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CONTENTS

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CORAL BAY NICKEL HPAL PLANT EXPANSION PROJECT

By

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ABSTRACT

This Paper will present Coral Bay Nickel Corporation (CBNC) High Pressure Acid Leach (HPAL) Plant Project in the Philippines, mainly its Expansion activities. The original Plant was inaugurated on April 5, 2005 and has achieved its nameplate capacity of 10,000 Ni-Tons/Y in year 2007, where it produced 10, 078 Ni-tons. It was again achieved on the next year, where it produced 10,562 Ni-tons. The Expansion Plant was essentially designed to more than double the production capacity of CBNC HPAL Plant to 22,000 Ni-Tons and 1,500 Co-Tons in a year. Line-2 is basically a mirror-image of Line-1, where each major process circuit is duplicated. To increase Nickel throughput, the High Rate Ore Thickener type of Line-1 was replaced with a High Compression Thickener type in Line-2 to ensure higher %solids of ore slurry. Moreover, GEHO Pumps operation innovation was introduced by the use of Parallel method, which minimized operation down time. To achieve greater efficiency and high availability rate in the 2-Plant operation, tie-in lines were incorporated in the design, where vital solutions and slurries can be transferred from one Plant to another, depending on operational requirements.

The Construction of the Expansion plant was started in year 2006 and achieved its Mechanical Completion on February 20, 2009. After 6 months, Commissioning Completion was achieved on May 2009.

INTRODUCTION

Coral Bay Nickel Corporation (CBNC) was founded on April 2002, as a joint venture of four (4) companies namely, Mitsui Corporation (18%), Sojitz Corporation (18%), Rio Tuba Nickel (RTN) Corporation (10%) and Sumitomo Metal Mining (SMM) Corporation with a controlling stake of 54%. Aside from its capital share, RTN Corporation also supplies the Ore and Limestone for the High Pressure Acid Leach (HPAL) Plant located in Rio Tuba, Bataraza, Palawan, Philippines. The product of this Plant, a Mixed (Ni/Co) Sulphide is shipped to the SMM's Nickel Refinery in Niihama, Japan. SMM Corporation provides the Technology and Management personnel to the Plant, as well as the Sulfuric Acid, H_2SO_4, which is the main reagent for the HPAL process. Figure 1 below illustrates this relationship.

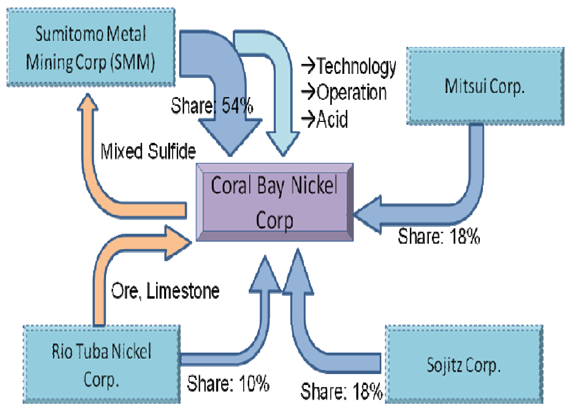

Figure 1: CBNC Shareholders Profile

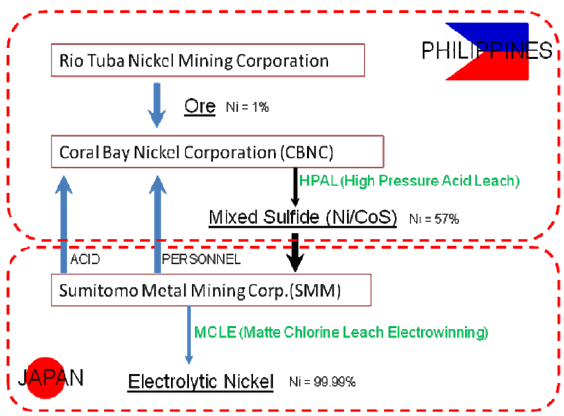

Figure 2: Geographical Relationship Profile

Figure 2 above shows the progression of Nickel metal from a low of 1% presence in Laterite ore mined by Rio Tuba Nickel Corporation, which is extracted and converted to an intermediate product by Coral Bay Nickel Corporation HPAL Plant to 57% concentration. The Niihama Nickel Refinery (NNR) in Japan refines this intermediate product to 99.99% of Nickel metal.

