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Consulting, Inc.

Review of La Oroya Smelter

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Prepared for: King & Spalding LLP in the Matter of an Arbitration Under the Rules of the United Nations Commission on International Trade Law

Dr. Eric Partelpoeg, Ph.D.

Prepared by
Eric Partelpoeg of EHP Consulting, Inc
eric@ehp-consulting.com
+1(520) 615-4030
Tucson, Arizona 85718

1.0 BACKGROUND

I have been retained by King & Spalding, LLP to evaluate efforts by Doe Run Peru (DRP) to upgrade and modernize the La Oroya Metallurgical Complex (the Complex or CMLO, for its Spanish initials—"*Complejo Metalúrgico La Oroya*"); the timeframes for those upgrades imposed by the Government of Peru; and the relative standards and practices of DRP, which operated the CMLO between 1997 and 2009, as compared with those of the State-owned company *Empresa Minera del Centro del Perú* (Centromin), which operated the facility from 1974 to 1997.

My opinions are based on a review of documents describing the CMLO and the process undertaken by DRP to upgrade the facility, as well as my personal inspection of the CMLO in 2006 while serving on an expert panel assembled by the Peruvian Ministry of Energy and Mines (MEM) tasked with evaluating DRP's request for an extension of time to complete certain necessary improvements.

My opinions are also based on my education and professional experience that has focused on the study and implementation of smelting technologies and smelting industry practices. I am currently the Principal at EHP Consulting, Inc., located in Tucson, Arizona. I have more than 30 years of experience working in pyrometallurgical industries that include copper smelting, zinc roasting, molybdenum roasting, smelter off-gas systems, and acid plants. During my career, I have worked at smelters in Canada and the United States, and I have also visited and inspected smelters in Asia, Africa, Australia, Europe, and South America. I hold Bachelors and Masters Degrees in Engineering from McGill University, and a doctorate in Metallurgical Engineering from the University of Arizona. I am the author or co-author of several technical papers and one book relating to smelting technologies and smelting industry practices. These publications are listed in my curriculum vitae, which is attached as Appendix A.

2.0 SUMMARY OF OPINIONS

1. At the time Centromin transferred the CMLO to DRP, critical equipment installed at the facility was inappropriate for use in a smelting facility that was required to reduce its emissions to meet modern emission limits and air quality standards. In particular, the copper circuit was sub-standard and outdated—this circuit could not be updated to comply with emissions reduction requirements and would require a complete replacement. This required DRP to undertake a complex project to design and replace the copper circuit equipment, which was not identified in the PAMA. The lead and zinc circuits required significant upgrades and the design and installation of new emission control equipment.
2. DRP acted reasonably and appropriately in its efforts to upgrade and modernize the CMLO. Due to the complexity and condition of the CMLO facility, I agree with the 1996 Knight Piésold opinion that more than 10 years was required to accomplish the goals of the PAMA.
3. Due to its complexity, the copper circuit replacement was inherently a multi-year project and it is not surprising that additional time was needed to complete the project. DRP requested a project extension in 2006 and was granted this relief. I visited the CMLO in 2006 and had the opinion then, and continue to have the opinion, that the scope of the copper circuit replacement was significant and that even a 2009 completion date was aggressive.

4. The global economic crisis of 2008-2009 severely impacted the mining and metals industry and in particular the capital projects that were underway or planned by these companies. This event understandably impacted DRP's ability to execute the copper circuit replacement and construction of the copper circuit acid plant in the time provided.
5. DRP's 2009 request for an extension of time to complete the copper circuit replacement and construction of the copper circuit acid plant was reasonable due to the parallel PAMA and other projects and upgrades that DRP was conducting and the extraordinary conditions in which these projects were being performed.
6. DRP's standards and practices were significantly more protective of the environment and public health than those used by Centromin between 1975 and 1997.

3.0 REPORT ORGANIZATION

The purpose of this report is to provide my opinions on the condition of the CMLO and the plans and execution of projects that DRP carried out to reduce emissions. To establish the basis for these opinions, the report is organized as follows:

Section 4: This section of the report introduces the basics of smelter operations and their emissions. A brief overview of copper, lead, and zinc technologies is provided.

Section 5: This section of the report describes the CMLO operations as acquired by DRP in 1997. The condition of the operations is described, particularly with respect to emission sources.

Section 6: This section of the report describes the improvement projects that DRP undertook to modernize the facilities, increase the efficiency of pollution control equipment, and decrease smelter emissions.

Section 7: This section of the report summarizes the standards and practices of the DRP operations and compares them to the CMLO operations under Centromin. This section will also include the opinions that I formed during my site visit to the CMLO in 2006.

Section 8: This section reviews the reasonableness of DRP's requests for PAMA project extensions. My opinions on this reasonableness are drawn from the reviews and observations presented in the earlier sections of this report, as well as project specific issues and challenges.

Section 9: This section summarizes my conclusions and opinions.

4.0 INTRODUCTION TO SMELTER TECHNOLOGY, OPERATIONS AND EMISSIONS

This section of the report provides a general introduction to copper, lead, and zinc production. This background information is important to gain a perspective of the relative levels of effort that was required by DRP to update the CMLO smelting technologies (for copper, lead, and zinc) to achieve the PAMA targeted emission limits.

Smelters produce metals (e.g. copper, zinc, and lead) from minerals that contain other elements. One of the predominant elements in these minerals is sulfur; hence the minerals processed at smelters are referred to as sulfide minerals. Smelters separate the sulfur from the mineral as sulfur dioxide (SO_2). Prior to the DRP modifications discussed in this report, most of the SO_2 at CMLO was released to the atmosphere. The other major impurity in the minerals is iron; the iron is separated from the metal as an iron oxide slag.

4.1 SMELTER EMISSIONS

Smelter gaseous emissions can include gas components such as sulfur dioxide (SO_2) and particulates (such as lead, arsenic, silica, or other pollutants). Particulate emissions are typically associated with uncontrolled SO_2 emissions (although there can be particulate emissions without an associated source of SO_2). There are three categories of smelter gaseous emissions:

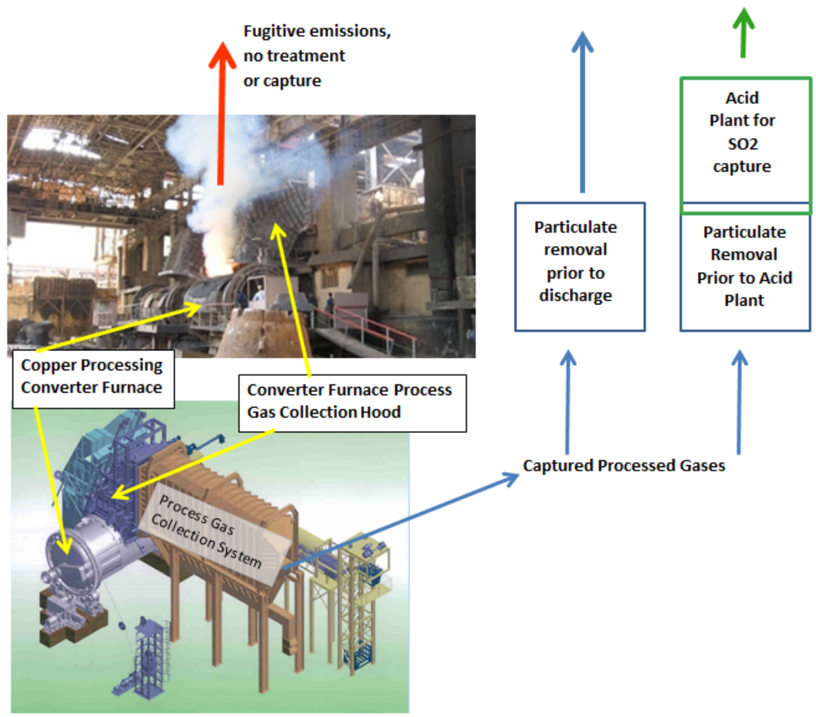
1. Category 1. Uncontrolled low level fugitive emissions that are not captured by smelter process equipment. These emissions drift from the smelter and enter the surrounding areas. Uncaptured fugitive emissions are the most egregious of the emission types because they are not treated by pollution control equipment, and because they can result in very high concentrations of pollutants at ground level.

2. Category 2. Stack (or chimney) emissions that are captured at the smelter and then typically treated to capture some or most of the particulates prior to their discharge from the stack. Typical treatment equipment to capture particulates includes Cottrells (electrostatic precipitators) and fabric filter baghouses. Gases (such as SO_2) and the uncaptured portion of the particulate emissions are emitted from the stack where they are dispersed.

3. Category 3. Emissions that are captured and efficiently processed to remove all of the particulates and more than 95% of the SO_2 by processing the flow through an engineered control system such as a sulfuric acid plant.

Figure 4-1 shows examples of these three emission categories. In this example, the top photo shows uncaptured fugitive emissions that are released from a copper converter (Category 1). The bottom schematic shows that copper converter process gases can be captured and partially processed by only particulate removal (Category 2), or fully processed by particulate removal followed by SO_2 capture in an acid plant (Category 3).

Figure 4-1 Schematic Representation of Emission Destinations



In the first half of the 20th century, SO_2 produced in smelters was typically allowed to escape into the atmosphere without a concerted effort to recover the SO_2. Towards the end of the 20th century (from the 1970s on), however, it was recognized that these emissions would have to be reduced. In order to reduce SO_2 emissions, smelters modernized their processes to increase the SO_2 concentration from 1-2% SO_2 (which could not be recovered) to a more concentrated stream of SO_2 (6-25% SO_2), which is amenable to capture and subsequent recovery as sulfuric acid.

The following sections of the report discuss copper, lead, and zinc processing with an emphasis on how the processing technology affects smelter emissions.

4.2 COPPER SMELTING

The overall copper process is shown in Figure 4-2; this block diagram also shows the sulfuric acid plant that processes the sulfur dioxide generated in the roasting and converting steps. The production of sulfuric acid from a copper smelter requires smelter process gas with an SO_2 concentration in the range of at least 6-10% and a relatively even flow of process gas.

Matte is the product of the primary copper smelting furnace; it is a molten solution of copper, iron, and sulfur, as well as some impurity elements (such as lead and zinc). Matte is categorized by its copper content, or its “grade”. A 30% copper matte grade refers to matte with only 30% copper. Note that the smelting process shown in Figure 4-2 shows that copper matte is produced with a wide range of copper content (30-80% copper)[1]. The matte grade from a smelting furnace is largely determined by the type of smelting furnace that is used. Table 4-1 summarizes typical characteristics of the various smelting furnace types. There are very few old technology reverberatory furnaces in operation due to their characteristic of requiring high fuel input and due to their generation of high volume, low SO_2 concentration off-gas that is not amenable for treatment in a sulfuric acid plant. Most modern copper smelters employ either flash smelting technology or lance/bath smelting technology (for example Isasmelt technology).

Figure 4-2 Overall Copper Circuit Block Diagram

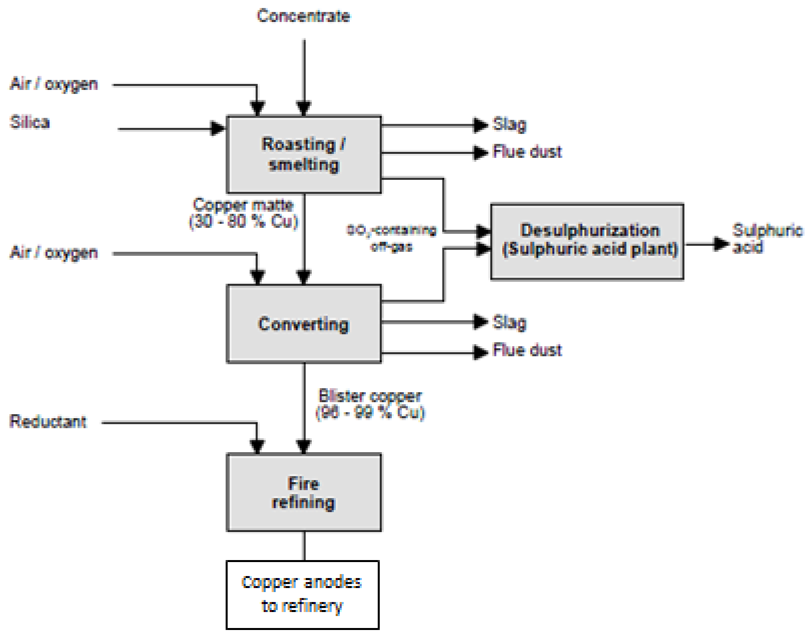


Table 4-1 Summary of Smelting Furnace Technologies

Smelting Furnace Technology	Fuel Requirement	Pure Oxygen Input	Furnace Off-Gas Volume	Typical Matte Grade	Furnace Off-Gas SO_2 content	Off-Gas Amenable as Input to Acid Plant
Reverberatory furnace	High	None to medium	High	30-40%	Low	No
Electric Furnace	None	None	Low	30-40%	Low	No
Flash furnace	Low to none	Medium to High	Low	58-70%	15-40%	Yes
Isasmelt (Lance-bath smelting)	Low to none	Medium to High	Low	58-65%	15-40%	Yes

[1] While Figure 4-2 shows the upper range of matte grade at 80% copper, the typical maximum grade associated with modern smelting technologies in common use is 70% copper; hence Table 4-1's limit of matte grade is 70% copper).

Matte is transferred from the smelting furnace to the converters, which remove the balance of the iron and sulfur by blowing air into the molten matte. The converting process is prone to high levels of fugitive emissions (see Section 5.1.3 and Figure 5-1 below). To minimize a copper circuit's dependence on converters, modern smelting technologies produce higher grade matte (typically 60%) compared to the 30% copper that is associated with old smelting technology like reverberatory furnaces.

Figure 4-3 shows block flows and qualitative emissions associated with old-technology reverberatory furnace copper smelters and Figure 4-4 shows the flows and emissions associated with modern copper smelters. As the figures indicate, modern copper smelters inherently have lower levels of fugitive emissions and they produce a process off-gas that is amenable to recovery of SO_2 as sulfuric acid.

Figure 4-3 Block Flows and Qualitative Emissions from Old Technology (Reverberatory Furnace) Copper Smelters

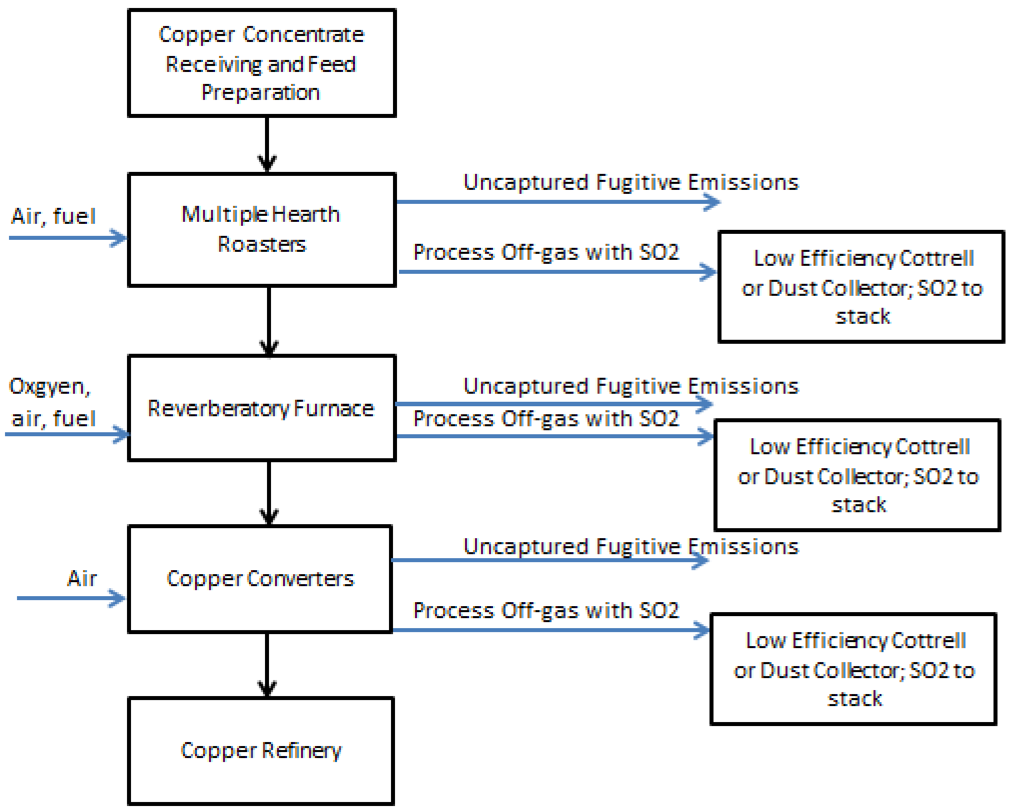
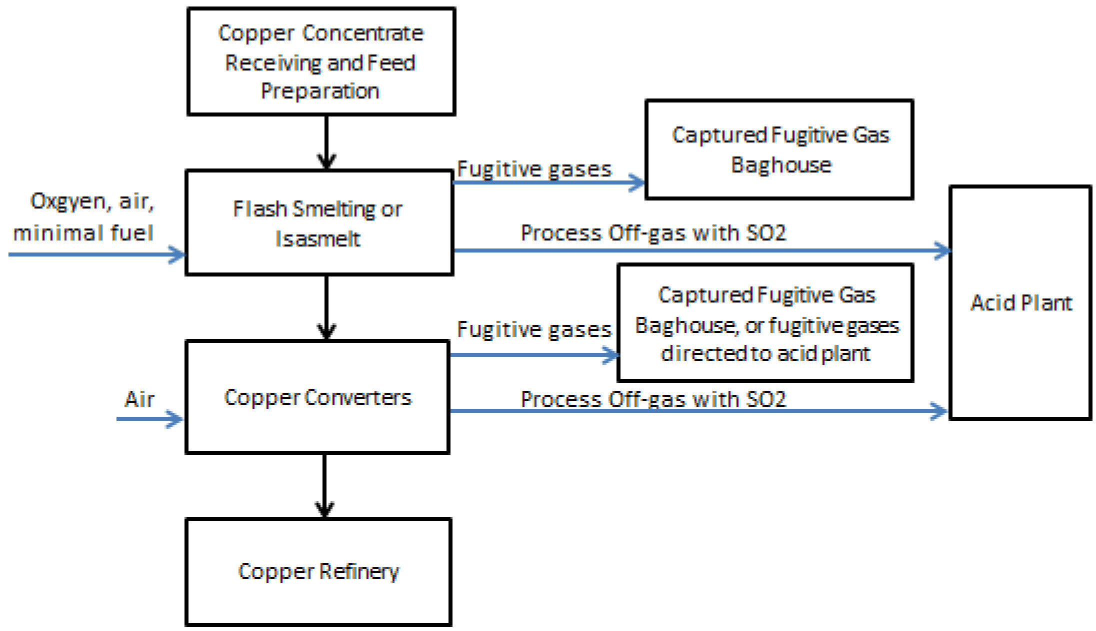


Figure 4-4 Block Flows and Qualitative Emissions from Modern Copper Smelters



4.3 LEAD SMELTING TECHNOLOGY

Lead smelting technology has advanced to a lesser degree than copper smelting technologies. The two major steps in producing lead are:

1. Sintering of lead concentrate. This involves the feeding of heated lead concentrate onto a perforated metallic conveyor belt. As the lead feed progresses through the conveyor, air is blown through the belt's perforations to react with most of the sulfur in the concentrate and generate SO_2. The sinter machine product is a solid pebble sized lead oxide that progresses to the lead blast furnace.

2. Smelting of the sintered machine product. The sinter product is fed to a blast furnace where the lead oxide is reacted with carbon to produce lead metal. Impurities are removed as slag.

Figure 4-5 shows the block flow diagram of lead sinter / blast furnace technology with limited pollution control equipment. In this case, the air injected into the sinter machine exits from a central gas off-take. The total sinter machine off-gas is too dilute in SO_2 to enable its conversion to sulfuric acid. Without effective enclosures and pollution control equipment, fugitive emissions from the blast furnace area can result in low level emissions of lead fumes to the smelter area with the potential for these emissions to drift beyond the smelter property.

