with the use of cyanide in the mining industry worldwide for over a quarter of a century and in my career and travels have been involved with and seen all sides of the mining industry. Mining of minerals and metals is essential to the prosperity and quality of life of people in both established and developing nations. Minerals and metals provide the basic infrastructure of our global systems of education, health, communication, transportation, commerce, and defense. The establishment of basic industries like mining in a developing nation can provide the economic foundation for prosperity and hope for a better life.

However, the inherent value of mining does not justify disregard for the rights of people or protection of the environment. Since humans manage the mining industry, and at times either disregard their social and legal responsibilities or accidents inadvertently occur, civil and criminal laws and penalties have been enacted and enforced. Taken collectively, the European Union and individual Eastern European countries numerical narrative standards for cyanide in air, tailings disposal facilities, and surface waters are amongst the most stringent in the world and highly protective of humans and the environment.

Whether or not mining in general should be allowed is not debatable from a practical viewpoint, since humans have been using metals and minerals extracted from the Earth for many millennia and will continue to do so for many more. Globally, there is a struggle to define sustainable development and manage limited resources, while the demand for metals and minerals increases rapidly along with the number of mines.

Recycling of metals and minerals is effective only to a point, so exploration continues into less developed more remote, and sometimes more pristine areas within the world. Clearly, there are mineral deposits, the development of which is neither economically nor environmentally justifiable. Through the well-established economic feasibility and environmental assessment process, marginal mineral deposits can be identified and eliminated from further consideration. The environmental assessment process was designed to allow public scrutiny and input into proposed mining projects.

In the case of precious metals, cyanide has been used at hundreds of mines for over a century to aid in the recovery of gold, through the well-known process of cyanidation. This process is well established and is used in the recovery of about ninety percent of the gold worldwide.

Although the mining industry has spent many millions of dollars over many years pursuing alternatives to cyanide, at present there is no substitute more effective, easier to use, less costly and safer from an environmental and human health standpoint. Other than cyanide, four other alternative chemical extraction systems have been studied extensively over several decades. These include thiourea, bromine-bromide, chlorine-chloride, and ammonium thiosulfate. None of these systems exhibit a set of comprehensive environmental, economic, and metallurgical characteristics superior to those associated with cyanide. Therefore, none of these processes have found widespread use or support by governments, industry, academia, or other organizations.

Regardless of the perceived or real risks associated with cyanide used by the established and regulated mining companies, it is far superior and safer for society than the impacts that can arise from direct smelting or the use of mercury amalgamation employed in the recovery of gold by hundreds of thousands of unregulated artisanal small scale miners.

There are nearly endless rumors and unsubstantiated reports published in newspapers and on the Internet regarding the dangers associated with cyanide. Unfortunately, one country has decided it was prudent to ban the use of this important industrial chemical.

In South America, there are isolated situations in which municipalities have placed restrictions on the transport of cyanide and countries have placed restrictions on specific mining practices, such as heap leaching. There is also a partial ban of the use of cyanide in the State of Montana in the U.S. in situations where open pit mines are proposed in conjunction with heap leaching. The partial ban was the result of a referendum aimed at stopping one particular mining project. Ironically, the cyanide ban does not apply to operations utilizing underground mining, tailings disposal facilities, or conventional cyanide extraction processes. No bans on the use of cyanide in the mining industry exist in the countries of Greece and Turkey as often quoted.

The controversy surrounding mining has recently focused upon the gold industry and the use of cyanide. The fear of cyanide arises from several historical sources. It is this fear that is sometimes exploited to generate negative public sentiment against mining. If cyanide is used improperly, it is toxic to humans and the environment. There is no question regarding this matter. However, the same statement applies to common household products like bleach, which contain chlorine, a chemical nearly as toxic as cyanide. Fatal accidents in and around the home and while in a vehicle far exceed those associated with industrial cyanide exposure, yet these risks are deemed acceptable.