The nascent HPAL technology, combined with the proven Matte Chlorine Leach Electrowinning (MCLE) process of Sumitomo Metal Mining (SMM) has made this transformation of ore to pure metal possible.

In year 2000, SMM conducted the bankable feasibility study for the HPAL Plant in Rio Tuba, using the stockpiled Ore of Rio Tuba Nickel Corporation. RTN exports raw Nickel ore to Japan, and those that were below its cut-off grade were segregated into stockpiles and conveniently mapped.

By April 2002, CBNC was incorporated and construction of the Rio Tuba Plant started on January 2003. Mechanical Completion was achieved on August 2004.

Coral Bay Nickel Corporation's High Pressure Acid Leach (HPAL) Plant was inaugurated on April 5, 2005.

The Plant was designed to produce 10,000 tons of Nickel and 750 tons of Cobalt in a year. It achieved nameplate capacity in the year 2007, merely 2 years after its Mechanical Completion, where 10,078 Ni-Tons were produced. It was again achieved the next year, producing 10,562 Ni-Tons.

The Expansion Project of the HPAL Plant started in 2006 when the Engineering, Procurement and Construction (EPC) contract was awarded to Japan Gas Corporation (JGC) Philippines in April, the same Company that built Line-1. Basically, the expansion Plant design is just a mirror-image of the original Plant, duplicating its major Process circuits. In incorporating key improvements, such as tie-in lines of vital solutions and slurries, the Plant's overall Efficiency and availability was enhanced.

Mechanical Completion was achieved on February 20, 2009. Commissioning was completed on May 2009.

CBNC Profile

Location:	Barangay Rio Tuba, Bataraza, Palawan, SW of Manila, Philippines (about 250-km from Puerto Princesa, provincial capital)
Capital:	US$ 180 M + US$ 370 M
Product:	MS (NiS/CoS); Ni = 55 – 58 %; Co = 4 – 5%
Capacity:	22,000 Ni-T per year 1,500 Co-T per year
Resources:	2 Million DM Tons per year @ 1.26% Ni and 0.09% Co

Figure 3: CBNC HPAL Plant Location Map

CBNC is a major contributor to the country's economy, where it registered a net income of US$ 234 Million in the year 2009, which was about 10% of total income from metallic minerals mining in the Philippines on that year as shown in Figure 4 below[(1)]. The Company also employs directly and indirectly approximately 2,000 persons. Through the Social Development Management Program (SDMP), it is able to provide financial assistance to a school, hospital, road and other infrastructures building, housing, water and electrical supply and other supports to local government units.

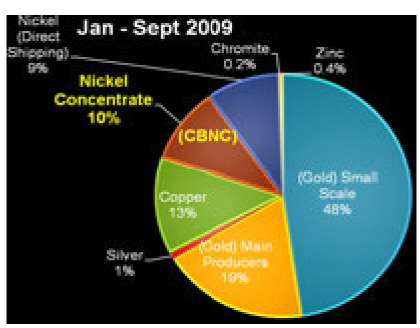

Figure 4: Philippine Metallic Mining Production in Jan – Sept 2009.
Source: Philippine Chamber of Commerce

CBNC Nickel Production

In its 3rd year of Operations, Coral Bay Nickel HPAL Plant was able to achieve its nameplate capacity of 10,000 Ni-tons in 2007. The Plant was able to sustain the production the next year, where it again produced 10,562 Ni-tons. Figure 5 below shows the annual production output of the Plant from 2005 where it started commercial operation up to year 2011 where it projects to produce more than 22,000 Ni-tons, its new nameplate capacity. However, since the Plant has been registering continuous annual growth; the Company is hoping to sustain it by actually targeting 23,000 Ni-tons in 2011. Furthermore, the target for year 2012 is 24,000 Ni-tons.

Notably, Coral Bay Nickel HPAL plant has breached the 2,000-Ni-ton per month for 6 months already. This monthly production Ni-ton quantity had been used as a benchmark on monthly achievements, which is based on nameplate capacity of each plant.

However, the highest monthly Production output thus far was registered on December 2010 with 2, 310 Ni-tons. With this milestone, 2,300 Ni-tons in a month has become the new benchmark of superior performance.