Figure 4-5 Lead Sinter / Blast Furnace Technology with Limited Pollution Control

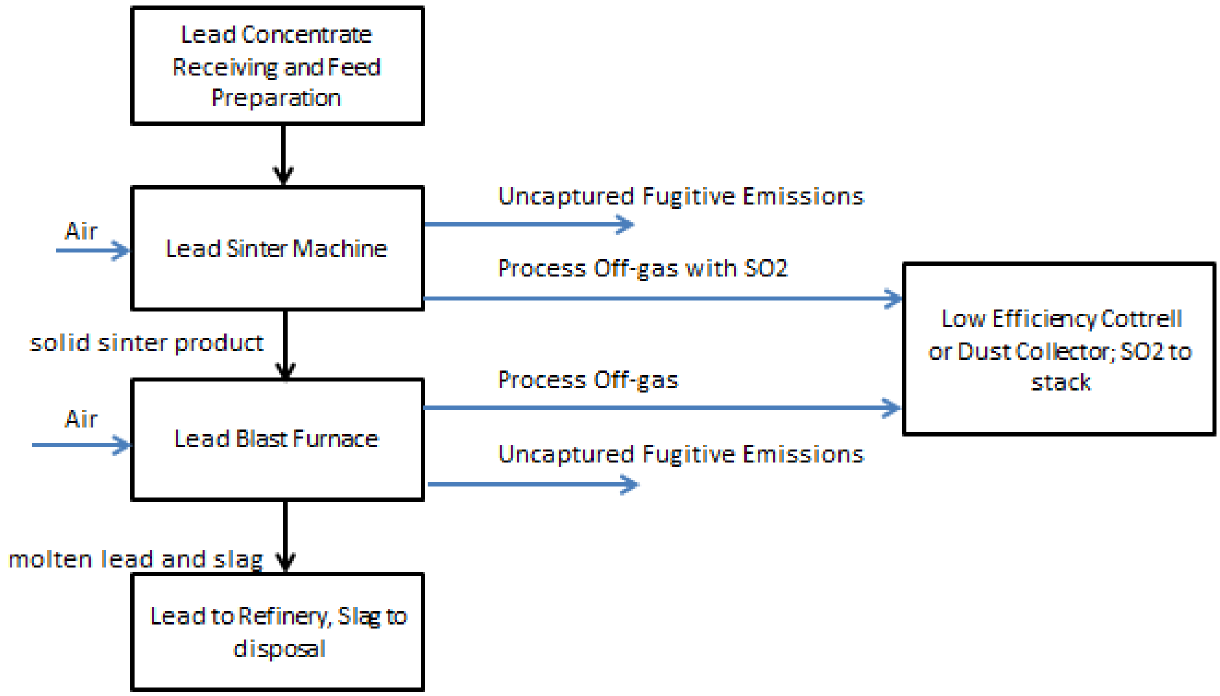
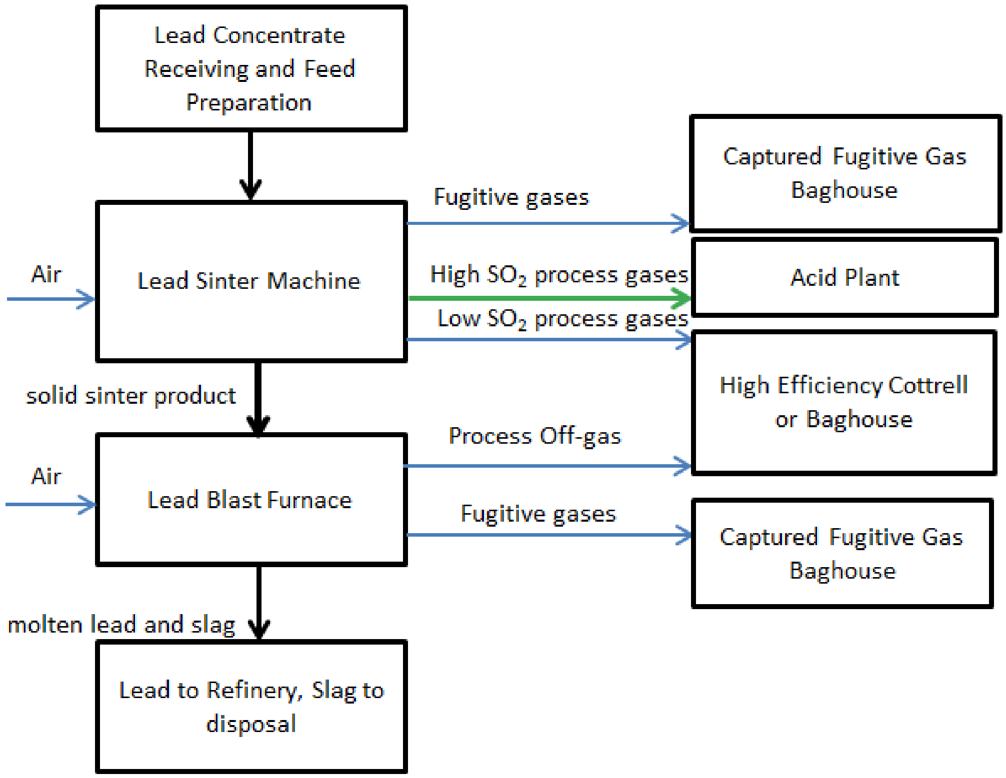


Figure 4-6 shows the block flow diagram of a lead sinter / blast furnace that has been modified to include modern pollution control equipment. In this case the sinter machine air supply and gas off-take is modified to create two process off-gas streams. Most of the SO_2 is removed through a low gas flow with sufficient SO_2 concentration to enable its treatment in an acid plant. A small portion of the SO_2 remains in a second off-gas stream, which is cooled and particulates are removed (by, for example, a baghouse) before discharging to a stack. Figure 4-6 also shows that sinter machine and blast furnace fugitive emissions are captured and processed through baghouses to remove particulates and lead fumes.

Figure 4-6 Lead Sinter / Blast Furnace Technology with Pollution Control



While other lead production technologies have been developed, the predominant method of lead production today is still based on sinter machines and blast furnaces. Since the discussion of other lead production technologies is not relevant to this case, they are not discussed in this report.

4.4 ZINC EXTRACTION TECHNOLOGY

Fluid bed roasting of zinc concentrates was developed in the 1950s and remains the technology of choice for the conversion of zinc sulfide concentrates to zinc oxide. The technology consists of feeding zinc concentrate into an enclosed roasting vessel that blows air into the roaster through a perforated plate that is installed at the bottom of the roaster. The design of the roaster is based on selecting the appropriate air velocity in the roaster to effectively suspend the zinc concentrate particles to ensure efficient oxidation.

The off-gas of fluidized bed zinc roasters typically contains 8-10% SO_2 which is amenable to acid production. Since the mid-20th century, most zinc roasters have had an associated acid plant to recover SO_2 (although a few facilities operated roasters without acid plants to recover the SO_2). Older installations with acid plants require ongoing maintenance and periodic replacement of major components to ensure their continued efficient operation. Figure 4-7 and Figure 4-8 show the basic flows of zinc roasters with and without an acid plant. Turbulent layer roasters (TLR) are a specialized type of fluid bed roasters. These types of roasters are often used in zinc processing.

Figure 4-7 Typical Zinc Fluid Bed Roaster Block Diagram without Acid Recovery

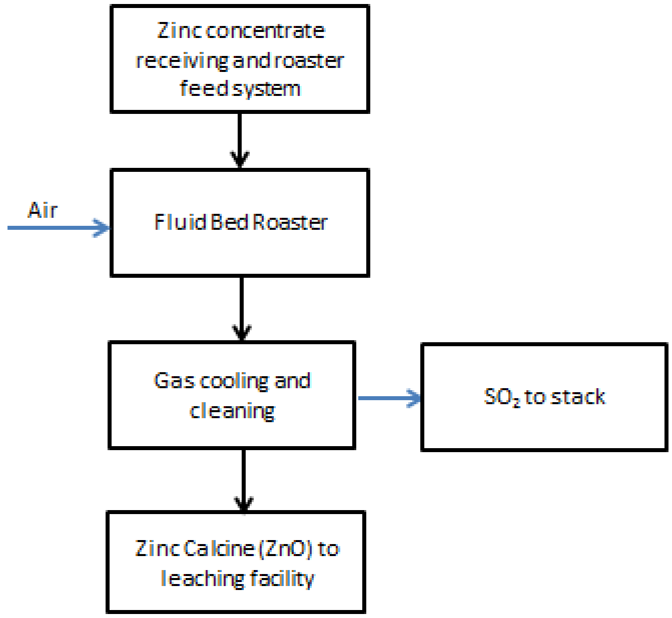
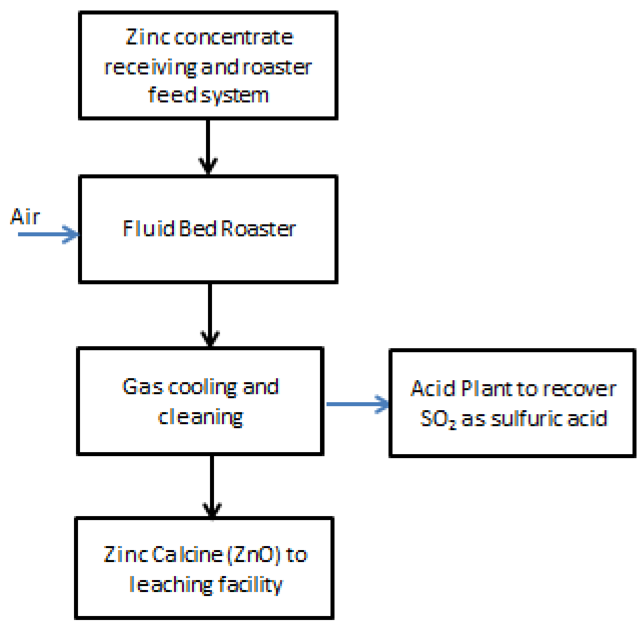


Figure 4-8 Typical Zinc Fluid Bed Roaster Block Diagram with Acid Recovery



5.0 CMLO OPERATIONS UNDER CENTROMIN

The CMLO is a pyrometallurgical and refining facility that processes complex poly-metallic mineral concentrates produced primarily at mines located in the central Andes region of Peru. The CMLO consists of two primary components: a pyrometallurgical, or smelting, complex located on the banks of the Mantaro River and a refining complex located about 2 km away on the banks of the Yauli River.

The CMLO utilizes three primary “circuits,” as well as other processes, to smelt and refine different mineral concentrates to produce copper, lead, zinc, and other valuable non-ferrous metals (i.e., metals other than iron). This report focuses primarily on the technologies used to extract copper, lead, and zinc, which are the primary metals produced at the Complex. Other circuits such as the silver and precious metal circuits are important to CMLO but these are not discussed here due to their relative low contribution to emissions (although DRP addressed many of these emission sources as well).

The following sections provide an overview of the technologies and conditions of the CMLO facility while under Centromin control.

5.1 COPPER CIRCUIT THROUGH BLISTER COPPER

The Centromin era copper circuit was essentially identical to the copper circuit without pollution control equipment described in Section 4.2 and shown in Figure 4-3. Equipment was old and outdated. The following pages provide a brief overview of the system.

5.1.1 Feed Preparation and Handling

Feed (the concentrates and other materials fed into the smelting process) preparation and handling occurred in an open area of the smelter facility. Feed was delivered by trucks that would transfer copper concentrate from local mines in the area. There was no system to clean the undercarriage or tires of these trucks, which led to copper concentrate contamination from the feed system to the roads within the smelter complex and to the public roads leading to the smelter.

5.1.2 Smelting Technology

The primary smelting facility consisted of multiple hearth roasters followed by a reverberatory furnace. The multiple hearth roasters were fuel-fired; their purpose was to dry the concentrate, oxidize some of the sulfur in the concentrate, and to remove arsenic as arsenic trioxide. The off-gas from these types of roasters is high in volume and low in SO_2 concentration making it unsuitable for conversion to sulfuric acid.

The roaster product, or calcine, progressed to the reverberatory furnace where the calcine was melted. The furnace was heated by oxygen-enriched fuel burners. The reverberatory furnace produced:

1. Molten “matte” that contained most of the input copper. The copper content of the matte was relatively low (approximately 30% copper). The balance of the matte was predominantly iron and sulfur along with some impurity elements. The molten matte was transferred into ladles and overhead cranes then transferred the matte to the copper converters.

2. Molten "slag" that contained iron oxide, silica, some of the feed's impurity elements and minimal copper. The slag was transferred out of the furnace where it is quickly frozen by water sprays into small granules. The granulated slag was removed from the smelter area and stored in stockpiles.

3. An off-gas that contained sulfur dioxide, and the combustion products of the burner system used to heat the furnace. The off-gas also contained particulate matter and some of the volatile elements that entered the furnace with concentrate. This off-gas was high in volume and low in SO_2 concentration and was not suitable for further processing in a sulfuric acid plant.

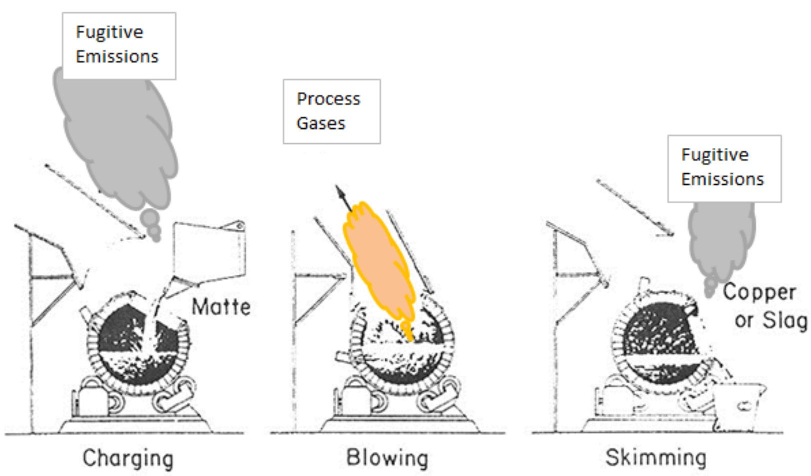
5.1.3 Converting Technology

The matte produced in the reverberatory furnace was further processed in converting furnaces (converters). The molten copper-iron-sulfur matte had air blown into it. Silica flux was added to combine with the iron as it became oxidized by the air. The iron oxide – silica mixture became a slag that was periodically removed from the converter. The converters produced a "blister" copper that was approximately 98% pure copper. The copper was transferred to ladles for further processing.

The operation of a converter is a batch process; Figure 5-1 shows the major steps:

1. Matte is transferred from the reverberatory furnace in ladles. This transfer releases fugitive emissions.
2. Once sufficient matte has been added to the converter, air is blown into the molten bath and the converter is rotated to direct the off-gases into a hood. During the Centromin era, these gases were treated through an old Cottrell (a type of electrostatic precipitator that is designed to remove particulates from the gas) prior to discharge to the stack.
3. Periodically slag produced in the converter is removed by rotating the converter to enable the slag to pour into a ladle. During this operation, fugitive emissions are released to the atmosphere.

Figure 5-1 Batch Steps Associated with Matte Converting



Due to the low grade matte (30% copper) produced by the reverberatory furnace, the smelter relied on the converters to remove the bulk of the iron and sulfur and accordingly, five converters were installed at the CMLO. The processing activities associated with converting were the largest source of copper circuit fugitive emissions.

By the 1980s, most copper smelters worldwide using the equipment employed at the CMLO had already been shut down or upgraded with more modern technology. In all but a few cases, these upgrades occurred in the 1970s or earlier. The installed copper circuit at CMLO was totally inappropriate for a smelter that required the capture of sulfur dioxide emissions.

Table 5-1 shows the 1995 status of Latin American smelters which lagged behind other smelters worldwide in phasing out reverberatory furnace technology. The column on the right shows the percentage of input sulfur that was not emitted as SO_2. This table shows that the CMLO lagged behind even other smelters in Latin America, most of which were operating sulfur recovery acid plants. In fact, even the 22% capture figure for the CMLO is misleading as this reflects CMLO SO_2 recovery actually associated with the zinc circuit—there was effectively no SO_2 recovered from the CMLO copper circuit when DRP acquired the complex.

Table 5-1 Copper Smelter By-Product Acid (EPD 1996—data from 1995)

Table 9: Copper Smelter By-Product Acid - Latin America

Plant	Country	Smelter type	Blister Cu Production ('000t)	Acid/ Copper Ratio	Acid Production ('000t)	Sulphur Capture %S
Dias d'Avila	Brazil	Outokumpu flash	130	2.42	411	92
Caletones	Chile	Reverb/El Teniente	353	0.07	25	5
Chagres	Chile	Outokumpu flash	80	1.34	107	77
Chuquicamata	Chile	Outokumpu flash	440	2.52	1143	79
La Negra	Chile	Reverberatory	85	0.82	70	55
Las Ventanas	Chile	Reverberatory	116	0.95	200	70
Paipote	Chile	Reverberatory	72	0.78	50	40
Potrerillos	Chile	Reverberatory	137			
Cananea	Mexico	Reverberatory	56			
La Caridad	Mexico	Outokumpu flash	184	3.01	553	90
San Luis Potosi	Mexico	Blast furnace	41			
Ilo	Peru	Reverberatory	277			
La Oroya	Peru	Reverberatory	62	0.59	48	22

5.2 LEAD CIRCUIT

The CMLO's lead circuit under Centromin is described in some detail in Knight Piésold's 1996 report. It is based on the lead industry's standard technology that includes a sinter machine followed by a lead blast furnace (see Section 4.3 of this report for a general description of this technology). At the time of the acquisition, 100% of the sinter machine's off-gas was directed to the Cottrell electrostatic precipitator to remove particulates from the off-gas before discharging the gases to the main stack.

The Cottrell installation was more than 60 years old and its efficiency was lower than modern systems. There were no controls to capture lead circuit SO_2.

The lead circuit operated by Centromin was similar to the low-pollution-control lead system discussed earlier and shown in Figure 4-5.

5.3 ZINC CIRCUIT

The Knight Piésold 1996 report describes the zinc circuit in some detail. The circuit utilized reasonably modern roasting technology, consisting of three "Jersey" brand fluid bed roasters and one "Lurgi" brand fluid bed roaster (also referred to as a turbulent layer roaster). Off-gas from the smaller Jersey roasters was treated by the Cottrell before being released to the main stack; off-gas from the Lurgi roaster was cooled, cleaned, and then processed through an acid plant to recover SO_2 as sulfuric acid. See Figure 4-7 and Figure 4-8 for the block flow diagrams of the two systems.

It is clear that the CMLO zinc circuit acid plant was in poor condition at the time of DRP's acquisition. As discussed in Section 6.1, this plant was identified by DRP as requiring major refurbishment to restore its capacity and design reliability.

5.4 OTHER CMLO PROCESSES

While copper, lead, and zinc were the major product streams at the CMLO, there were ancillary plants at the CMLO that processed recycle streams (e.g., lead anodes from the refinery) or produced minor quantities of other products (e.g., arsenic trioxide and cadmium). Many of these ancillary plants had emissions associated with them (which were addressed by DRP after its acquisition).

5.5 POLLUTION CONTROL STATUS AND EQUIPMENT

Aside from the zinc circuit acid plant (which was in disrepair), Centromin relied primarily on the 1940s era central Cottrell to recover particulates from process gases before discharge to the main stack. Diagram 4.1.1 /1 of the 1997 PAMA shows the major CMLO gas streams.

During the Centromin era, there were a large number of fugitive emission sources. The PAMA identified 80 sources of fugitive emissions (Table 4.1.1/10 of PAMA). The PAMA did not, however, identify projects to address these sources.

6.0 DRP'S IMPROVEMENT OF THE CMLO

This section of the report reviews the DRP improvements to the CMLO facilities. These improvements are discussed (to the extent practicable) in the chronological order in which the improvements took place.