Some believe the banning of gold mining would eliminate the need for cyanide. On the contrary, the vast majority of cyanide is used in the manufacture of products like plastics and pharmaceuticals. Although the specific quantity varies from year to year, typically only about ten percent of the total cyanide produced globally is used in mining. Products generated from cyanide are in ever increasing demand around the world. The benefits of cyanide are many and its products are used safely each day by hundreds of millions of people. There are no suitable chemical substitutes available for cyanide and its elimination would in turn hinder the progress of people in developing countries and emerging nations seeking a better life and higher standard of living. People do not, will not, and cannot live in a risk free environment. Risk free environments do not exist and cannot be mandated or legislated.

Although precautions are taken in the design and operation of a mine to prevent environmental impacts and mishaps, they do occur. Specifically in the gold mining industry, the most notable recent event was the release of cyanide and metals containing solution from the tailings impoundment at the Aurul Mine near Baia Mare in Romania in the year 2000.

Based upon published information by international investigation teams, apparently three basic principles of environmental management were ignored. First, there was apparently no detailed water balance and management plan for the mine. Second, excessively high cyanide concentrations were allowed in the tailings solution. Third, there was apparently no dedicated treatment facility capable of quickly reducing the cyanide and metals levels within the stored tailings solution. A review of environmental incidents involving the mining industry reveals the three primary causes include transportation accidents, breaches in solution conveyance systems, and tailings dam mishaps. Additional focus on these three aspects of a mining operation through implementation of a comprehensive environmental management system can reduce the risk of an incident to negligible levels.

The total number and magnitude of impacts of such incidents involving cyanide are quite small in comparison with the environmental disasters caused by nature and other industries worldwide. The real risks arising from driving a vehicle are much greater than the perceived ones associated with the use of cyanide.

By having a proper water management and treatment system, and by maintaining cyanide levels in the tailings solution at those being proposed by the European Union, the impacts of the regrettable and irresponsible incident in Romania could have been prevented or at a minimum dramatically reduced.

Some people conclude industry, as a whole, should be halted due to occasional inadequacies of an industrial facility leading to an environmental mishap. Although we do not have to apologize for the existence of risk, we do have to take responsibility for ignoring it.

There is an ethical and moral requirement to quantify and communicate the level of risk to workers and the public. By acknowledging and being aware of risks the proper level of emergency preparedness and response can be implemented thereby either avoiding accidents or dramatically reducing their severity.

There is an overwhelming technical knowledge base related to the various scientific and engineering aspects of cyanide. Literally thousands of literature citations exist on the subject of cyanide, which have appeared in hundreds of publications around the world. Cyanide has been studied equally to or more than any other chemical known to humans. The analysis, toxicity, environmental fate, and treatment of cyanide have been studied extensively by scores of researchers. There is sufficient technical information to use this chemical safely in mining. This knowledge extends to the compounds related to and associated with cyanide found in metallurgical process solutions.

The toxicologically significant forms of cyanide can be measured accurately and reliably down to environmentally important levels employing one or several analytical methods. The toxicity of cyanide in its various forms is very well understood and appropriate numerical standards and guidelines can be and have been promulgated throughout the world for the protection of workers, the public, and the environment.

The fate of cyanide once it enters the air, water, or soil environment has been studied in detail through modeling and monitoring over the past two decades. There are many proven chemical, physical, and biological treatment systems employed worldwide that can remove or recover cyanide down to environmentally acceptable levels.

Cyanide can be manufactured, transported, stored, used, and disposed of safely if proper scientific principles are followed and engineering procedures applied. Chemical suppliers exist that adhere to international standards of care with many decades of experience in producing cyanide. Gold mines using cyanide can be designed, built, operated, and closed without severe long term environmental impacts.

As a comparison, there are literally hundreds of documented natural sources of cyanide. Of particular importance is the cassava plant, which is a food staple for hundreds of millions of people living within the equatorial regions of the planet. This plant contains very high levels of natural occurring cyanogenic glycosides, which can release acutely toxic levels of cyanide if improperly prepared and consumed. The resulting affliction is called Konzo, which results in the partial paralysis of the limbs, particularly the legs. Konzo is most prevalent amongst young children with thousands of documented cases, creating a human health issue more deleterious than caused by use of cyanide in the mining industry.