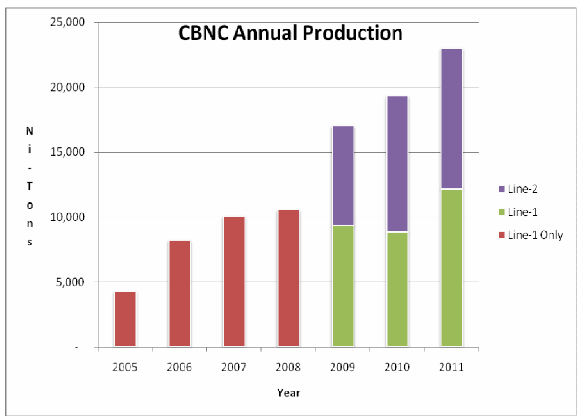

Figure 5: Coral Bay Nickel Corporation's Annual Nickel Production from 2005 to 2010

CBNC Flow Sheet

The stockpiled ores of Rio Tuba Nickel mines are delivered by trucks to the Plant site. The Coral Bay Nickel Plant processes this ore to produce Mixed (Ni/Co) Sulfides and sent to Niihama Nickel Refinery in Japan.

Figure 6 below shows the Process Flow Sheet of the Coral Bay Nickel HPAL Process. The flow sheet on the left shows the Line-1 and the flow sheet on the right is Line-2. As mentioned earlier, Line-2 is basically designed same as Line-1. Even the sizes of key equipments such as the Autoclave, CCD Thickeners, and Reactors are fundamentally the same.

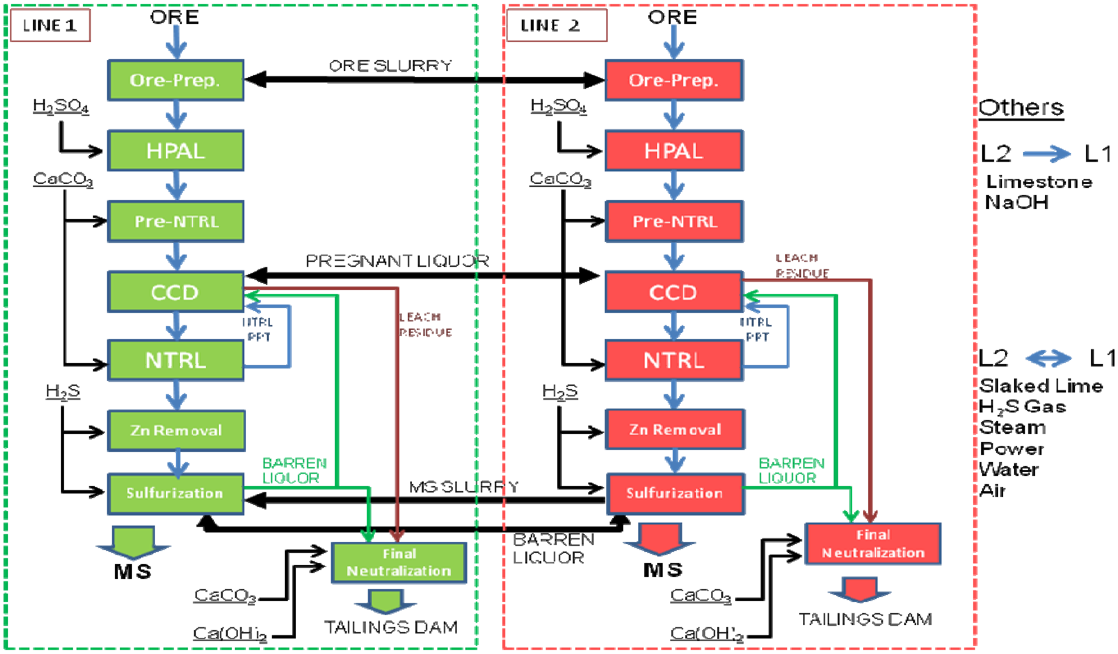

Figure 6: CBNC Process Flow sheet showing the tie-in lines.

Each major process circuit is briefly explained below:

1. Ore Preparation Circuit

   Laterite ores are screened in this circuit from +150-mm to -1.8-mm particles and pulped into 40 - 43% solids slurry. By blending of three different kinds of laterite ores, the resulting slurry has a typical assay of 1.26%Ni, 0.09% Co, 2.21% Mg, and 8.15% Si.

2. High Pressure Acid Leach

   The Ore slurry is pre-heated up to 200°C before pumping to the Autoclave using a Positive Displacement Pump. Using 99.8% H_2SO4 as lixiviant, the leaching reaction is carried out on 245°C and 4.0 MPa. The exiting leached slurry, which has a free acidity of 45 – 50 gpL is de-pressurized by a series of 3 flash tanks and sent to Pre-Neutralization Circuit. The recovered steam from the flash tanks is recycled back to the pre-heaters to heat the ore slurry prior to injection to the autoclave.