DRP's initial guidance for CMLO modernization was outlined in the PAMA. The PAMA recognized that the copper circuit would have to be modified in order to comply with PAMA SO_2 emission reduction goals. The description of the process modifications included systems that in my opinion are not proven in the copper industry. For example, the PAMA suggested that copper concentrate be processed through a new roaster prior to smelting in the reverberatory furnace and further processing through a CMT (a furnace that operates in a manner that is similar to copper converters). Such a process scheme was not a proven technology used in modern, low-emission copper smelters.

Further, the PAMA suggested that all CMLO process gases be treated through two new acid plants. One would process the lead and zinc circuit off-gases and the other would process copper circuit off-gases. Later, DRP contracted with the PAMA's selected engineering firm (SNC) to evaluate smelting options. One of SNC's initial recommendations was to process all CMLO gases through a single new acid plant, as opposed to the two plants identified in the PAMA.

In fact, neither the two acid plant option nor the one acid plant option was technically appropriate for the CMLO operations. Nor was it feasible to simply modify the existing copper circuit technology. Ultimately, DRP developed a sound design plan that involved the following features:

1. A dedicated acid plant for each circuit;
2. A modified lead circuit that is based on the industry standard sinter / blast furnace technology;
3. A zinc circuit with all roasting gases reporting to a refurbished and upgraded acid plant; and
4. A new copper circuit that is based on proven, low-emission technology that minimized converter activities.

Due to inappropriately conceived SO_2 control projects (both in the PAMA and later by SNC) and the time required to properly plan, engineer, and construct new facilities, the copper project execution would have required more time than originally set out in the PAMA (see Sections 8.1 and 8.2 for further discussion of schedules).

6.1 ZINC CIRCUIT

DRP shut down the three Jersey roasters in December 2004. The Lurgi fluid bed roaster (also referred to as the "TLR" or turbulent layer roaster) continued to operate but in order to ensure efficient conversion of SO_2 from this roaster, DRP upgraded the acid plant gas scrubbing system and portions of the acid plant. This $5.7 million investment included a new cooling tower, a new drying tower, and other critical acid plant repairs. It resulted in an acid plant with higher capacity to process gases with reduced emissions.

6.2 LEAD CIRCUIT

DRP modified the sinter machine gas off-take system that resulted in an off-gas with an SO_2 concentration that was suitable for processing through an acid plant.

A gas scrubbing system was designed and installed to process this gas, which was then directed to a new sulfuric acid plant (Figure 6-1). The acid plant was designed and supplied by Fleck Chemical Industries (a Canadian firm that specializes in sulfuric acid plants). The acid plant was designed with an annual capacity of 115,000 metric tons of acid. The total cost of this project was $49.6 million USD.

Figure 6-1 Operational Lead Circuit Acid Plant

In addition to the processing of this SO_2 stream, DRP's efforts in the lead circuit included the installation of several fugitive gas system improvements. These included projects such as the enclosure of the lead circuit furnace area and other circuit processes, and the construction of new baghouses to remove particulate matter and prevent its discharge to the environment. See Section 6.4 for further details. In parallel to these environmental projects, DRP also improved the operating efficiency of the lead circuit. For example, lead blast furnace air-oxygen control systems were improved to improve the process control of the system (see Section 6.2.2 of DRP's 2001 "Report to our Communities". It is my experience that operational and control system improvements typically result in more stable process off-gas flows—this results in improved and more efficient off-gas cleaning systems.

6.3 COPPER CIRCUIT

While the initial PAMA guidance for copper circuit upgrades and subsequent initial suggestions by SNC (the PAMA's selected technology consultant) to DRP were flawed, DRP finally developed an appropriate copper circuit design that is shown in Figure 6-2. This new copper circuit design included:

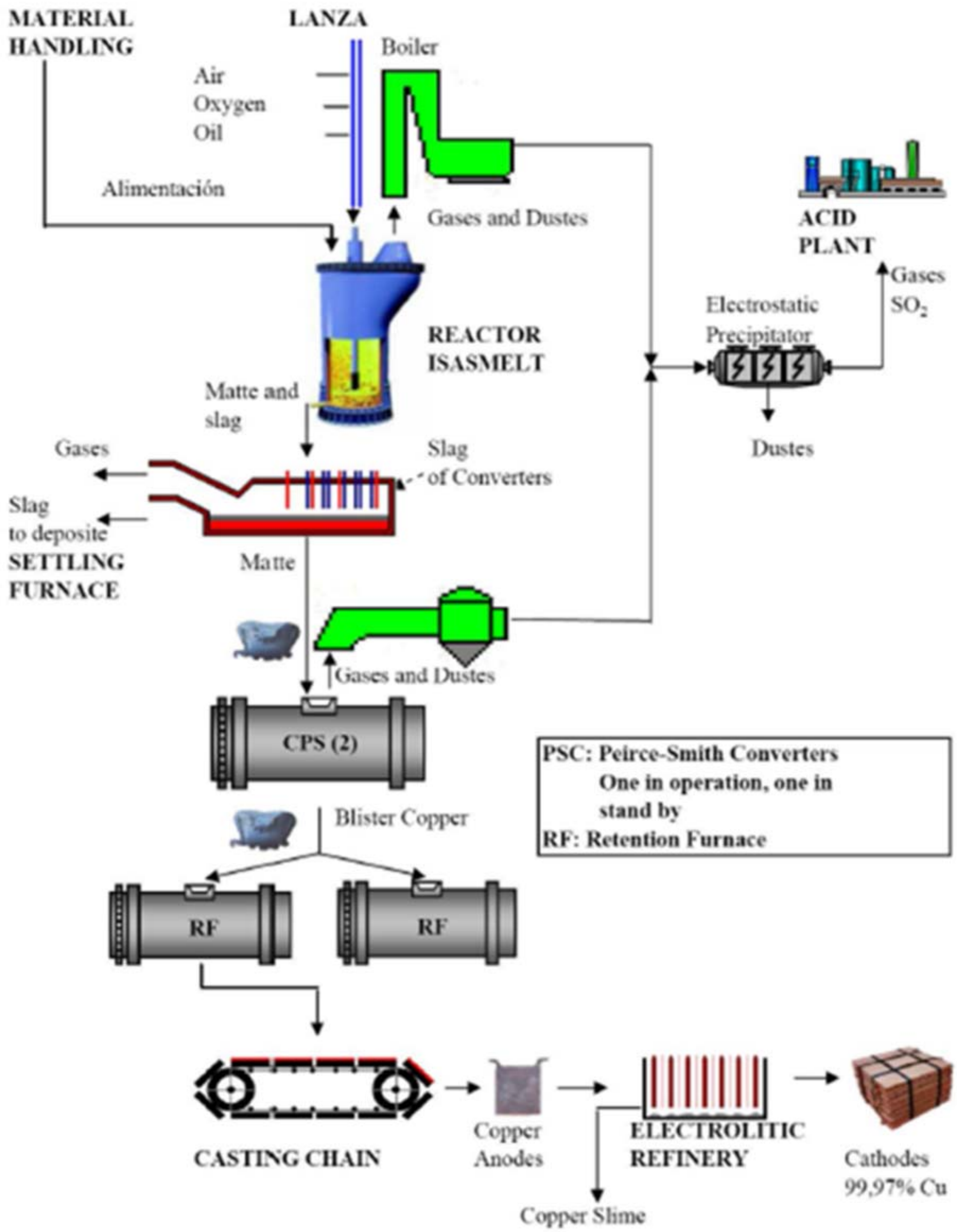
1. A new state-of-the-art, but proven Isasmelt smelting vessel. This vessel would completely eliminate the high-emission roaster and reverberatory furnace smelting system that DRP inherited from Centromin. This technology has been proven to be a reliable smelting vessel that can consistently produce high concentration SO_2 gases that are suitable for acid recovery. The technology minimizes the use of fuel and requires a relatively small footprint, which makes its installation within an existing smelter feasible. As a note, this is the same technology that was implemented by Southern Peru Copper at its Ilo Smelter.

2. New, standard size converters to replace the five undersized converters in use at the CMLO. With the new converters, the new copper circuit would only require the operation of one converter (another would be hot and ready to operate and the third would be a cold standby unit). The design could reduce converter requirements because the Isasmelt vessel would produce a 60% copper matte that required almost 50% less converting than the Centromin era

30% copper matte. As noted earlier (Figure 5-1), this is significant because converter operations are a source of fugitive emissions.

3. A new acid plant that would process Isasmelt and converter process gases.

Figure 6-2 DRP Copper Circuit Design



6.4 FUGITIVE EMISSIONS / COMPLEMENTARY PROJECTS

As noted above, the PAMA identified a large number of fugitive emission sources but did not include specific projects to control these emissions. DRP recognized that control of these sources was important in order to reduce the level of emissions and their environmental and public health impacts. Some of the major projects implemented by DRP to reduce fugitive emissions were:

- Bedding plant enclosures
- Area paving, truck wash stations, and industrial sweepers
- Lead blast furnace baghouse
- Zinc area baghouse
- Baghouses for ancillary operations (including anode residues, arsenic, and lead dross plant)

In addition to these fugitive emissions reduction projects, DRP improved the performance efficiency of the Cottrell (dust collecting electrostatic precipitator) that processed gases prior to their discharge to the main stack. This was accomplished by upgrading the electrical control system of the Cottrell and also by decreasing the gas flow to the unit (by for example, routing gases to other control devices such as directing lead sinter machine gases to the new lead circuit acid plant).

7.0 DRP STANDARDS AND PRACTICES

In order to develop an opinion of DRP standards and practices while operating CMLO (and in comparison to Centromin standards and practices), I have relied upon documents and observations that include:

1. The 1997 PAMA document that describes the condition of the Centromin era operations.

2. The 1996 Knight Piésold environmental evaluation of the CMLO.

3. Emission data submitted by Activos Mineros (attached as Appendix B) and other reports and documents that summarize CMLO emissions from 1997-2008.

4. The PAMA projects and complementary projects completed and planned by DRP.

5. My observations from my 2006 visit to the CMLO while serving on a Panel of Experts on behalf of the Peruvian Ministry of Mines and Energy (MEM). This visit was documented in my report to the MEM.

6. The Osinergmin oversight reports that documented the progress of DRP in constructing the new copper smelter.

Based on a careful review of these documents, it is my opinion that:

1. DRP significantly decreased CMLO fugitive and stack emissions. This improved the workplace environment and reduced the impact to the surrounding communities.

2. DRP significantly improved overall plant SO_2 and particulate capture through the shutdown of the three Jersey roasters, its refurbishment of the zinc circuit acid plant, and its installation of the lead circuit acid plant. These refurbishments were consistent with worldwide standards and norms associated with zinc and lead circuit modernizations. Its design of the copper circuit was appropriate, and consistent with world standards for copper smelter facilities. The construction of the new copper circuit and acid plant progressed as expeditiously as possible under the circumstances associated with construction within an operating smelter facility and due to the special considerations discussed in Section 8.2.

3. DRP significantly improved CMLO safety programs and decreased accident and injury rates compared to the Centromin era.

In summary, particularly considering that DRP was challenged with upgrades, modifications, and replacements associated with the CMLO, its standards and practices were at or beyond the levels expected by any smelter operator under similar conditions and constraints. DRP standards and practices with respect to environmental impact, employee exposure, and emission controls exceeded the standards and practices evident during the Centromin era.

8.0 DRP EXTENSION REQUESTS

The PAMA laid out a 10-year program to carry out a specific list of smelter improvements. There are two issues associated with the PAMA that affected DRP's ability (or would have affected any other company's ability) to achieve the targeted emission reductions: (1) the PAMA did not address all of the issues associated with reducing emissions from the complex (e.g. the suggested copper circuit design was flawed and it failed to include fugitive emission projects) , and (2) the 10-year PAMA schedule appears to be arbitrary and not based on an engineering schedule or realistic evaluation of the time required to complete the identified projects.

In 1996, Knight Piésold raised concerns about the scope of work that was required at the CMLO and the 10-year time period for completion of the PAMA projects. For example, Knight Piésold suggested that the 75-80% sulfur recovery goal may not be possible "*except by multiple process changes and/or major modifications to much of the smelter.*" Knight Piésold continued that required changes "*may well take in excess of the ten year implementation schedule being considered by the Peruvian Ministry*".

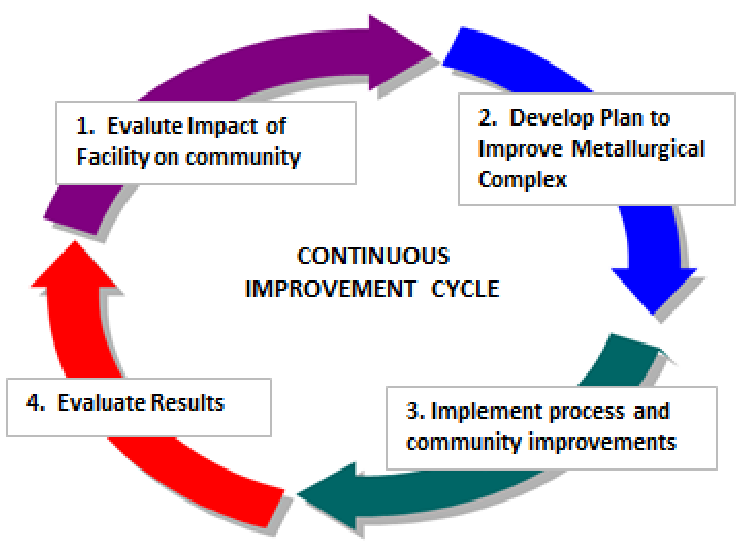
In addition, Knight Piésold cautioned that mere "*achievement of the proposed emission limits may not ensure compliance with all proposed ambient standards*" (page 33). This caution is consistent with DRP's plan for improving the CMLO, which included many projects to reduce smelter area fugitive emissions that were not mandated by the PAMA but were conducted by DRP in parallel to executing the PAMA list of projects.

8.1 GENERAL PROJECT EXECUTION SCHEDULE DISCUSSION

As discussed above, smelters were not historically designed or operated to control their emissions. Thus, many smelters that commenced operations in the early 20th century were essentially uncontrolled, meaning that no pollution control technologies were employed at all (with the exception of rudimentary dust capture to recover and recycle some of the valuable metal values from particulates in smelter off-gas). As the environmental and public health impacts that result from their emissions became better understood, however, these older smelters were forced to either cease operations or modernize their facilities to limit their emissions and environmental impacts.

The process of upgrading and modernizing an operational smelter to reduce emissions and environmental impacts is a complex and time-consuming endeavor. In smelters around the world, successful emission reduction projects result from a multi-step cycle of continuous improvement involving all stakeholders. Step 1 in this process cycle is to evaluate the impact of the facility on the surrounding communities. Step 2 is to use the impacts identified in the first step to develop a plan to mitigate environmental impacts. Step 3 is to design and implement the plan to reduce environmental impacts. Step 4 is to evaluate the results of the plan that has been implemented, in order to determine whether the plan has been successful in reducing impacts to acceptable levels, or whether additional steps are required to reach acceptable emission levels and environmental impacts (in which case the process would begin again at Step 1). This process is depicted below in Figure 8-1.

Figure 8-1 Smelter Continuous Improvement Cycles



While the precise timeline to complete each step of the process above will vary, it takes years to develop and implement an improvement plan. Even once environmental and health impacts have been determined (Step 1), more than five years would typically be required to develop and implement a plan of improvement (Steps 2 and 3). An example timeline for this process taken from the 2006 report prepared by the panel of experts and submitted to MEM is set forth below:

1. Develop a plan for improvement, which can include the following steps:

    a. Scoping level studies to quantify smelter operating parameters (1-2 years). These studies will determine base operating parameters in the smelter as well as developing a "short-list" of acceptable technologies for the process changes.

b. Prefeasibility and feasibility studies (1 year). These studies are required to obtain +/- 15% cost estimates to secure funding as well as to develop the design criteria essential for detail engineering.

2. Project implementation

a. Detail engineering. This phase of the project (typically one year) clearly defines the process design conditions. During this phase of the project all engineering drawings are developed and equipment specifications are written to enable the purchase of necessary equipment.

b. Procurement (purchasing). This phase of the project includes:

i. Issuing requests for quotations to suppliers of equipment (much of this effort can be done concurrently with detail engineering).

ii. Waiting for suppliers to respond to the requests. For complex turnkey systems (for example sulfuric acid plants), vendors required 2-3 months to develop competitive bids.

iii. Bid analysis (two weeks is required for complex systems).

iv. Final contract negotiations (often one month is required to agree to all terms and conditions).

v. Delivery of equipment (1-1.5 years for complex equipment, the upper end of this range is appropriate to use during periods of economic expansion, such as 2005-2006, as fabrication shops are busy).

c. Construction. This phase of the project can require up to 1-2 years and includes:

i. Site work (civil and concrete)

ii. Structural steel and setting equipment in place

iii. Installing piping, instrumentation and electrical power to the equipment

iv. Installing support utilities for the process as required (for example cooling water systems, pressurized air)

d. Commissioning and start-up. For complex operations, equipment commissioning and start-up typically requires a period of several months.

8.2 FACTORS THAT CAN AFFECT PROJECT TIMELINES

While the total time to complete all activities shown above is in the range of five to seven years, special considerations may affect the time required to complete the necessary work. For example, fast-track projects can be accomplished more quickly as some (but not all) activities can be ongoing concurrently. At the same time, specific characteristics of the facility being upgraded such as its location, capacity, feed materials processed, and physical condition, as well as conditions in the broader metal market, may complicate the modernization process and mean that more time is required. Project timelines are also always impacted by regulatory processes and the time to apply for and receive necessary permits and approvals. For example, in 2012 I worked on a copper smelter project that anticipated that eight years would be required from the start of the prefeasibility study until the new smelter was operating.

The CMLO highlights many of the special considerations that can affect the time required to upgrade and modernize an antiquated smelter facility. Collectively, I believe these issues complicated the design and execution of the project and contributed to a longer project execution schedule.

8.2.1 Elevation and Location

The CMLO is located in a relatively remote section of the Andes Mountains at high altitude (3,720 meters above sea level). This affects project design and execution because systems designed to operate at lower elevations must be specially designed and engineered to operate at elevation where atmospheric pressures and gas densities are lower. (The atmospheric pressure at 3,720 m is 0.63 of the atmospheric pressure at sea level.) Likewise, transportation constraints can limit the ability to move large equipment over the Andes Mountains on winding mountain roads. This can complicate a modernization project by forcing equipment to be fabricated on-site, rather than shipped to the site for installation.

8.2.2 Project Scope and Complexity

The CMLO was in particularly poor condition by world standards when it was acquired in October 1997. In the Centromin era (mid-1970s to mid-1990s) most old-technology copper smelters like the CMLO were either planning to cease operations or actively planning and executing modernization projects to address energy efficiency and emission issues. Centromin, however, did not commence this work and instead transferred a substandard facility to DRP in late 1997. As a result, a great deal of work in virtually every operational area was required to modernize the CMLO. Undertaking a modernization project on this scale, while maintaining the ongoing operations necessary to finance the work, can lengthen design and construction schedules and require additional time to complete.

The complexity and time required to complete design and engineering projects can also be affected by the distribution of impurity elements in the concentrate feeds processed at the facility. Impurity elements can include valuable impurities such as silver and gold as well as “problem” impurities such as lead, arsenic, cadmium, and selenium. In all cases, it is important (but often difficult) to know how these elements distribute within the smelter.