Manmade cyanide is also indiscriminately introduced into the environment in massive quantities through discharges from municipal wastewater treatment plants and vehicle exhaust. Iron cyanide is used as anti-caking agent in table and road salt, an anti-corrosion agent in fir retardants, and in cosmetics.

In order to address growing environmental concerns surrounding cyanide management, the United Nations Environmental Program (UNEP) hosted a workshop in Paris in May 2000 to address the issue of creating a voluntary international code for management of cyanide at gold mining operations. Attending the workshop were over forty delegates from government agencies like the USEPA, non-governmental organizations like World Wildlife Fund for Nature, global cyanide producers, several international mining companies, and technical experts.

I was fortunate to be among the invited guests as a leading technical expert and to provide a global perspective on cyanide and the environment to the delegates. The consensus of the multi-stakeholder group was cyanide is a valuable chemical and support of its continued use in gold mining is acceptable as long as operations develop a comprehensive management plan to safe guard human health and minimize the potential risk of environmental incidents and impacts.

The International Cyanide Management Institute (ICMI) was formed along with an industry voluntary Cyanide Code that has support of many major mining, cyanide producing, and transportation companies throughout the world.

Adherence to the principles and standards contained in the cyanide code coupled with independent auditing and certification would reduce the risk of cyanide related environmental incidents to a negligible level. The Rosia Montana gold mining project proposed by Rosia Montana Gold Corporation and its parent company Gabriel Resources would be certified under the Cyanide Code and develop a comprehensive chemical management plan that adheres to its stringent principles and standards. Beyond the Cyanide Code itself, new mining projects must follow the more stringent EU tailings disposal guidelines for residual cyanide levels.

Although regrettably slow in its inception and implementation, ICMI has made tremendous progress attacking cyanide producers, transporters, and users to the Cyanide Code. To date ICMI has secured fourteen mining companies, eight cyanide producers, and seven cyanide transporters as signatories in a total of twenty-nine countries. Eighty-seven gold mining operations are slated for certification in over twenty countries. As of this statement over twenty gold mining operations have been certified in a half dozen countries. Since the original UNEP meeting in May 2000 thankfully there has been no major cyanide related incident in the world for over seven years.

The realistic issues and concerns raised by concerned citizens regarding mining can be dealt with and managed in a manner compatible with sound environmental principles and practices. The risks associated with cyanide and mining can be measured, monitored, and minimized to an acceptable degree.

However, if the mishaps associated with cyanide have been of such magnitude to discontinue its use, imposing an identical measure of acceptable risk on other companies would surely eliminate many valuable industrial processes exhibiting much greater adverse impacts to the environment.

The much greater devastation of natural disasters would continue nonetheless. It is necessary to put into perspective the potential benefits and impacts on our lives from particular industries and from nature itself.

There are risks associated with the use of cyanide as exist with nearly all industrial processes and in our daily lives. The key to using cyanide safely is to recognize the risks and minimize them through abatement, preparedness, and communication. The primary risks associated with the use of cyanide in mining involve potential exposure to workers or a release into the environment.

Therefore, it is necessary to develop a proper plan to manage, monitor, and minimize its use. The important aspects of that plan include a focus on transportation from supplier to site, onsite storage and handling, solution conveyance, treatment and disposal, process and environmental monitoring, emergency preparedness and response, risk communication, and worker safety and health.

It is sincerely hoped the information provided herein will provide the People of Romania a balanced and renewed perspective about the benefits of cyanide when used prudently and properly. The banning of cyanide and curtailing of its use will not eliminate the many risks people are exposed to and must cope with every day. Clearly, the benefits of cyanide outweigh its detriments, and our society and lives would be adversely affected without it and its useful products we rely upon every day.