3. Pre-Neutralization

   The Leached slurry which has a pH of < 1 and free acid concentration of 45 – 50 gpL is neutralized to a pH of 2.7 – 3 using Limestone slurry. The reaction is carried out in 45 minutes and the neutralized slurry is sent to Counter Current Decantation circuit for washing.

4. Counter Current Decantation (CCD)

   Seven (7) thickeners are used in this circuit to wash the Leached slurry using Barren Liquor from Sulfurization Circuit. The resulting Pregnant Liquor overflow has a Nickel concentration of 4 – 4.5 gpL, which is sent to Neutralization circuit. The thickened solids of 40 – 45% Solids are sent to Final Neutralization circuit for treatment prior to disposal to Tailings Dam.

5. Neutralization

   The Pregnant Liquor from CCD circuit is neutralized using Limestone slurry to pH 3.2 – 3.4. The objective is to remove impurities such as Iron, Aluminum and Chromium by precipitating them as hydroxides. The resulting solids are thickened and sent back to CCD circuit and the clear neutralized overflow is sent to Zn Removal circuit.

6. Zn Removal

   The objective of this circuit is to remove Zinc from the Pregnant liquor using H_2S gas as it will co-precipitate with Nickel and Cobalt in the Sulfurization Circuit. Zinc is a major impurity of the final MS product as it will have adverse effects in the final refining process in Niihama Nickel Refinery in Japan. The precipitated ZnS solids are removed from the Pregnant Liquor using Polishing Filters.

7. Sulfurization

The Zn-free Pregnant Liquor is sent to Sulfurization circuit for the complete precipitation of Nickel and Cobalt to produce Mixed Sulfides. H_2S gas is used to recover over 99% of Nickel and Cobalt at a temperature of 63 – 70°C and pressure of 200 – 270 kPaG. The barren liquor, which contains 0.04 – 0.09 grams per Liter of Nickel, is sent to CCD circuit as wash water for Leach residue. Excess barren liquor is sent to Final Neutralization for treatment before disposal to Tailings Dam.

MS Product is bagged using flexible containers weighing 1,750 – 1,800 kilograms. The MS powder has a typical analysis as the following:

Table 1: Coral Bay Nickel MS Product profile

Component	Concentration	Unit
Ni	55 – 57	%
Co	4 – 5	%
Fe	0.2 – 0.5	%
S	30 – 35	%
Moisture	10 – 12	%
Particle Size (@50%D)	40 – 50	µm

8. Final Neutralization

The Leached residue thickened in CCD circuit and excess barren liquor from Sulfurization circuit are combined and treated in Final Neutralized circuit. The objective of this circuit is to remove the heavy metals such as Manganese, Iron and Chromium and adjust pH up to 8.5 – 9.0, using Limestone slurry in the first tank and Slaked Lime slurry in the succeeding tanks. The neutralized slurry is discharged to the Tailings Dam.

Most of the Supernatant in the Tailings Dam is recycled back to the Plant to be used in the production of Limestone and Slaked Lime slurries and feed water to Ore Preparation circuit. Excess Supernatant is discharged to the sea.

New Developments

1. Ore Thickener

Line 1 uses the Outokumpu's SUPAFLO® High Rate Thickener (HRT) type while Line-2 has the SUPAFLO® High Compression Thickener (HCT) type**.** SUPAFLO® High rate thickeners are suitable for all applications where flocculants can be used in the process and where the feed rate does not vary substantially over a short period of time. It has a short retention time and generates clear overflow. SUPAFLO® High compression thickeners provide consistently higher underflow density due to its extended high compression zone [(2)].

On July 2009, an FLSmidth's Dorr-Oliver® EIMCO® Deep Cone Paste Thickener (DCT) was added to Line-1. The EIMCO® Deep Cone® Paste Thickeners combine a proven system for optimizing flocculation with deep tankage design to allow maximum gravity reduction in the surface area and a substantial increase in underflow solids concentration. Settled solids can be brought to a density approaching consolidation and discharged at high viscosity[(3)].