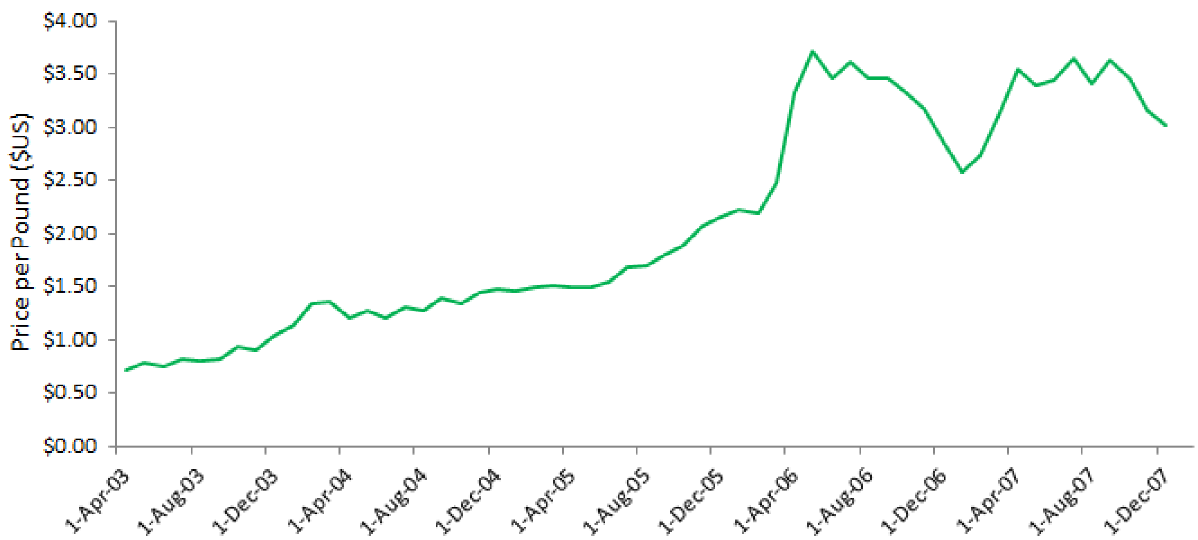
This problem is compounded at the CMLO due to the poly-metallic nature of the facility’s metal production circuits because impurity elements can enter production processes through multiple sources (e.g., a portion of the copper containing feed stock is obtained from the lead circuit, meaning that some level of lead and other impurities will enter the copper circuit following processing in the lead circuit.) Because all of these impurity streams must be accounted for, design engineers working on a modernization project would not be able to rely on the historical distribution of impurity elements from other facilities, but rather must engineer the project based on specific characteristics of all feed stock processed at the CMLO. This complicates the design and engineering process and can require additional time to complete.

Finally, in the case of the CMLO, the PAMA provided some guidance on how the copper circuit should be developed. This guidance, however, proved to be flawed and DRP likely was negatively impacted by this early guidance as their initial design concepts progressed on the basis of faulty PAMA guidance.

8.2.3 Economic Conditions

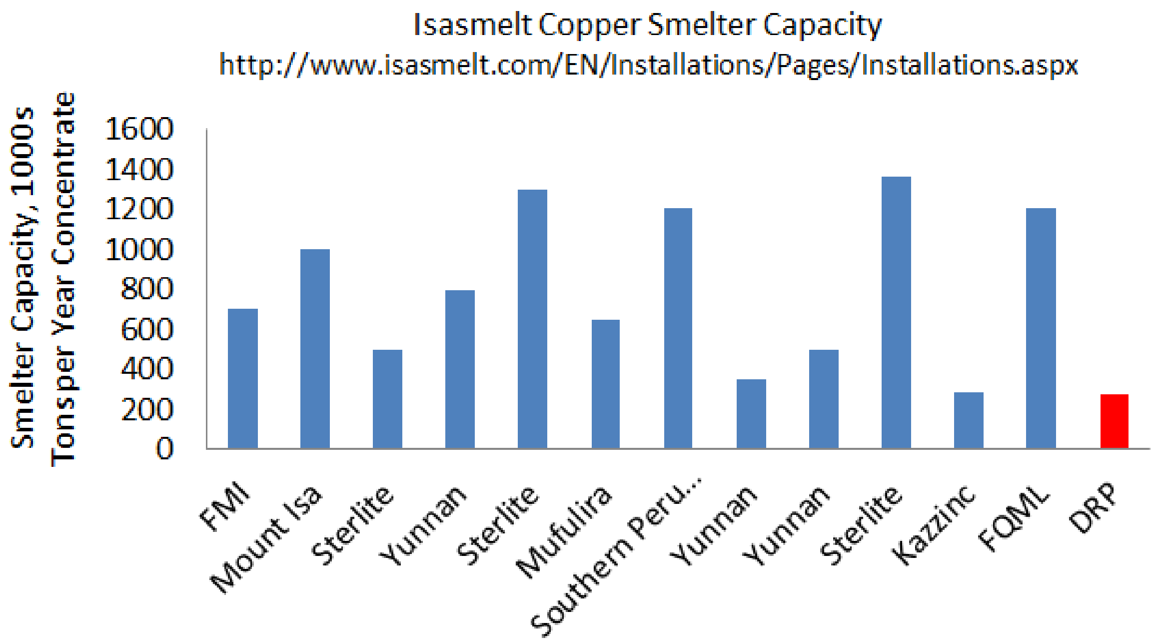
The time to complete capital projects can be affected by conditions in metal markets and the relative size of the facility. As shown in Figure 8-2, work was occurring on the process to modernize the CMLO during a "boom" in the metals market when copper prices were approaching an all-time high and there was intense movement to complete projects associated with copper production at other smelters. During these periods of significant industry expansion, facilities must compete for design, engineering, and fabrication resources.

Figure 8-2 Price of Copper between April 2003 – Dec 2007



Competition can be particularly difficult for smaller capacity facilities like the CMLO, which as shown in Figure 8-3 has a low capacity when compared to other smelters that had been upgraded with modern Isasmelt technology. This is because major design, engineering, and fabrication service providers tend to focus their resources on larger projects with larger potential profits. Thus, it can require additional time for smaller facilities to complete necessary work.

Figure 8-3 Isasmelt Smelter Capacity, thousands of tons per year concentrate



8.3 THE 2006 EXTENSION

As discussed above, Knight Piésold cautioned in 1996 that 10 years would be insufficient to complete necessary improvements to the CMLO. This concern proved correct, and DRP requested that MEM grant it an extension of time under its PAMA to complete upgrades to the facility.

In 2006, I served on a panel of international experts that was asked by MEM to evaluate DRP's efforts to improve the CMLO and its request for an extension of time. In this capacity, I visited the CMLO in April 2006, interviewed DRP personnel, and reviewed documents related to DRP's planned improvements. The scope of my 2006 review included the following:

1. A review of the technology used in the copper, lead and zinc circuits, with particular attention to the impact of the technology on emissions and the level of ease / difficulty associated with controlling these emissions.

2. An analysis of the copper and lead pyrometallurgical production circuits, in order to evaluate the existing measures and propose additional measures for the management/elimination of recirculating flows (particularly fine dusts) in those production circuits.

3. An analysis of the copper and lead pyrometallurgical production circuits, in order to evaluate the existing measures and propose additional measures for the reduction of fugitive emissions and emissions from the stack in the copper, lead and zinc production circuits, which include, among other aspects: design and efficiency of the baghouses, electrostatic precipitator units, and the collection of the gases collected into these systems.

4. A review of DRP execution plans to reduce fugitive emissions, including a review of the investment and task execution schedules.

5. A review of the copper pyrometallurgical upgrade project, with particular focus on minimization of project schedule while maximizing SO_2 collection efficiency.

6. A review of the sulfuric acid production processes of the lead and copper circuits.

7. An evaluation of the project schedule for the implementation of the proposed lead circuit's sulfuric acid plant.

8. An evaluation of the execution deadline for each of the activities proposed for the modernization and implementation of the copper circuit's sulfuric acid plant, which include the monthly investment schedules and tasks execution schedules.

9. An analysis of the proposed reorganizations in the Environmental Management Program and Contingency Program for the operation and maintenance of the different systems and equipment to be implemented.

10. Other recommendations that were relevant to the project.

A copy of my May 2006 report is attached as Appendix C. Relevant opinions from my May 2006 reports are summarized below.

The DRP fugitive emission reduction projects required a significant effort and were necessary to control emissions from the facility. This program was appropriate and was being planned and executed properly.

With regard to the copper circuit, I concluded that any attempt to continue the use of the existing reverberatory furnace was not consistent with the goal of significantly reducing smelter emissions. Hence the PAMA plan to continue the use of the reverberatory furnace was not a viable approach to achieve the PAMA emission reduction goals.

DRP appropriately identified the Isasmelt technology as the key component of the new copper circuit. This furnace would decrease the dependency on converters (by increasing smelting furnace matte grade from 30% copper to 60% copper). This in turn would result in decreased converter related fugitive emissions. The Isasmelt vessel would also produce a highly concentrated SO_2 that, coupled with converter off-gases, would produce a blended copper circuit off-gas that is ideal for acid production. Isasmelt technology could be incorporated into an existing smelter footprint and the technology was also appropriate with respect to its metallurgical ability to process impurities in the CMLO concentrate.

I was asked to evaluate the schedule for completing the copper circuit replacement which showed an end of 2009 completion. I explained that this schedule was very aggressive and would require an extraordinary effort to ensure its timely completion.

I went on to note a number of challenges associated with the on-time completion of these projects and believed there was considerable risk of schedule slippage such that additional time would be required.

8.4 2009 EXTENSION REQUEST

I have reviewed relevant Osinergmin reports that summarized the 2008 progress of the construction of the new copper smelter (Osinergmin is a Peruvian government agency that was tasked to monitor and report on the progress of PAMA project at CMLO). DRP was making extraordinary progress in 2008 with the execution of the copper circuit construction but significant efforts were still required to complete the project. Considering that DRP acquired a totally non-compliant copper circuit in 1997, and considering flawed plans in both the PAMA and the 2004 SNC prefeasibility study, in my opinion, the performance of DRP to advance the copper circuit to the extent that they had by mid-2008 was impressive.

Progress of the copper circuit installation continued during 2008. The Osinergmin November report (dated December 4, 2008) indicated:

1. The overall copper circuit project had advanced to 47% completion.
2. The copper circuit acid plant was over 50% complete.
3. The infrastructure component of the copper circuit project was 75% complete. This portion of the project included an electrical substation and other electrical infrastructure, a new oxygen plant, a water treatment system, a water cooling system, and a fuel piping system.

Based on the information provided by Osinergmin, the efforts of DRP continued to track towards a potential late 2009 completion—barring a major "force majeure" type incident[2]. In fact, a major force majeure incident occurred as is discussed below.

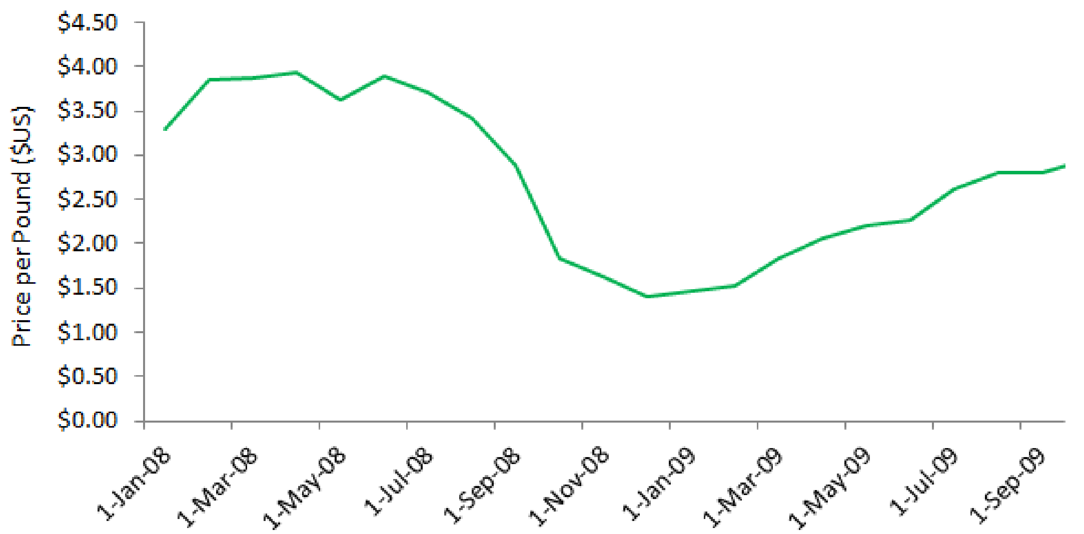
8.4.1 Global Economic Crisis

In 2008, the price of copper and other metals collapsed in conjunction with the global economic crisis. This had sweeping effects in the mining and metallurgical sector. Figure 8-4 shows that the price of copper dropped by over 50% from mid-2008 to early 2009. Lead and zinc prices also decreased over 50% from their 2008 peaks.

Concurrently with the decline in metal prices, the global financial sector was reeling with troubles of their own—financing of projects came to a near standstill. Financing of projects in the mining and metals industry were severely impacted because of the decline in metal prices. These impacts were felt throughout the industry including the largest of mining companies and the smallest.

[2] While in 2008 Osinergmin and DRP were still targeting a late 2009 completion, it is my experience that the rate of progress in the final stages of smelter construction often slows. In my opinion there was a risk, that even absent force majeure problems, some of the final construction tasks would be pushed into early 2010.

Figure 8-4 Effect of Global Economic Crisis on Copper Price



8.4.2 Summary

Based on my perspective of the project (and to the limit that my experience and expertise allows for) the reasons explained by DRP in its request for a PAMA extension were reasonable. DRP should have earned the trust of the appropriate regulatory agencies based on the projects that had been accomplished by the end of 2008. With this trust and the unique financial conditions of 2009, a PAMA extension should have been granted.

9.0 CONCLUSIONS

In summary, my primary opinions and findings related to the DRP PAMA execution and the extension request are:

1. At the time Centromin transferred the CMLO to DRP, critical equipment installed at the facility was inappropriate for use in a smelting facility that was required to reduce its emissions to meet modern emission limits and air quality standards. In particular, the copper circuit was sub-standard and outdated—this circuit could not be updated to comply with emissions reduction requirements and would require a complete replacement. This required DRP to undertake a complex project to design and replace the copper circuit equipment, which was not identified in the PAMA. The lead and zinc circuits required significant upgrades and the design and installation of new emission control equipment.
2. DRP acted reasonably and appropriately in its efforts to upgrade and modernize the CMLO. Due to the complexity and condition of the CMLO facility, I agree with the 1996 Knight Piésold opinion that more than 10 years was required to accomplish the goals of the PAMA.
3. Due to its complexity, the copper circuit replacement was inherently a multi-year project and it is not surprising that additional time was needed to complete the project. DRP requested a

project extension in 2006 and was granted this relief. I visited the CMLO in 2006 and had the opinion then, and continue to have the opinion, that the scope of the copper circuit replacement was significant and that even a 2009 completion date was aggressive.

4. The global economic crisis of 2008-2009 severely impacted the mining and metals industry and in particular the capital projects that were underway or planned by these companies. This event understandably impacted DRP's ability to execute the copper circuit replacement and construction of the copper circuit acid plant in the time provided.
5. DRP's 2009 request for an extension of time to complete the copper circuit replacement and construction of the copper circuit acid plant was reasonable due to the parallel PAMA and other projects and upgrades that DRP was conducting and the extraordinary conditions in which these projects were being performed.
6. DRP's standards and practices were significantly more protective of the environment and public health than those used by Centromin between 1975 and 1997.

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APPENDIX A: DR. ERIC PARTELPOEG CURRICULUM VITAE

Eric Partelpoeg, Ph.D

EHP Consulting, Inc.
6038 Camino Miraval, Tucson AZ 85718
(520) 615-4030 *eric@ehp-consulting.com*

Summary: 30 years of experience in process industry operations, project management, metallurgical process modeling, and technical consulting.

- Process optimization / process modeling expertise in a diverse range of technologies (including sulfuric acid technologies, copper smelting, molybdenum roasting, crystallization processes, steam systems /energy recovery, and off-gas processing).
- Project management of small ($<100,000) and large (>$100 million) projects in all phases—conceptual, feasibility, detail design, procurement, and construction.
- Commissioning of process plants (scrubbers, baghouses, furnaces, acid plant components).
- Due diligence of process plants (associated with mergers and acquisitions and initial public offerings) and expert witness testimony (acid dew point corrosion, furnace failures, and accidents).
- International experience (Chile, Peru, Brazil, Mexico, Bulgaria, Serbia, Spain, China, India, Australia, Thailand, Canada, USA, and Democratic Republic of Congo).

Industry Specific Experience

Sulfur / Sulfur Dioxide / Sulfuric Acid

- Project Management: 1,350 tpd sulfuric acid plant in Arizona (sulfur burning). Client's Project Manager from concept to commencement of construction. Responsible for developing project scope, reviewing and approving project design criteria, procurement packages, detail engineering, project schedules, and project budget ($100 million). Project scope included: (a) sulfur steaming, unloading and storage, (b) sulfur burning acid plant (MECS technology), (c) turbine generator system (15 MW), and (d) plant infrastructure (water treatment, cooling water system, acid storage and load-out, and electrical infrastructure)
- Technical Oversight: Client's representative for the technical design of a 600 tpd acid plant (in the DRC), Chemetics technology. Reviewed and approved procurement packages associated with the plant. Client's representative for the technical design of 180 tpd sulfur burning system to produce 15% SO_2 at 50 psig for hydrometallurgical service.
- Project Management: Feasibility study for a combined 600 tpd acid plant and 250 tpd SO_2 plant (Fleck technology). Plant evaluated for South American mine. Similar scope and responsibility for a feasibility study in Arizona
- Project Review: Review of sulfur burning acid plant (Outotec technology) considered for installation in South America.
- Molten sulfur piping upgrade (lead process engineer to improve system reliability (Nevada).
- Acid Plant troubleshooting and modeling: Lurgi plant (Nevada), Monsanto technology (USA and Brazil), Chemetics technology (USA).

- Commissioning of acid towers (New Mexico), operating manager of metallurgical acid plant (New Mexico).
- Acid Plant modeling and basic engineering for a 950 tpd acid plant designed to support a copper leaching operation.
- Sulfur / SO_2 system project management and system optimization (hydrometallurgical facility that uses SO_2 to improve leaching efficiency.

Copper

- Operating management experience (Inco flash furnace technology and Outotec flash smelting technology).
- Technical manager, copper smelter (Outotec technology), major projects included: (a) flash furnace modeling, (b) slag chemistry studies, (c) converter optimization, and (d) energy reduction programs.
- Project Manager (Feasibility Study): SX-EW technology implementation (confidential client technology), South America. Project scope included the development of all leaching and extraction mass balances, acid and reagent balances, and electrowinning tankhouse design modifications.
- Technical Review Manager: Reviewed and approved for purchase the process equipment for a copper and cobalt leaching system. Process equipment responsibility included sulfuric acid plant, SO_2 gas system, and selected areas of the leaching process.
- ISA Smelting process improvement consulting (India)
- Review of smelter concentrate impurity distribution (Eastern Europe, Outotec technology)
- Waste heat boiler troubleshooting and optimization (SO_3 reduction).
- Due Diligence projects:
  - Technical review on behalf of an international agency and a South American federal government of a metallurgical complex (copper, lead, zinc) with a focus on modernization plans, evaluation of emission control equipment, and emission reduction programs.
  - Technical evaluation of an Eastern Europe smelter privatization program on behalf of the World Bank.
  - Due diligence and economic evaluation of copper smelters in Europe, Asia, and South America
  - Independent Project Review (IPR) of process plant upgrade project, with a focus on gas handling issues (waste heat boiler and electrostatic precipitator)
  - Review of furnace off-gas quenching technology.
- Process / heat and mass balance models:
  - Flash smelting furnace model (including off-gas system through scrubbing)
  - Copper converter computer model
  - ISASMELT process model
  - Electric Furnace Models
- Copper sulfate crystal production modeling and optimization and plant troubleshooting.
- Heat recovery study from smelter off-gas study including smelter steam optimization and turbine generation.
- Independent project review: audit/review of a comparison of ISASMELT and Outotec technologies.