The three thickener type's construction differences are shown in Figure 7 below. HCT has about 1.5 times the height of the HRT and the cone slope has 1.5 times the angle. On the other side, DCT has 2 times the height of HCT and the cone slope has 2 times the angle. This distinction in construction design spelled the difference of the three thickeners underflow slurry output.

			HRT	HCT	DCT
Tank	Diameter	m	20.0	20.0	14.0
	Depth	m	2.6	4.0	8.9
	Slope	°	9.5	14.0	30.0
Drum	Diameter	m			2.0

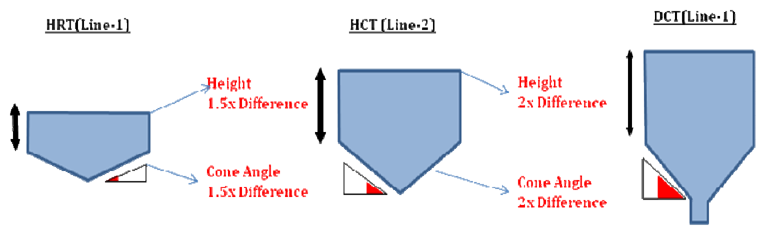

Figure 7: Difference of construction of three thickener types

Based on the latest CBNC Operations data a shown in Figure 8 below, HCT can generate about 1% more than the Solids % of the HRT with respect to Silica concentration. Furthermore, DCT can generate about 3% more than that of HCT. High %solids of ore slurry increase the Nickel throughput of the Plant, with optimal volumetric flow rate.

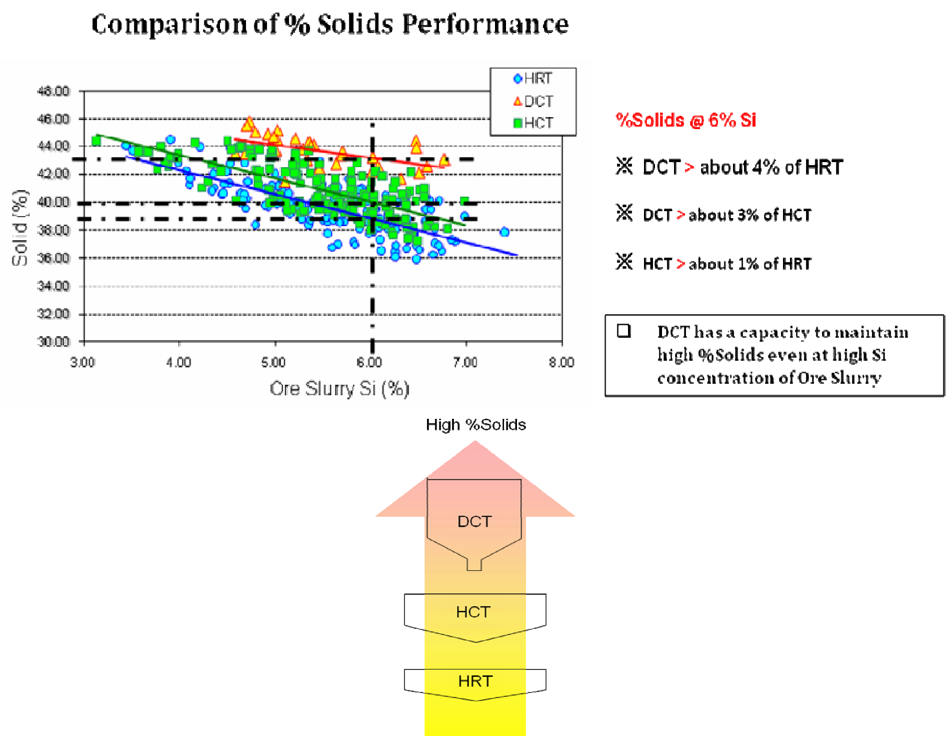

Figure 8: High Rate Thickener (HRT) and High Compression Thickener (HCT) comparison

2. Oversize Ore Removal

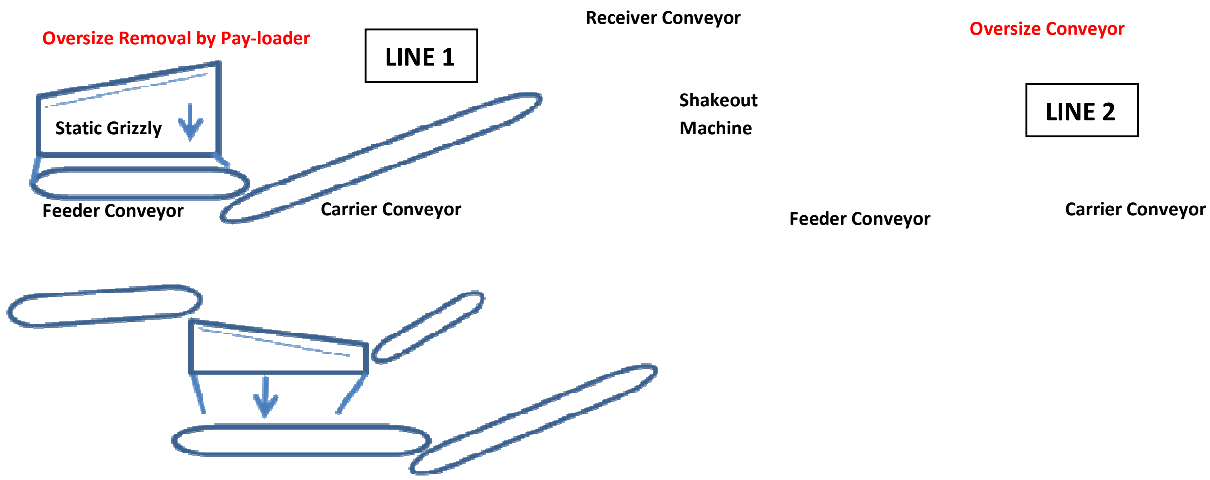

Figure 9: Line 1 and Line-2 Ore feeding circuits.

Payloaders are used in feeding ore for both lines. In Line-1, ore is dumped into a hopper with a 150-mm gap grizzly. Oversize ores that stay on top of the grizzly are removed by the same payloaders.

In Line-2 however, ore is dumped into a main conveyor. This conveyor feeds the ore to a Shakeout machine with a 150-mm mesh bars to separate oversize ores. The shakeout machine mesh bars has a slope of at least 5 degrees that allow the oversize to be removed at the other end due to continuous up and down movement of the machine to shake off ores. The oversize then drops onto a conveyor at the end of the shakeout machine that moves it to a depository awaiting transfer to another location using dump trucks.

This Line-2 new ore screening design added more efficiency as it eliminates human intervention in gathering the oversize ores. Continuous feeding of ore can then be achieved.

3. HPAL GEHO® Pumps Parallel Operation

Ore slurry is pumped into the Autoclave using a Positive Displacement Pump made by Weir Minerals, which is called GEHO® Pump. This is the most important pump in the Plant as it practically outlines the Plant Availability. In order for the Plant to operate continuously, the GEHO® pump must be available all the time.

The GEHO® Heatbarrier type design is used in CBNC HPAL plant. The design and model of the pumps of both lines is similar. This GEHO® Heatbarrier pump is a crankshaft driven two-cylinder double-acting and three-cylinder single-acting high temperature piston diaphragm pumps. The Heatbarrier design handles slurry up to 210℃. A drop-leg pipe connects the valves to the dead-headed diaphragm housing. The water jacket and oscillating separator sustain a low diaphragm temperature (below 100℃) with minimum heat loss. A free floating separator, which oscillates with the pump stroke speed, acts as a mechanical heat barrier to minimize heat transfer losses and equipment sizing. The poppet valves are the only wear parts[(4)].

The poppet valves or more commonly known as cone valves, being the only wear parts, hugely affect not only the Maintenance cost but also the availability of the GEHO® Pump, and consequently the HPAL operation. Without sacrificing operation rate, Coral Bay Nickel has been able to lengthen the life of its GEHO® cone valves by the use of Parallel Operation. Basically, all pumps in the Plant are available in two's to ensure continuous operation whereby one unit is spare while the other is in operation. The HPAL GEHO® pump is no exception; however, Coral Bay Nickel has been using the two pumps always in Parallel operation.

When two pumps having common Suction and Discharge lines are operated at the same time, they are said to be running in Parallel.

When in Single Operation, GEHO® Pump has to be operated at 83% to 100% output all the time and this takes a toll on the cone valves. The wear rate of the cone valves is caused by multiple factors such as particle size and abrasiveness of the materials, but it is enhanced by the amount of the material that passes through it. Parallel operation enables Coral Bay Nickel Plant to run the GEHO® Pump to a minimum of 50% to a maximum of 60% output per unit only.