Gas Cooling, Cleaning, Scrubbing, and Emissions

- Emission modeling of molybdenum roasters and gas scrubbers.
- Project manager and principal process engineer for the replacement of the Inco Furnace settling chamber with a quench tower and a new scrubbing system. Responsibilities included process engineering, design review, commissioning, and operation.
- Anode off-gas baghouse project (feasibility study, operating and maintenance manual and commissioning)
- Project manager and principal process engineer for the design, construction, and commissioning of a 350,000 acfm fugitive gas baghouse.
- VOC scrubber review / concentrate dryer emission minimization.
- Limestone gas scrubbing optimization
- Autoclave scrubbing system stud, mercury scrubbing system review.
- Smelter fugitive gas improvement project (feasibility study including computer flow model)
- Acid plant gas scrubbing system optimization studies.
- Acid Dew Point modeling / prediction
- Feasibility study to evaluate SO_2 neutralization options and costs.

Molybdenum

- Project manager (feasibility study for location in China) for molybdenum roasting facility complete with gas cleaning system and acid plant.
- Molybdenum roasting heat and mass balance models (for roaster projects in Chile, Nevada, Iowa, Arizona, and China).
- Specifications for the gas cleaning and scrubbing system of a molybdenum roasting facility (Feasibility study, US).
- Hydrogen reduction furnaces, mass and heat balance models, furnace troubleshooting.
- Scoping study, molybdenum roasting and pressure oxidation comparison (Australia).
- Feasibility study: molybdenum roasting (Australia).

Gold

- Fluid Bed Roasting process model development for refractory gold mining project.
- Budgetary Capital and Operating Cost estimate: Fluid bed roaster project
- Process gas handling option review for gold / pyrite fluid bed roasting project.
- Fluid bed roaster acid plant troubleshooting / process model to improve system reliability.

Other Projects

- Process review/audit of zinc roasting, acid plant operations, and oxide leaching and electrowinning.
- Expert witness testimony and reviews of accidents and process plant failures.
- Boiler corrosion study and expert witness testimony.
- Electrostatic precipitator corrosion failure, expert witness report.

- Detail review of process plant mothballing costs.
- Due diligence review of direct reduced iron technology including detailed mass and heat balance model.
- Due diligence of microwave direct iron technology
- Vacuum evaporation system troubleshooting and optimization including mass and heat balance model.

Education, Publications, Affiliations, Employment History

Education: Ph.D. Metallurgical Engineering, Minor in Mineral Economics, University of Arizona, 1985
M.Eng. Metallurgical Engineering, McGill University, Montreal, Canada, 1980
B.Eng. Metallurgical Engineering, McGill University, Montreal, Canada, 1977

Affiliations: TMS, AIME

Publications: <u>Flash Smelting, Analysis, Control, and Optimization</u>, W.G. Davenport, co-author, Pergamon Press 1987 (Second Edition published by TMS in 2001), <u>Process Control and Automation in Extractive Metallurgy</u>, D.C. Himmesoete, co-editor, TMS 1989, Numerous papers dealing with Phelps Dodge smelter subjects authored and co-authored during 1985-1995 (rotary drying, slag fluidity, smelter improvements, etc.).

EHP Consulting, Inc.	2002 - Date
Jacobs Engineering Group	2001 - 2002
The Winters Company	1996 - 2001
Phelps Dodge Chino Smelter	1988 - 1996
Phelps Dodge Hidalgo Smelter	1981 - 1988
Inco Metals Company	1977 – 1978

APPENDIX B: ACTIVOS MINEROS EMISSION DATA

EMISION DE GASES Y MATERIAL PARTICULADO POR LA
CHIMENEA PRINCIPAL
1 922 - 2 008

	Año	Perdida Chimenea	Elementos metalicos: Plomo	Elementos metalicos: Arsenico	SO_2
		t/año	t/año	t/año	t/año
CERRO DE PASCO CORPORATION	1,945	1,433			
	1,946	2,002			
	1,947	2,152			
	1,948	1,654			
	1,949	2,380			
	1,950	2,417			
	1,951	5,068			
	1,952	2,974			
	1,953	3,149			
	1,954	2,434			
	1,955	2,689			
	1,956	2,719			
	1,957	3,504			
	1,958	2,433			
	1,959	2,932			
	1,960	3,212			
	1,961	4,715			
	1,962	3,667			
	1,963	4,173			
	1,964	5,575			
	1,965	5,059			
	1,966	5,466			
	1,967	6,721			
	1,968	6,994			
	1,969	5,871			
	1,970	4,651			
	1,971	3,651			
	1,972	3,339			
	1,973	3,620			
CENTROMIN PERU S.A.	1,974	3,967			
	1,975	3,706	843	1,059	379,235
	1,976	4,292	785	967	384,345
	1,977	4,328	1,027	1,225	380,695
	1,978	4,502	1,018	1,190	387,630
	1,979	4,540	1,267	1,095	411,355
	1,980	4,397	1,285	1,008	364,635
	1,981	4,640	1,534	990	377,045
	1,982	4,670	1,560	949	413,180
	1,983	4,348	1,552	923	412,450
	1,984	4,960	1,582	863	375,220
	1,985	5,059	1,553	832	378,505
	1,986	4,413	1,176	608	350,400
	1,987	4,621	1,039	578	400,770
	1,988	3,544	1,030	452	330,690
	1,989	4,957	1,376	858	393,470
	1,990	4,698	1,272	773	369,380
	1,991	3,818	1,100	610	335,435
	1,992	3,865	1,152	591	308,425
	1,993	3,639	922	501	331,420
	1,994	3,267	807	561	296,745
	1,995	3,249	841	648	328,135
	1,996	2,329	767	488	353,685
	22.Oct.1997	1,761	570	417	350,950
DOE RUN PERU S.R.L.	23.Oct.1997	411	133	97	81,809
	1,998	1,942	835	445	467,324
	1,999	1,789	844	422	459,020
	2,000	2,555	542	422	317,466
	2,001	2,475	496	345	332,278
	2,002	2,449	480	434	331,380
	2,003	2,464	519	333	328,135
	2,004	2,245	623	308	333,814
	2,005	2,106	530	275	296,851
	2,006	2,022	489	255	291,624
	2,007	1,117	371	198	292,442
	2 008**	824	183	73	206,225
C de P/CMP	Sub total (Hasta Oct.1 997)	204,223	26,060	18,185	8,413,800
	Extrapolando 1 922-1 944	100,998			
	Extrapolando 1 922-1 974		35,350	24,668	11,413,502
	Total 1 922 - Octubre 1997	305,221	61,410	42,853	19,827,302
DRP SRL	Total Octubre 1 997-2008	22,423	6,044	3,607	3,738,368

** Data preliminar

Fuente: CMP SA; PAMA Original, Vol V

ACTIVOS MINEROS S.A.C.
Vº Bº
Gerencia de Operaciones

APPENDIX C: DR. PARTELPOEG PORTION OF 2006 PANEL OF EXPERTS REPORT

APPENDIX A

PARTELPOEG REVIEW OF PAMA PROJECTS

May 10, 2006

Report Prepared by:

Eric Partelpoeg, Ph.D
EHP Consulting, Inc.
6038 N Camino Miraval
Tucson AZ, 85718
(520)615-4030
eric@ehp-consulting.com

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DISCLAIMER

This report is based on the best information available to Eric Partelpoeg within the time constraints of the review. The material in it reflects his best judgement in light of the information available to him at the time of preparation. Specifically, it is based on information supplied by site representatives, a review of reports, discussions with individuals, and several tours of parts of the facility. He has prepared this report using information understood to be factual and correct and shall not be responsible for conditions arising from information or facts which were not fully disclosed to him, or for conditions which can only be confirmed through sampling or monitoring.

This report was prepared by the Dr. Eric Partelpoeg for the Ministry of Energy and Mines, Peru to aid in their decision-making with respect to an Exceptional Extension Request for the Sulphuric Acid Plants project of La Oroya Metallurgical Complex PAMA. Any use of, or reliance or decision based on this report by any third party is the sole and exclusive responsibility of such third party. Dr. Partelpoeg accepts no responsibility for damages, if any, suffered by any third party as a result of the use of, or reliance or decision based on, this report.

1.0 SCOPE OF REVIEW

This section of the report was written by Dr. Partelpoeg, but has also been reviewed by other members of the Panel of Experts. Dr. Partelpoeg was asked to address the following specific items:

1. Review the technology used in the copper, lead and zinc circuits, with particular attention to the impact of the technology on emissions and the level of ease / difficulty associated with controlling these emissions.
2. Analyze the copper and lead pyrometallurgical production circuits, in order to evaluate the existing measures and propose additional measures for the management/elimination of recirculating flows (particularly fine dusts) in those production circuits.
3. Analyze the copper and lead pyrometallurgical production circuits, in order to evaluate the existing measures and propose additional measures for the reduction of fugitive emissions and emissions from the stack in the copper, lead and zinc production circuits, which include, among other aspects: design and efficiency of the baghouses, electrostatic precipitator units, and the collection of the gases collected into theses systems.
4. Review and comment on the DRP execution plans to reduce fugitive emissions, including a review of the investment and task execution schedules.
5. Review and comment on the copper pyrometallurgical upgrade project, with particular focus on minimization of project schedule while maximizing SO_2 collection efficiency.
6. Review and comment on the sulfuric acid production processes of the lead and copper circuits.
7. Evaluate the project schedule for the implementation of the proposed lead circuit's sulfuric acid plant. Offer suggestions to improve the schedule, if possible.
8. Evaluate the execution deadline for each of the activities proposed for the modernization and implementation of the copper circuit's sulfuric acid plant,

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

which include the monthly investment schedules and tasks execution schedules. Offer suggestions to improve the schedule, if possible.

9. Analyze and propose reorganizations in the Environmental Management Program and Contingency Program for the operation and maintenance of the different systems and equipments to be implemented.
10. Make any other recommendations that are relevant to the project.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

2.0 SUMMARY OF CREDENTIALS

Dr. Partelpoeg received his Ph.D in Metallurgy from the University of Arizona in 1985. His Bachelor of Engineering and Masters of Engineering were earned at McGill University in Montreal Canada in 1977 and 1980 respectively. His smelter experience includes direct operations involvement in smelters in Finland, Canada, and the United States. He has participated in smelter projects in Australia, Asia (China, India, Thailand), Africa, Europe, and South America (Brazil, Chile, and Peru). These projects include due diligence reviews associated with mergers and acquisitions, problem-solving, computer modeling, failure analysis, and review of serious accidents. His pollution control experience includes project design, management, and construction of baghouses, electrostatic precipitators, scrubbers, and sulfuric acid plants.

A specific example of baghouse experience is the oversight and project management of a 250,000 Nm^3/hour copper converter fugitive gas baghouse project that was installed at the Phelps Dodge Chino Smelter in the mid 1990s.

In late 2005 Partelpoeg was involved in a feasibility study that was considering the installation of a 180,000 tpy acid plant. Discussions with acid plant suppliers at that time indicated that 3-4 months would be required to respond to a fixed price bid and that approximately two years would be required from the time the contract was signed to first acid production.

Examples of electrostatic precipitator experience include: (1) upgrading of precipitator controls and precipitator internals at the Chino Smelter in the late 1980s, (2) precipitator inspections in Nevada, Brazil, and Australia, and (3) expert witness evaluation of an electrostatic precipitator that failed due to acid dew point corrosion.

3.0 SUMMARY OF ACTIVITIES AT LA OROYA

Partelpoeg's La Oroya activities are summarized in the following tables:

1. Table 3-1 summarizes Partelpoeg activities at La Oroya.
2. Table 3-2 summarizes the key documents that have been reviewed (most obtained from MEM or DRP, some from public sources), and
3. Table 3-3 provides a snapshot and comment of photos taken at the site.

Table 3-1 Summary of La Oroya Activities

	Activity	Comments
1	View of complex from across the river (April 10)	Observed smelter at 1:00 pm, noted NO_2 emission release, smelter fugitives
2	DRP review of PAMA related programs (April 10)	DRP's presentation reiterated their commitment to the projects and schedules that they have submitted to MEM with the PAMA extension request
3	Preliminary tour of facility (April 10)	Visited lead blast furnace tapping floor, overview of copper converter aisle, lead anode area, zinc refinery, and vehicle wash station
4	Meeting with smelter projects team (April 11)	Reviewed fugitive emission reduction program details, discussed blast furnace enclosure plan, concentrate storage emissions control plan, requested key documents. Reviewed NO_2 scrubber design, reviewed sinter plant baghouse projects. Project team acknowledged that if lead acid plant not procured from Fleck, the schedule will slip. Reviewed unique ability of ISA-Smelt to process high-impurity feed. Planning water-cooled hoods for converters. Will install one rotary holding furnace. No details or concepts have been developed to address emissions during reducing stage of copper production. Montgomery Watson (MWH Peru, S.A.) responsible for October 2006 start-p of waste water plant. Jim Minster (retired Doe Run US mechanical lead) on project team to help expedite project. If DRP misses the copper modernization project schedule, the reverberatory furnace will be shut down; DRP will not ask for extension to operate reverberatory furnace beyond December 2009.
5	Tour of Central Cottrell (April 11)	Reviewed layout of precipitators and precipitator control systems (SQ-300 installed in 2001). Area has dedicated mechanics and shift engineers. All data on company intranet system to allow easy access to operating data. All transformers PCB-free. No plans currently to have converter fugitive gases to central Cottrell after copper modernization (fugitives to acid plant).
6	Meeting with smelter projects team (April 12)	Reviewed adequacy of metallurgical accounting, reviewed lead balance. Discussed replacement of sinter area scrubbers with baghouses. Reviewed plan to extract high strength SO_2 from sinter machine. Discussed possibility of replacing 60+ year old central Cottrell with new high efficiency unit once PAMA projects are complete. C-side baghouses for bedding plant transfer points. Receive 40-50 trucks per day. Road to bedding plant was dirt two years ago. Now concrete.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

7	Brief meeting with Dan Vornberg April 12.	Remaining uncontrolled SO_2 split is approximately one third from the lead circuit and two thirds from the copper circuit. Sinter plant scrubber discharge of 116 metric tons per year (tpy) measured. Based on estimated unit efficiencies, this discharge should decrease to 4 tpy.

Table 3-2 Summary of Key Documents

	Document Reviewed	Relevance to Project
1	06_Baghouse Schedule Ventilation Projects.pdf	Detailed DRP schedule for 2006 fugitive emission reduction projects. The schedule to complete all projects is tight.
2	05_Proposal for Blast Furnace BHSE Rev 3.pdf	Feb 13, 2006 document from GE (new owners of BHA) for baghouse for blast furnace area. The proposal indicates that GE will supply all of the technical components of the baghouse and DRP will arrange for the bulk steel components of the baghouse (including structural supports, the and the main baghouse unit). This avoids the freight problems associated with delivering bulky items to La Oroya but increases project risk as the construction of the baghouse is to tight tolerances and DRP must assume the project management of the local fabrication.
3	12A_Sinter Machine Study Bob Nutten Report.pdf	The February 2005 report that outlines the concept of how to produce acid from lead sinter machine process off-gases.
4	Tri-Mer Brochure (Tri-Mer Packed Bed Tower Scrubbers), from www.tri-mer.com (09_Scrubber for nitrous gases.pdf)	Nitrous oxide gases (NO_2) were observed by the Panel on April 10. DRP has ordered a packed bed scrubber system from Tri-Mer. An initial review suggests that the Tri-Mer technology is appropriate for this application.
5	Folder: 08_Design specification ventilation baghouses	A series of files associated with the August 2001 submittal of a report by BHA that reviewed the off-gas handling system at DRP.
6	12E_Schedule NSAP Lead Circuit.pdf	Detailed DRP schedule for the lead acid plant. The schedule assumes that Fleck Chemical Industries will supply the technology. Other acid plant suppliers would need more time.
7	13C1_GENERAL ARRANGEMENT Cu SMELTER PROJECT.pdf	General arrangement drawing of new copper smelting system including new acid plant.
8	13A1_Oferta COPRIM.pdf	Engineering and construction offer from COPRIM, a major Chilean firm, for the copper modernization plan
9	13B1_DRP Cu SMELTER – INDEC SA PROPOSAL BE-EPCM	Engineering and construction offer from INDEC, a major Chilean firm, for the copper modernization plan
10	ANEXO II Crono Inver y Ejec Modern Cu Mar 18.pdf	Schedule and cost estimate for copper modernization plan (excluding acid plant details).
11	BancoMundial_AsesoresMEM _10Abr06.pdf	DRP Powerpoint presentation, which includes the cost and schedule of the copper plant acid plant.
12	Lead_Apendice C.pdf	A summary of expected lead emissions after improvement projects. The document indicates that agglomerator scrubber area emissions of 116 mtpy lead would decrease to 4 tpy with their replacement by baghouses.
13	"Ventilation Projects Summary (Fugitive Emissions), April 12, 2006	A summary of fugitive emissions proposals from GE and the current (early April, 2006) status of the fugitive emission reduction projects.
14	c12s06-EPALeadReview.pdf	http://www.epa.gov/ttn/chief/ap42/ch12/final/c12s06.pdf A review of lead processes and relative sources of emissions for these processes.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

15	b12s06-EPALeadReview02.pdf	http://www.epa.gov/ttn/chief/ap42/ch12/bgdocs/b12s06.pdf background data for previous paper.
16	c12s03-EPACuReview.pdf	http://www.epa.gov/ttn/chief/ap42/ch12/final/c12s03.pdf review of copper smelters and emissions
17	c12s03-EPACuReview02.pdf	http://www.epa.gov/ttn/chief/ap42/ch12/bgdocs/b12s03.pdf background data for previous paper
18	c12s07-EPAZincReview.pdf	http://www.epa.gov/ttn/chief/ap42/ch12/final/c12s07.pdf background review of zinc processes
19	Outokumpu-Lurgi Zinc FBR.pdf	Description of Lurgi fluid bed roasting technology
20	LeadTechnologies-LDAINT-technotes.pdf	Review of lead extraction technologies
21	http://www.xstratatech.com/doc/isasmelt4_en.pdf	Review of ISASmelt technology
22	Daily Report Stack Emissions.pdf	DRP stack emission data

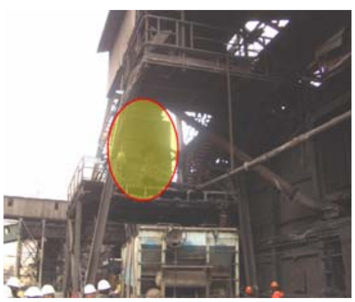
Table 3-3 Summary of Key Photos from Site Visits

#	Photo	Comments
1		A view of the blending plant. The blending plant is centrally located within the smelter complex and DRP's plan to build walls and install a water spray system to maintain concentrate moisture at 10% to minimize dust losses is a reasonable approach towards reducing bedding plant fugitive emissions.
2		This view shows concentrate dropping from the overhead conveyor onto the concentrate bed. Maximum dust losses from this conveyor would occur when the bed is empty and wind velocity is high.
3		The orange / brown emissions at the left of this photo are nitrous oxide (NO_2) emissions from the anodic residue plant. DRP will be installing a NOx scrubber manufactured by Tri-Mer. The April 12, 2006 document (Item 13 from Table 3-2) indicates that the Tri-Mer proposal is under evaluation. If this purchase order is not finalized quickly, it will be difficult to complete this project in 2006.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

4		A view of fugitive emissions on April 10, 2006.
5		The tapping area of the lead blast furnace. DRP is utilizing their experience at Herculaneum to design the blast furnace enclosure system.
6		A view of the copper converter aisle. On this occasion, converter aisle fugitives emissions were low. The current plan for the copper plant modernization is planning on venting converter fugitives to the acid plant. Careful review of this concept is required as typically the volume required to control converter fugitives is much higher than air addition requirements in an acid plant. The furnace in the foreground is the blister holding furnace. In the future it will be modified to refine blister copper to anode copper.
7		A few of the central Cottrell plenum. The central Cottrell system is more than sixty years old and its efficiency is lower that more modern units.
8		In 2001, DRP did upgrade the power control system of most of the central Cottrell units. This photo shows a modern precipitator control interface. This equipment maximizes the efficiency of the units (but still not up to the level of new precipitators).