The positive displacement of fluid and fixed volume is the result of the fluid being mechanically moved through their pump passage on a regular cycle. This means that regardless of the system they discharge into, the pressure and volume will remain constant. The power of the driving device and its speed, limit the volume and pressure.[5] Therefore, when two (2) GEHO® Pumps are running at 50% in Parallel, it has an equivalent output to a single-unit operation at 100%. This allowed Coral Bay Nickel Plant to operate its GEHO® pumps continuously in a longer period of time, and the result is illustrated in Table 2 below.

Table 2: Comparison of Single and Parallel GEHO® Pump Operation with respect to Cone Valve life

Year	Operation Method	GEHO® A	GEHO® B
2006	Single @ 100%	9.8 Days	7.5 Days
2010	Parallel @ 60%	19.5 days	21.8 days
• Longest cone valve life recorded was 68 days without replacement.			

Replacement of cone valves usually consumes about 5 hours of maintenance, and with the current currency exchange rates, it costs about US$ 32,000, excluding labor.

4. Supernatant Recycle

Coral Bay Nickel's neutralized waste slurry is discharged to the Tailings dam. The solids are allowed to settle and the Supernatant is recycled back to the Plant for the dilution of Chemicals such as Limestone and Slaked Lime. Excess Supernatant is discharged to the sea. This water contains high Calcium e.g. 400 – 600 mg/L, making it unusable for Ore Slurry preparation. Scaling of the pre-heaters depends on magnesium and calcium of the feed water[(6)].

To increase the recycle of Supernatant back to the Plant, Line-2 included Calcium Removal facilities to reduce calcium to less than 30 parts per million (ppm). This enables the Plant to conserve up to 200 m3/hr of raw water for Ore slurry preparation. This becomes handy especially during the dry months from March to July. Table 3 below shows the raw water, Supernatant and the Calcium-removed Supernatant water elemental analysis taken from the CBNC March 2010 Operations data.

Table 3: Raw water, Supernatant, and treated Supernatant components analysis (CBNC March 2010 Operations Average Data)

Water type	Si	Mg	Mn	Ca
Raw Water, gpL	0.02	0.03	< 0.001	< 0.01
Ca-removed Supernatant, gpL	< 0.01	0.03	< 0.001	0.02
Supernatant Water, gpL	< 0.01	0.09	0.001	0.57

5. Pipeline Tie-ins

To boost the efficiency of 2-Plant operation, tie-in lines were incorporated in the design. Ore slurry, Pregnant Liquor and Barren Liquor can be transferred from Line-1 to Line-2 and vice versa. Also, Slaked Lime, H_2S gas, and utilities such as water, steam and power can be interchanged by the two lines whenever needed. Moreover, the Limestone slurry preparation and Caustic Soda (NaOH) dissolution facilities in Line-2 were upgraded 150% of Line-1; hence, it can supply Line-1 also. Excess MS Slurry of Line-2 is also transferred to Line-1 since the MS bagging facilities of the former is half of the latter.

Table 4: Summary of Tie-in Pipelines of Coral Bay Nickel HPAL Plant

Area	Material	Direction of Transfer
Ore Preparation	Ore Slurry	L1 ← → L2
CCD	Pregnant Liquor	L1 ←→ L2
Sulfurization	MS Slurry	L1 ← L2
H_2S Plant	H_2S Gas	L1 ← → L2
Chemicals	Limestone	L1 → L2
	Slaked Lime	L1 ← → L2
	NaOH	L1 ←L2
	Calcium-Free Supernatant	L1 ←L2
Utilities	Air, Power, Water, Steam	L1 ← → L2

Table 4 above shows the Line-1 and Line-2 tie-in lines and direction of flow of vital process solution and slurry and other materials that allowed more flexibility to Plant Operations as the inventory holding capacities are practically enhanced. The Operation rates of the two lines can be adjusted accordingly. For example, if one train of Ore Preparation is shut down for maintenance repairs for more than 6 hours, HPAL operation rate need not be decreased because Ore slurry is available for transfer from another line. As a result, both lines can maintain its maximum operation rate. One train of Ore Preparation is designed to operate up to 80% of Plant Operations, and two trains are continuously operating in parallel.