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

9		This view, from an upper level of the lead agglomerator area shows the general location of the lead system acid plant. Highlighted in the top right hand corner are the two scrubbers that will be replaced by baghouses in 2006. These scrubbers are estimated to release 116 mtpy lead; the new baghouse emission rate is estimated at 4 mtpy lead. This is the area where maximum emission reduction can occur per dollar / sole of investment.
10		This photo shows the top of the lead agglomerator. Barely visible are fugitive emissions that are leaking by cracks in the top of the agglomerator gas collection plenum. Due to the high temperature inside the agglomerator, it is likely that these fugitives are high in lead content.
11		A view of the agglomerator baghouses scheduled for re-build and upgrades in 2006.
12		The highlighted area shows the area of the scrubber that collects dust from the bedding plant conveyor belt transfer points. This scrubber is being replaced by a baghouse in 2006.
13		Footings for the new baghouse for the bedding plant conveyor belt transfer points being prepared.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

14		A view of the vehicle wash station. An efficiency check of the system should be considered, particularly to determine if the undercarriage of vehicles and tire treads are adequately cleaned. The water pressure seemed lower than other vehicle wash stations that Partelpoeg has driven through.
15		A view of the lead refinery tankhouse. The employees are wearing respirators. Emissions from the copper and lead refinery should be considered when updating the La Oroya area emissions model.
16		A view of blister copper in the copper refinery. The rough shape of the copper surface is due to sulfur in the copper that results in an uneven surface when the copper solidifies.

It should be noted that one of the activities not accomplished was a complete walk-through of the facility. Areas not inspected include, but are not limited to:

1. The zinc roaster and acid plant,
2. The process operations that focus on impurities such as arsenic, cadmium, and antimony.
3. The Anodic Residues Plant,
4. A close-up inspection of the copper converters,
5. The copper roasters.

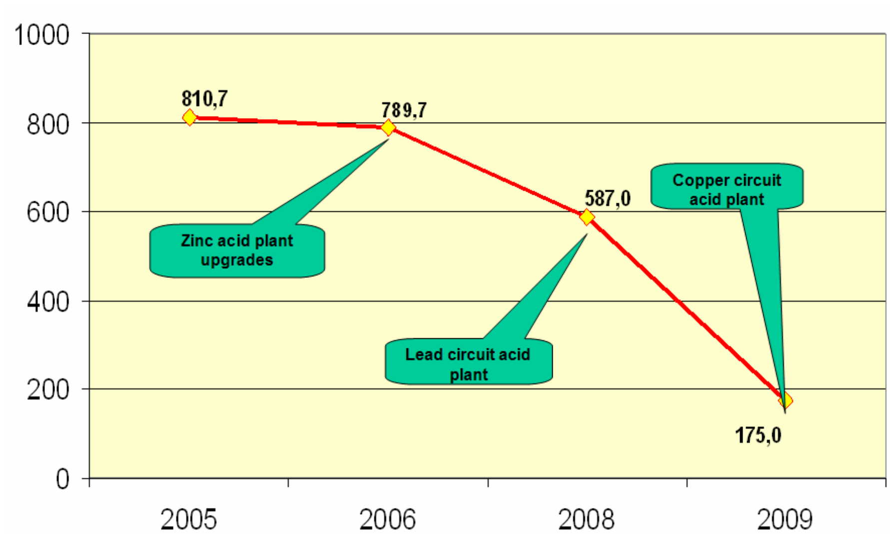
ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

4.0 BACKGROUND TO PAMA PROJECTS

The following pages provide a general background to the emissions issues at DRP as well as a brief overview of the PAMA extension projects. The purpose of this overview is to help clarify the discussion and positions in subsequent sections of this appendix.

Figure 4-1 shows DRP's estimate (translated from a PowerPoint presentation provided to the Panel of Experts) of main stack SO_2 emissions with the presumption that the PAMA extension plan will be modified. The reduction to 175 metric tons per day (tpd) from current levels (approximately 800 tpd) represents a percentage decrease of approximately 78%.

Figure 4-1 Metric Tons per Day SO_2 Emissions
(from BancoMundial_AsesoresMEM_10Abr06.ppt)

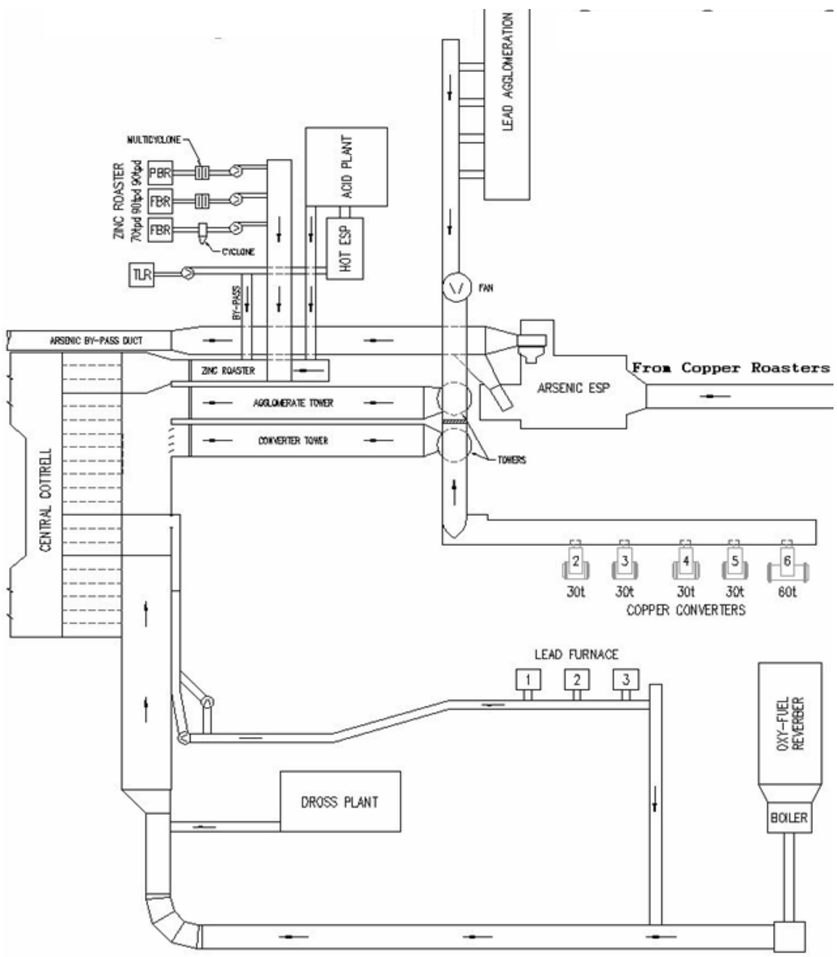


The PAMA extension request includes three major projects proposed by DRP to reduce emissions, (1) a reduction of fugitive emissions, (2) addition of an acid plant in the lead circuit, and (3) a modernization of the copper circuit that includes new smelting technology and a new acid plant. Figure 4-2 shows an overview of the

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

existing gas collection system. Currently the primary control technology to reduce particulate emissions into the main stack is the “Central Cottrell”. It consists of 21 electrostatic precipitators. These precipitators process gas from the zinc roasters, the copper system (including roasters, the oxy-fuel fired reverberatory furnace, and the converters) and the lead system (including the agglomeration plant, the blast furnace area, and the dross plant area). The precipitators are installed in parallel and the inlet gas enters through a common inlet plenum. The gases from the various circuits enter the plenum in different locations (as shown in Figure 4-2).

Figure 4-2 Overview of La Oroya Gas Collection System



The first major program associated with reducing both lead containing fugitive emissions and lead emissions to the main stack is the installation of baghouses to process gas from the lead blast furnace area and the lead dross plant. These

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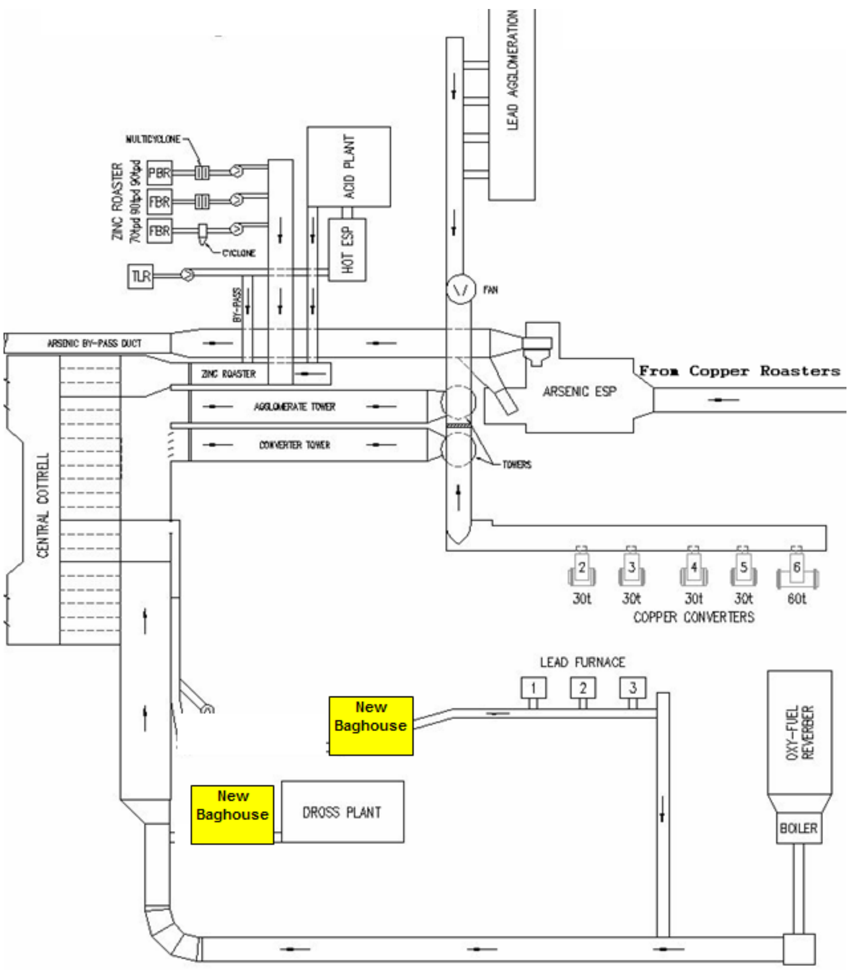
(520)615-4030
ERIC@EHP-CONSULTING.COM

additions are shown in Figure 4-3. The Central Cottrell dust removal efficiency is approximately 95% (based on DRP measurements). It is likely that the efficiency of removing elements that leave the process as vapors (such as lead) is even lower because their particle size may be sub-micron. The installation of baghouses for these flows should result in collection efficiencies that are greater than 99%. These baghouses will have decrease emissions two ways: (1) a direct reduction of emissions due to high baghouse efficiency, (2) reduced flows to the Central Cottrell which should to some extent, improve Central Cottrell efficiency. These improvements are scheduled to be completed in 2006.

Figure 4-3 Projected Plan to install Lead Circuit Baghouses



ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

Figure 4-4 shows the addition of the lead circuit acid plant. The DRP plan is to remove approximately 55,000-60,000 Nm^3/hour of process gas from the agglomerator (sinter machine). The gas will be extracted where SO_2 concentrations are highest (approximately 6% SO_2). This project is scheduled for completion in late 2008 and will reduce SO_2 emissions (see Figure 4-4).

Figure 4-4 Proposed Lead Circuit Acid Plant

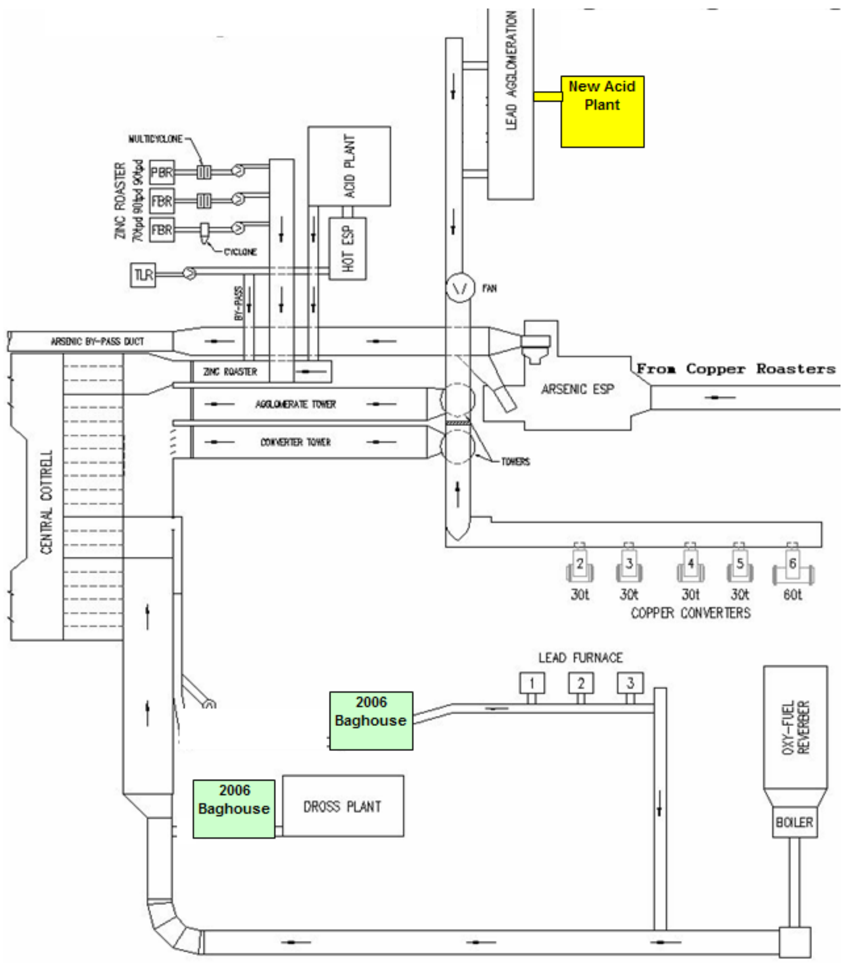
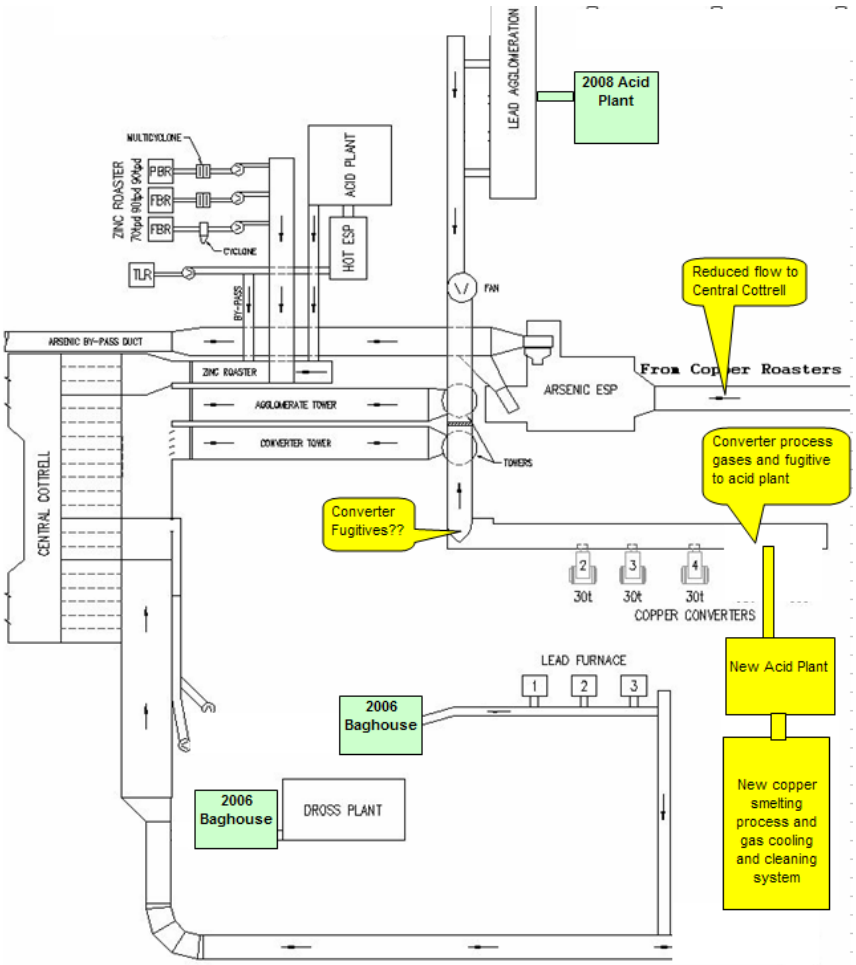


Figure 4-5 shows the general plan of the copper modernization project. Of all of the projects discussed in this section, this one is significantly more complex in terms of engineering required and the complexity of the equipment. This project will reduce SO_2 emissions to 175 tpd (below the Peruvian limit of 195 tpd). Figure 4-5 shows a caption noting “Converter Fugitives?”. At this time, DRP is not planning on

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

directing any of the converter fugitives to the main stack. Rather, the preliminary DRP plans indicate that converter fugitives will be processed through the copper circuit acid plant. This subject is discussed further in Section Figure 7-3—Partelpoeg suggests that this plan be studied carefully during engineering to confirm its feasibility.

Figure 4-5 Copper Circuit Modernization Project



ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

5.0 REVIEW OF LA OROYA METALLURGICAL TECHNOLOGIES

5.1 LEAD CIRCUIT

The lead circuit consists of the following major unit operations:

1. Concentrate receiving and bedding plant,
2. Concentrate agglomeration / sintering plant,
3. Lead blast furnaces,
4. Lead dross plant,
5. Lead anode casting,
6. Lead refinery.

This technology is dated (see Document #20 in Table 3-2, http://www.ldaint.org/technotes1.htm). Newer technologies include the Kivcet process which is also described in the afore-mentioned reference. Additional background information is summarized in Documents #14 and #15 of Table 3-2. These documents outline the emissions expected from the technologies employed at DRP. Newer technologies (such as the ISASmelt and Kivcet processes) are much more amenable to emissions controls.

5.2 COPPER CIRCUIT

The copper circuit consists of the following major unit operations:

1. Concentrate receiving and bedding plant,
2. Multiple-hearth roasters,
3. Oxy-fuel fired reverberatory furnace smelting,
4. Copper converting
5. Blister holding and casting into anode-shaped blocks.
6. Copper refinery

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

These technologies are described in Documents #16 and #17 of Table 3-2. These copper processing technologies are not amenable to efficient control of emissions. While copper converting is often associated with modern smelters, the DRP reverberatory furnace produces a low grade (30% copper) matte. The remainder of the matte is iron and sulfur. Converters produce lower emissions per unit of copper produced if the matte grade is higher (modern copper smelters have a matte grade in the range of 60-70% copper).

5.3 ZINC CIRCUIT

The zinc circuit consists of the following major unit operations:

1. Fluid bed roasting in a Lurgi roaster (now owned by Outokumpu). Fluid bed roasting of zinc concentrate is recognized as a modern, low emission technology.
2. Zinc oxide leaching.
3. Zinc refining.

DRP provided the following description of their zinc roasting operation:

- The zinc concentrates are fed directly into the cylindrical roaster. The roaster operates autogenously at a temperature of 940-950ºC.
- Temperature control is achieved with three cooling coils, inserted inside the roaster. Approximately the 70% of the load charge is transporting with the gases. The calcine precipitates in the waste heat boiler (WHB), cyclones and electrostatic precipitator, which cleans and cools the gases to 350ºC. 30% of the feed is discharged through the roaster bottom; the entire roaster product is processed through the leaching circuit.
- The process gas to the acid plant is 7.5% SO2.
- The Lurgi roaster capacity is 260 tpd and it uses air with oxygen enrichment.

Zinc extraction technologies are described in general terms in Document #18 of Table 3-2. This technology can be operated with low emissions. At DRP the zinc circuit acid plant is old. Currently, Fleck Chemical Industries, Incorporated (FCII), (a Canadian engineering firm specializing in acid plant upgrades) has summarized the zinc acid plant as follows:

> The scope of the detailed engineering work currently in progress by FCII for the upgrade of this acid plant includes:
>
> (i) Replacement of the Dry Tower and all internals with a new one.
>
> (ii) Replacement of the Dry Tower Pump Tank with a new one
>
> (iii) Replacement of cast iron serpentine acid coolers for Dry Tower, Absorber Tower and Product with plate type acid coolers.
>
> The new coolers will eliminate the numerous strong acid leaks of the serpentine coolers
>
> (iv) Upgrade of acid pumps
>
> (v) Replacement of Peabody Scrubber with a new Quench Tower and Gas Cooling Tower system. This includes the Towers and the weak acid circulation system including a new Weak Acid Cooler and Effluent Stripper.
>
> The new system will greatly reduce the quantity of weak acid effluent from 80 m^3/h to approximately 3.5 m^3/h.
>
> (vi) Replacement of all cast iron internals of existing converter.

These enhancements will improve the reliability of the acid plant. Fugitive emissions are still possible from leaks in ducts and expansion joints. Fleck is a relatively small firm and the zinc acid plant upgrades are not being supplied as a turn-key project. Rather, Fleck is developing specifications and detailed drawings. DRP is responsible for the construction management of the upgrades with occasional field inspections by Fleck.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

6.0 PAMA RELATED PROJECTS

6.1 FUGITIVE DUST REDUCTION PROJECT

The design basis for the fugitive dust reduction project is the BHA report that was submitted on August 15, 2001. The report discusses electrostatic precipitator efficiency; it points out corrosion problems in process gas ductwork and suggests improvements to reduce emissions. DRP has relied on this 2001 study as the basis for the projects summarized in Table 6-1.

Table 6-1 Summary of DRP Fugitive Emission Reduction Projects

AFE #	Description	US$ 000
012-05	Blast furnace process baghouse	3,188
014-05	Dust collection equipment after arsenic kitchen	1,675
045-05	Dross furnace baghouse	2,121
015-05	Upgrade of Sinter Plant Ventilation system	1,726
016-05	Enclosure of the dross and lead furnace building	2,941
018-05	Nitrous oxide scrubber in Anodic Residues plant	2,092
019-05	Concentrate bedding plant spray systems (lead and copper)	1,074
020-05	Anodic Residues dust collection system improvements	2,641

Project 012-05 and 016-05 refers to the blast furnace enclosure and baghouse project, described earlier (see Figure 4-3). The design criteria of this project are largely based on Doe Run experience with similar projects in the U.S. and based on the limited discussions between DRP and Partelpoeg, the design appears to be well thought out. Similar comments apply to Project 045-05, the baghouse for the lead dross furnace. Both of these projects will reduce the gas load and lead input to the Central Cottrell, which will reduce dust emissions through the main stack.

Project 015-05 involves the upgrade of sinter plant baghouses and the replacement of scrubbers with new baghouses (in Table 3-3, see photos # 9 and #11).

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(520)615-4030
ERIC@EHP-CONSULTING.COM

Based on DRP projections of emissions reductions (Reference # 12 in Table 3-2), the scrubber replacements will have a significant benefit to low-level lead emissions. Technically, the scrubber emissions are not classified as a fugitive emission as the scrubber outlet gases have been cleaned. From a practical perspective, however, the emissions exiting the scrubber have the same effect on the community as a fugitive emission since the outlet stack is at a relatively low level. Accordingly, the replacement of the scrubbers should receive the highest possible priority in order to decrease lead emissions by over 100 tons per year from these sources.

DRP has indicated that the scrubber efficiency has been estimated to be in the range of 70-85% based on their experience with similar scrubbers in the US. While they have on several occasions measured scrubber outlet loadings, the inlet loading has not been measured to confirm the scrubber efficiency. Even though the scrubbers will soon be replaced by high efficiency baghouses, because the scrubbers are effectively a major source of fugitive emissions, the scrubbers should be tuned to maximum efficiency for the remainder of their duty life. To determine the approximate efficiency of the scrubbers, DRP can measure the difference between the solids and lead content in the scrubber feed water and scrubber effluent. Based on the 116 tpy lead outlet loading (from earlier DRP tests), the scrubber efficiency can be estimated. If the efficiency is low (e.g. less than 60%, the scrubber operating system should be evaluated (e.g. scrubber nozzle condition, water spray pressure, de-misters if the scrubber design includes them, etc.).

6.2 LEAD CIRCUIT ACID PLANT PROJECT

The basis of the lead circuit acid plant project design is the Nutten report (Reference # 3 in Table 3-2). This study states that the process gas flow-rate from the reaction zone of the agglomerator (sinter machine) is approximately 100,000 Nm^3/hour with a concentration of approximately 3% SO_2. This SO_2 concentration is too low for effective conversion to sulfuric acid. Nutten recommended that DRP install a gas collection system in the sinter machine that is physically closer to the sinter—where the SO_2 concentration is the highest. DRP has subsequently carried out tests and has

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

confirmed that a 6% SO_2 stream can be collected from the sinter machine. This gas stream will contain approximately 70-75% of the total SO_2 generated in the agglomerator.

DRP is planning on installing a single-contact acid plant to process this gas stream. DRP is developing a contract with Fleck Chemical Industries for the acid plant design. Fleck and DRP will plan on executing this project in a manner similar to the zinc acid plant upgrades that are currently in progress—Fleck will develop detail specifications and drawings and DRP will manage the construction.

6.3 COPPER CIRCUIT MODERNIZATION

DRP began a formal review of copper circuit modernization options in 2004 when SNC-Lavalin (a large Canadian engineering firm with metallurgical process plant expertise) conducted a pre-feasibility review of La Oroya modernization options. Further reviews in 2005 have resulted in DRP concluding that the following copper circuit upgrades are required:

1. Replace the oxy-fuel fired reverberatory furnace with ISASmelt technology. ISASmelt technology is reviewed in Document # 21 in Table 3-2). Advantages of ISASmelt technology that are particularly important for DRP include:
   a. Efficient distribution of impurities into the gas phase which results in low impurities in the copper matte. Accordingly a high (60% Cu) matte can be processed in the converters without risking high-impurity blister copper.
   b. The footprint of the ISASmelt is small which facilitates its installation into an operating smelter.
2. Gas cooling and cleaning. The ISASmelt off-gases (in the range of 20% SO_2) will be cooled in a boiler followed by controlled injection of water. The cooled gas (approximately 350ºC) will be cleaned in an electrostatic precipitator prior to further cleaning in the acid plant gas cleaning system.

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(520)615-4030
ERIC@EHP-CONSULTING.COM

3. Modified converter hoods. DRP is planning on modifying the hoods of three of their converters with water-cooled technology to allow for a tighter seal between the hood and the converter. Only one converter will be blowing, alternating with the other hot converter. The third converter is to allow for repairs and maintenance.

4. A new acid plant to process both ISASmelt and copper converter off-gases. The combined process gas is expected by DRP to be greater than 10% SO_2 in concentration. DRP is expecting to dilute this gas with fugitive gases collected from the two hot converters.

5. Currently, DRP produces blister copper in the converters (copper with a small fraction of sulfur remaining, which results in "blisters" developing on the surface of the copper when it freezes (see Photo #16 in Table 3-3). With the modernization, DRP is planning on refining the blister copper at the smelter to produce traditional anode copper (no sulfur, approximately 1000 ppm oxygen). DRP will cast the anode copper with new Outokumpu anode casting technology.

Figure 6-1 shows the area of the smelter that will be modernized. The ISASmelt vessel is in the bottom right hand corner of the figure. Figure 6-2 shows the ISASmelt on the left side, with the new acid plant to the right.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

Figure 6-1 New Copper Circuit Metallurgical Unit Operations

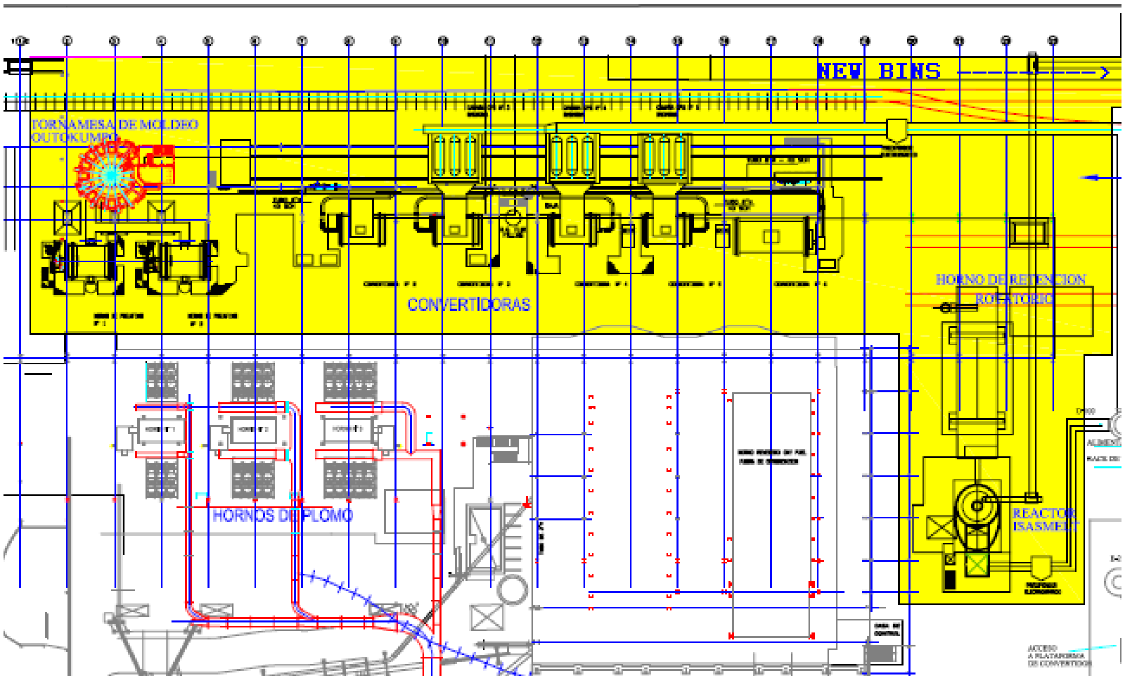
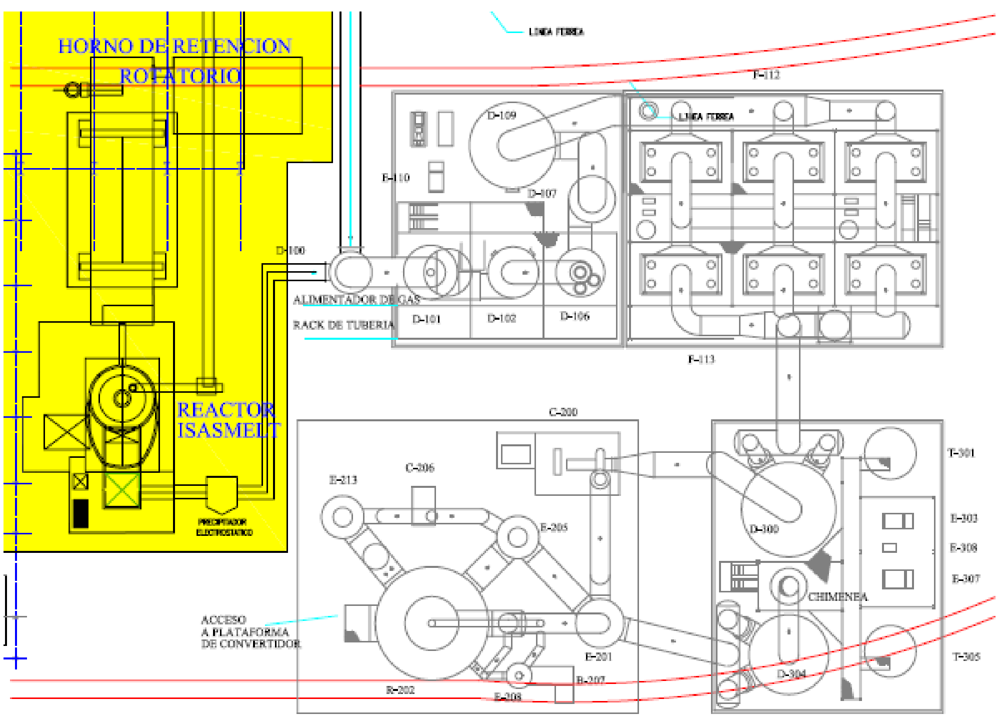


Figure 6-2 New Copper Circuit Acid Plant



ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

The new acid plant is expected to be a single contact acid plant. While not as efficient as a double contact acid plant (tail-gas emissions in the range of 1,000 ppm SO_2 instead of 200 ppm possible with a double contact plant), the project will significantly reduce SO_2 emissions from the smelter.

7.0 RESPONSE TO SPECIFIC QUESTIONS

7.1 REVIEW OF CORE TECHNOLOGIES

“Review the technology used in the copper, lead and zinc circuits, with particular attention to the impact of the technology on emissions and the level of ease / difficulty associated with controlling these emissions.”

The current copper circuit is not amenable to significant reductions in emissions. The reverberatory furnace off-gas is too dilute in SO_2 to facilitate conversion to sulfuric acid. Additionally, the low matte grade (30% Cu) from the furnace results in a high requirement for copper converters where the 70% (iron plus sulfur) is oxidized from the matte to produce blister copper. Currently all converter process gases (generated when air is injected into the converter) and non-process gases (residual gases evolved from the converter when is not blowing) are directed to the Central Cottrell. Fugitive emissions occur during the transfer of matte from the furnace to the converters, from the transfer of blister copper to the casting furnaces, and from the escape of process gases from the converter hood. These fugitive emissions contain SO_2 and heavy metals. The best way to reduce converter emissions is to reduce the reliance on converting by producing a high grade matte in the primary smelting furnace. This is one of the many reasons why modern smelting furnaces produce matte grades with copper concentrations in the range of 60-70% copper.

The DRP lead circuit is also not designed for effective capture of SO_2. The sinter (agglomeration) step produces a very low concentration SO_2 gas. Without a major change in technologies (e.g. Kivcet or ISASmelt), it is very difficult to significantly improve sulfur recovery beyond the methods being proposed by DRP.

The zinc circuit roaster and acid plant combination is up to date technology. The acid plant is old, however and the ductwork and vessels require a continuous maintenance program to minimize gas leaks.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

7.2 MINIMIZATION OF DUST RECYCLE

"Analyze the copper and lead pyrometallurgical production circuits, in order to evaluate the existing measures and propose additional measures for the management/elimination of recirculating flows (particularly fine dusts) in those production circuits."

The current complex configuration has not been optimized with respect to separation of dust types. Accordingly, the dust from one circuit can to some extent blend with gas from another circuit. Much of this co-mingling occurs in the Central Cottrell where, due to a common inlet plenum, gases from different processes can mix which results in a mixed composition dust that is captured from the hoppers of the precipitators.

DRP's proposed plans will significantly reduce the co-mingling of dusts (which adds to the recirculation load) because of the following initiatives:

1. The installation of the blast furnace baghouse and lead dross baghouses will isolate these lead-containing dusts from the Central Cottrell. The dust collected from these baghouses will not be contaminated with gas streams from the copper circuit.
2. The installation of the lead circuit acid plant will collect 60-75% of the SO_2 from the sinter machine. This SO_2 is extracted in the region of the machine with the highest temperatures. It is reasonable to expect that this region of the sinter machine also generates the highest amount of lead containing particulates and vapors. The gas cleaning system of the acid plant will collect this stream; presumably as a high lead dust / sludge. This further reduces the load of lead-containing dust from the Central Cottrell.
3. The installation of the baghouse after the Arsenic Kitchen (where most of the complex's arsenic trioxide is produced) will all but eliminate the source of arsenic from this process to the Central Cottrell and main stack flows.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

7.3 FUGITIVE EMISSION REDUCTION IN THE LEAD AND COPPER CIRCUITS

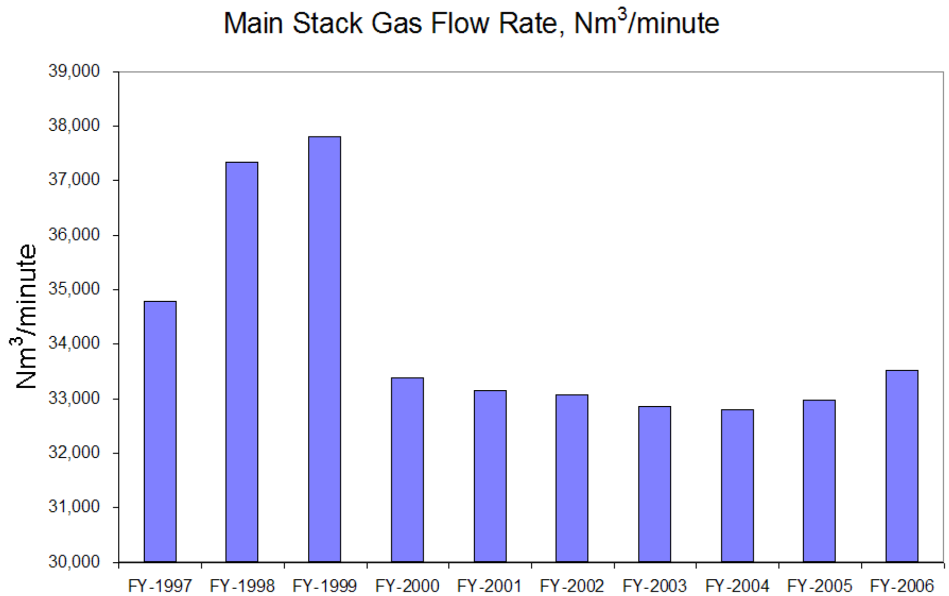
" Analyze the copper and lead pyrometallurgical production circuits, in order to evaluate the existing measures and propose additional measures for the reduction of fugitive emissions and emissions from the stack in the copper, lead and zinc production circuits, which include, among other aspects: design and efficiency of the baghouses, electrostatic precipitator units, and the collection of the gases collected into these systems"

The existing measures to collect fugitive emissions from the complex are inadequate. The review of GE proposals (new owner of BHA, the company supplying baghouse technology to DRP) for the baghouses indicates that the designs are all based on state of the art baghouses. These units will recover more than 99% of the dust, compared to Central Cottrell efficiency that is in the range of 94%. The only issue that is of some concern (from the perspective of employee exposures to either dust or confined spaces) is that the new proposals are for baghouses with walk-in plenums. This is different than the lift-off tops currently in use at the lead agglomerator (see Photo # 11 in Table 3-3). While this design feature does not impact baghouse efficiency, it does increase employee exposure to dusts when baghouse maintenance is being carried out.

The 2001 BHA smelter gas handling survey (Item #5 Table 3-2), points out several areas of the smelter where air is leaking into the gas handling ducts. Air leaks (air ingress / air infiltration) had increased over the years from corrosion; numerous photos are shown in the BHA report. During the two and half day visit, these areas of concern were not investigated. Any increase in gas flow-rate to the Central Cottrell reduces Cottrell operating efficiency. Figure 7-1 (data from Document # 22, Table 3-2) shows the flow rate of gas through the main stack from 1997 through 2006.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

Figure 7-1



The data do not suggest that the air ingress problems noted by BHA in 2001 were resolved. If this is confirmed, a program to decrease air ingress should be implemented in order to improve Central Cottrell efficiency. Once the baghouse projects are complete and once DRP fully addresses the air ingress issues, the total volume through the Central Cottrell should decrease significantly. At this time, a updated overall assessment (by BHA or other independent expert) should be conducted to determine the next phase of emission reduction projects.

During the April 10 review meeting, DRP indicated that they will replace the five small 12 foot diameter by 20 foot long converters with two additional 13 foot diameter by 30 foot long units (stating that the larger converter shells were already on site). On April 11, the project team stated that the current plan is to modify three of the existing 12 x 20 converters and abandon the other two 12 x 20 converters as well as the existing 13 x 30 unit. This second plan is reflected on Figure 6-1). At this time, DRP is not planning on venting converter fugitives to the main stack (either through a new baghouse or through the Central Cottrell). Rather, DRP believes that there will be sufficient capacity in the new copper circuit acid plant to process converter area fugitives. In Partelpoeg's opinion, it is unlikely that converter area fugitives can be effectively processed through the acid plant. Most (if not all) copper smelters have a

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

separate converter fugitive gas treatment system. It is recommended that the scope of the basic engineering should include an optimal converter fugitive collection and treatment system and not be predisposed upon treatment through the acid plant.

The modernized copper circuit will include the refining of blister copper to anode copper. The first step of blister refining is the oxidation of the residual sulfur that is in the copper. This is accomplished by blowing air through the copper. While this step adds to SO_2 in fugitive emissions (the anode furnaces are not hooded, see Photo #6, Table 3-3), the increase will be low, as the sulfur content in copper is a fraction of one per cent. After sulfur removal, the oxygen content of the copper is too high and a reductant must be injected to reduce the oxygen level to the range of 1,000 ppm oxygen in copper. This reduction can occur with the injection of propane (C_3H_8), reformed propane (propane cracked to CO and H_2), or steam. DRP has yet to define this aspect of the modernization. The use of only propane (without reforming or steam injection) results in only partial oxidation of the propane which results in a sooty fugitive emission. DRP should choose a reductant technology that produces a soot-free off-gas.

7.4 REVIEW OF DRP FUGITIVE EMISSION REDUCTION PROGRAM

"Review and comment on the DRP execution plans to reduce fugitive emissions, including a review of the investment and task execution schedules."

The DRP plan to reduce fugitive emissions by the end of 2006 is an ambitious plan that can be accomplished, but only if the highest levels of attention are given to each phase of the project. Execution of each project must remain on schedule to prevent one project on impacting another project. In general terms, the execution of the baghouse projects occurs in three areas:

1. Outside of Peru (e.g. BHA facilities in the US). The successful execution of this phase of the project will require near-continuous expediting by DRP. DRP has retained the services of Jim Minster (former Doe Run US mechanical lead from

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

the Buick facility) to assist with this task. The world-wide demand for BHA's equipment is high and BHA has to contend with shops outside of BHA's direct control (for example fan manufacturers). A few of the fans required for the project are currently scheduled for August and September deliveries. Any delays in manufacturing or shipping of these fans threaten the 2006 start-up.

2. In Peru but outside of La Oroya complex fence-line (e.g. local La Oroya shops). DRP discussed the current shortage of Peruvian steel due to an expansion currently underway at the Phelps Dodge Cerro Verde mine. The shops that are responsible for fabricating ductwork, platforms, and the baghouse boxes cannot be allowed to let their schedules slide. The schedule of individual projects is challenging in and of itself; in several cases the same type of equipment is scheduled for simultaneous fabrication. For example, ductwork for both the dross plant project and the anodic residue plant is scheduled for fabrication between April 3 and April 25. Unless this fabrication is occurring in separate shops, the delay in one project could impact the schedule of the other project.

3. Construction and commissioning activities at the property. Construction of the projects is of course dependent on timely delivery of new equipment. If delivery of equipment from one project is delayed, it may adversely affect the construction manning schedule of another project. It is too early in 2006 to predict the likelihood of such delays, but contingency plans should be developed.

With respect to overall project investments, the cost escalation of equipment related to these projects has been significant in 2005 and early 2006. Based on a review of GE / BHA proposal documents, some of the projects were still in the proposal stage in late March (for example the arsenic roster furnace ventilation baghouse). It is likely that any purchase order executed in late 2005 or early 2006 will have a total cost that may be 10-25% higher than expected based on best available information in early 2005.

Figure 7-2 shows a summarized schedule for the fugitive emission reduction projects. It shows that project engineering started in early 2005 (following the scoping

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

level investigations that started in 2001). As indicated in the previous paragraphs, this schedule is aggressive and significant efforts are required to avoid delays that jeopardize a 2006 completion.

Figure 7-2 Fugitive Emission Reduction Program

ID	Fugitive Emission Projects	Start	Finish
1	Scoping, Feasibility Study	1/5/2001	1/4/2005
2	Engineering	1/6/2005	7/28/2006
3	Purchasing	6/10/2005	10/31/2006
4	Construction	1/3/2005	10/27/2006
5	Start-up	10/2/2006	12/20/2006

GE / BHA were contacted by Partelpoeg on April 21, 2006. They (Fadi Moussa, [Fadi.Moussa@ge.com]) provided the same project schedule as DRP provided during the site visit. BHA was asked if there was a concern with achieving this schedule; no concerns were received.

7.5 COPPER MODERNIZATION PROGRAM

"Review and comment on the copper pyrometallurgical upgrade project, with particular focus on minimization of project schedule while maximizing SO_2 collection efficiency."

As was the case for the fugitive emission reduction project just discussed, the schedule of the copper modernization program is aggressive. The schedule is discussed in greater detail in Section 7.8. With respect to maximizing SO_2 collection efficiency, the area of converter fugitive emissions may be an opportunity that should be explored during basic engineering (see discussion on this subject in Section 7.3).

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

7.6 LEAD AND COPPER CIRCUIT SULFURIC ACID SYSTEMS

"Review and comment on the sulfuric acid production processes of the lead and copper circuits."

Both lead and copper sulfuric acid systems will be based on modern design. Typically new acid plant are designed with four catalytic conversion beds and two absorption towers to produce a final discharge gas concentration of 200-600 ppm SO_2. The La Oroya acid plants will be based on three catalytic conversion beds and one absorption tower. The discharge gas will be in the range of 1,400 – 1,900 ppm SO_2. This satisfies the initial goal of reducing SO_2 emissions to 175 metric tons per day (the acid plant component of this total is less than 10% of this total). Because other areas of the complex are greater sources of SO_2 emissions, it is technically reasonable to install single absorption acid plants at La Oroya. For the second phase of emission reduction (after the copper circuit has been commissioned), DRP should first evaluate methods to reduce emissions from the SO_2 sources that are the major sources of the 175 tpd emission rate—the acid plant tail-gas minimization does not, from a technical perspective, require first priority attention.

7.7 LEAD CIRCUIT ACID PLANT SCHEDULE

"Evaluate the project schedule for the implementation of the proposed lead circuit's sulfuric acid plant. Offer suggestions to improve the schedule, if possible."

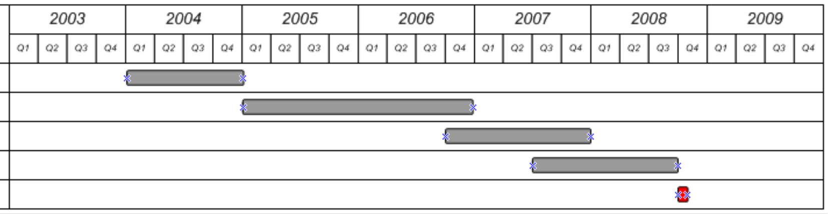
Fleck Chemical Industries is performing the engineering for the lead circuit acid plant. Achieving the 2008 project deadline is contingent on continued partnership between DRP and Fleck. Other, larger acid plant engineering firms would require another round of feasibility studies and negotiations. This would jeopardize the possibility of completing this project on schedule. While there is no reason to suspect that DRP and Fleck will not continue to work on this project together (and certainly Fleck is well qualified for this task), Fleck is a small firm with only a handful of key senior level engineers. Any loss of the Fleck team from the project would risk a delay

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

in the schedule. Figure 7-3 shows the lead circuit acid plant schedule—it is achievable but there is little opportunity for compression.

Figure 7-3 Lead Circuit Acid Plant Schedule

ID	Lead Acid Plant Project	Start	Finish
1	Scoping, Feasibility Study	1/5/2004	1/5/2005
2	Engineering	1/3/2005	12/26/2006
3	Purchasing	10/2/2006	12/31/2007
4	Construction	7/2/2007	9/30/2008
5	Start-up	10/1/2008	10/31/2008



7.8 COPPER MODERNIZATION SCHEDULE

“Evaluate the execution deadline for each of the activities proposed for the modernization and implementation of the copper circuit’s sulfuric acid plant, which include the monthly investment schedules and tasks execution schedules. Offer suggestions to improve the schedule, if possible.”

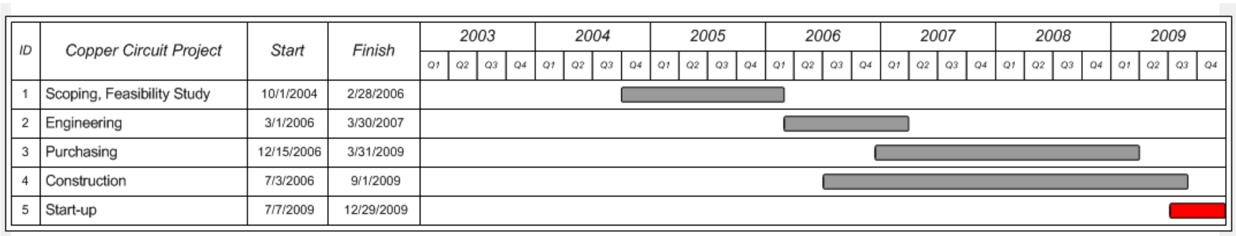
The copper modernization project is by far the most complex of the current DRP projects. Adding to the complexity are the tasks currently underway at DRP (zinc acid plant upgrades, fugitive emission reduction program, and the lead acid plant project). DRP has recognized the complexity of this project and has solicited engineering and project management assistance from Chile’s two major engineering firms with smelter experience (see Documents #8 and #9 in Table 3-2). Both of these firms (COPRIM and Indec) have expressed an interest in the project and they are qualified to carry out the work.

In order to execute this project, certain tasks must be carried out sequentially. For example the acid plant scope and engineering cannot start until the process conditions upstream of the acid plant have been fixed. This requires the completion of basic engineering of the smelting furnace / converter area. Figure 7-4 shows engineering extending into early 2007 for the smelter area. At this time (possibly in late 2006), it will be possible to adequately define the acid plant scope to request turnkey

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

acid plant packages from the major suppliers (MECS, Kvaerner-Chemetics, Outokumpu-Lurgi). These suppliers will demand a period of months (perhaps three months) to properly respond to the bid request. Once DRP has chosen a supplier and worked out all terms (special consideration is required for a large acid plant at La Oroya as major acid plant equipment may be too large for transport from Lima to La Oroya), a period of two years may be required before the acid plant is operational.

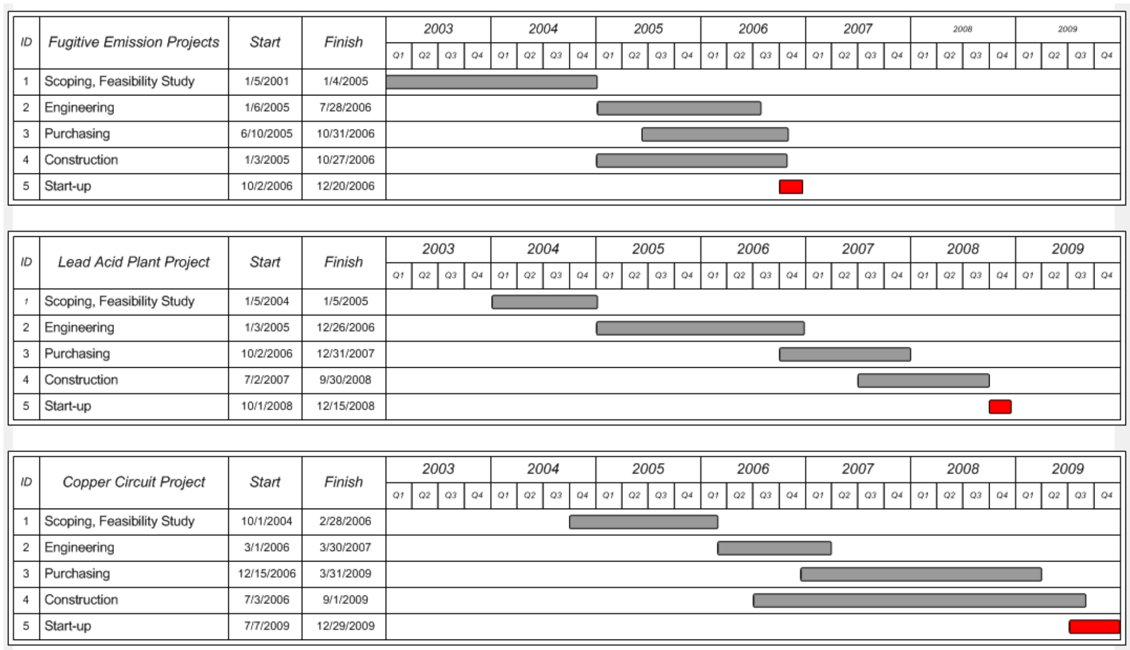
Figure 7-4 Copper Modernization Schedule



The conclusion of the schedule review is that the copper modernization schedule is aggressive and there is more risk of schedule slippage than opportunity for schedule compression. This conclusion is supported by Figure 7-5 that shows all three major projects at once. All of the projects are important and the activity levels in 2006-2007 will be very high. While the addition of a few expediters to the project would be useful, adding a new project team to, for example, focus on the copper modernization project could lead to more confusion and missed deadlines as one team may end up competing for the same resources as the other team.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

Figure 7-5 Overview of all Projects.



7.9 SUPPLEMENTARY CONTROL SYSTEM

"Analyze and propose reorganizations in the Environmental Management Program and Contingency Program for the operation and maintenance of the different systems and equipments to be implemented."

As discussed on the previous pages, DRP is making a strong effort to implement projects that will reduce emissions. During the visit it was evident that employees have been trained to wear personal protective equipment (e.g. respirators) to minimize exposure to lead and other contaminants. That being said, there appear to be opportunities to reduce the impact of fugitive emissions beyond the current level of effort. Dr. Young (Appendix B) discusses the implementation of a SCS that uses real-time meteorological data to minimize impact of DRP operations on the local community. Adding to this concept could be a new initiative by DRP operators and maintenance personnel to monitor, grade, and respond to new fugitive gas leaks on a real-time basis. DRP should evaluate the feasibility of creating a new task force that has the support at the highest levels of DRP. The team would:

1. Observe and repair fugitive gas leaks. The team would, based on their experience, develop and maintain a rating system on the sources of fugitive emissions. For example, the sources could be identified into the following source areas:
   a. Roasters
   b. Zinc acid plant
   c. Copper converter aisle
   d. Lead agglomerator
   e. Concentrate beds
   f. Roads
   g. Anodic residues plant
   h. etc. (DRP to continue with this list).
2. Rank the emissions from each source on a simple scale, for example:
   a. "A" for the area is as clean as possible (before project implementation),
   b. "B" the area is emitting an average level of fugitive emissions,
   c. "C" the area is emitting an above average level of fugitive emissions, and
   d. "D" there is a process or equipment upset that is resulting in a much higher than average level of fugitive emissions.
3. Areas with a "D" would result in the immediate mobilization of a dedicated maintenance crew. For example, on April 12, 2006 there was a "D" level of emissions from the zinc acid plant as it was evident that there was a leak in process ductwork or equipment as the SO_2 level at the lead agglomerator area was higher than normal. Perhaps DRP was already responding to this situation, but it is possible that a few hours could have slipped by before action was taken.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

During periods of no major upsets, the maintenance team would continue to work on their back-log of minor repairs (for example there was a maintenance team working on the Central Cottrell fixing small leaks on April 11. It is possible that this team would have to be dedicated to higher priority leaks should they occur.

The emissions reduction team would feed the condition of each area into the SCS program. If one or more areas was in a “D” mode, the SCS program could be triggered into a more aggressive mode to cut back on emissions earlier than if all areas were average or in a “B” mode.

The emission observers can also provide guidance to operators. For example they may notice high levels of emissions from the converter aisle. In some case these emissions can be reduced by rotating the converter towards the hood.

These concepts of a real-time dedicated approach to emissions minimization coupled with the SCS program have been proven in operating smelters. When Partelpoeg was the manager of the Phelps Dodge Chino Smelter (100 meters from the town of Hurley, New Mexico), such a system was implemented and ambient conditions improved significantly.

7.10 OTHER COMMENTS / RECOMMENDATIONS

“Make any other recommendations that are relevant to the project.”

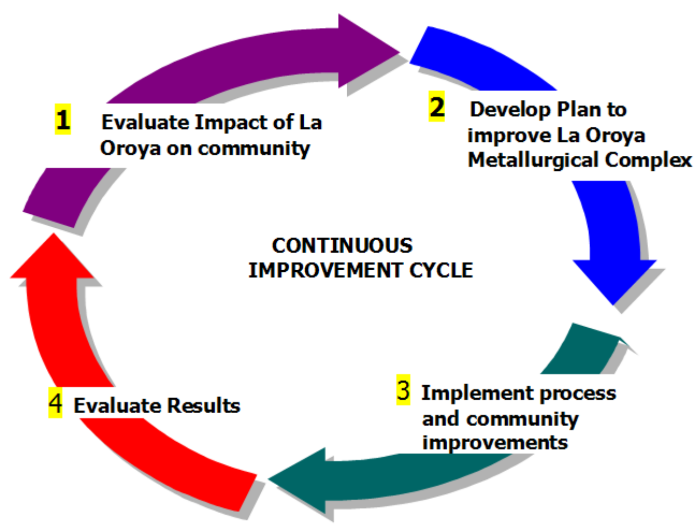
See Section 8.0, following page.

8.0 RECOMMENDATIONS

The following recommendations are presented in order of importance:

1. Based on my review of the complex and DRP's commitment to modernize the smelter within the timeline presented to MEM, I recommend that MEM grant DRP the PAMA extension. My discussions with DRP indicate that they are committed to a continuous improvement cycle as shown in Figure 8-1 (translated from a DRP presentation). The recommendation to grant the PAMA extension is based not only on the current project plans but also due to DRP stated commitment to continuous improvement.

Figure 8-1 Continuous Improvement Cycle



Some examples of continuous improvement include:

- Further reduction in emissions. For the case of La Oroya, a reasonable target for SO_2 emissions could be less than 100 tpd by the year 2020.
- Continued steps to reduce reliance on the Central Cottrell. As flows through the Cottrell decrease, it may be possible to replace the Cottrell with a modern electrostatic precipitator.

- Continued reduction of process gases by introducing technologies that rely on oxygen enrichment. This action will assist in achieving the previous two examples of continuous improvement.

2. All of the DRP projects (2006 completion of fugitive gas reduction, 2008 completion of the lead circuit acid plant, and 2009 completion of the copper circuit upgrade and acid plant) are on tight timelines. DRP provided detailed project schedules and indicated that they have expediting support from form DRP US experts. It is recommended that DRP develop a concise (absolutely limited to one page) project update report that is issued weekly. This report should provide an executive level summary that either affirms the project schedule or reports on schedule variances along with the action plan to recover from the variance. Vendors and outside shops should be required to provide input to this report with either a confirmation that all phases are on schedule or what action is being taken to recover time.
3. Once DRP makes the decision on whether COPRIM or Indec (see Documents #8 and #9 in Table 3-2) is selected for the copper modernization project, they should be asked to review the construction schedule of the fugitive emission program to confirm that the schedule is achievable as published or if modifications are required.
4. DRP should consider a program similar to the one described in Section 7.9 to improve the effectiveness of the SCS program.
5. The decision not to install a copper converter fugitive gas collection system (separate from the concept of using these gases as dilution air to the acid plant) should be reviewed with care. The copper circuit modernization plan should include a provision to send gases through the main stack when there is a sudden failure of the acid plant.
6. The lead sinter area scrubbers should not be shut down until the replacement baghouse is ready for start-up.

ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM

7. A review of the vehicle wash station efficiency should be carried out to determine its effectiveness in removing dust from tire treads and the underbody of vehicles.

8. The reliability of ducts and heat exchangers of the zinc acid plant should be reviewed to determine if an upgrade program is required to reduce the frequency and severity of gas leaks from the zinc acid plant.

Submitted by Eric Partelpoeg

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ERIC PARTELPOEG
(520)615-4030
ERIC@EHP-CONSULTING.COM