Expansion Plant Commissioning

1. Overall Project Schedule

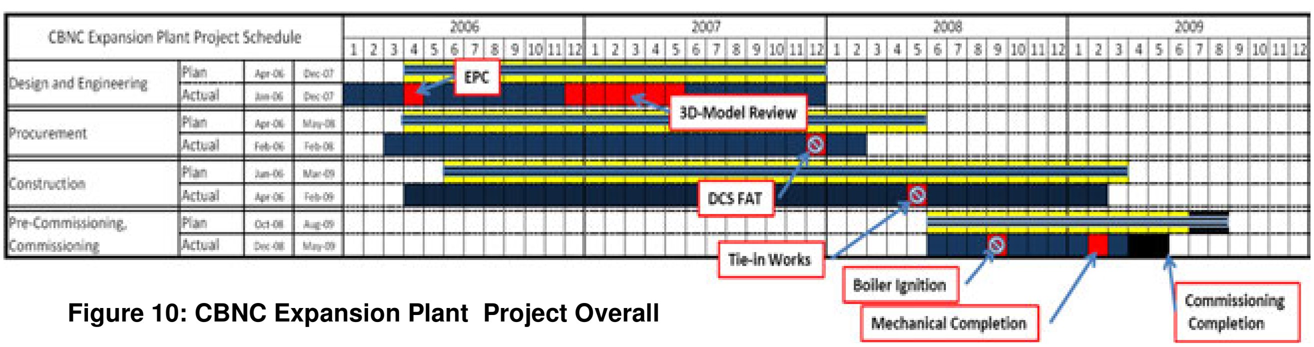

Figure 10: CBNC Expansion Plant Project Overall

Figure 10 above shows the overall schedule of Coral Bay Nickel HPAL Expansion project. The EPC Contract was signed on April 2006 and a total of six (6) months were spent to finish the 3D Model Review. The Engineering Design was completed on schedule.

Moreover, Procurement phase of the project was completed ahead as planned. The DCS Final Acceptance Test (FAT) was held on December 2007. Construction activities proceeded smoothly and it was completed just a month ahead of schedule. After the Tie-in activities with Line-1 common equipment on May 2008, Pre-Commissioning Activities started on June 2008, for the most part in Utilities area.

Expansion Plant's Boiler first Ignition took place on September 2008. By that time, Chemicals and other Auxiliary circuits were already in its pre-commissioning stages

Pre-commissioning of Process areas and its Commissioning proceeded accordingly.

2. Line-2 Commissioning

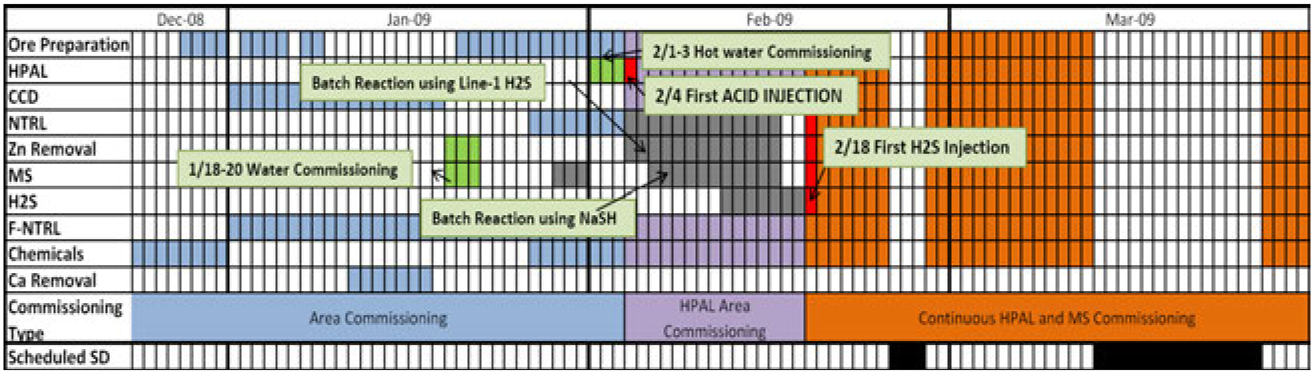

Figure 11: Line-2 Commissioning Schedule

Figure 11 above shows the Commissioning Schedule of Coral Bay Nickel's Line-2 Plant. Ore Preparation Circuit and Chemicals Preparation Circuit started its area commissioning on December 2008. Sulfurization Circuit had its Water Commissioning on January 18 – 20, 2009; while HPAL's Hot Water Commissioning was performed on February 1 – 3, 2009.

The Water Commissioning episodes served as training runs for the Operation team. While checking the interlocks and sequences, it also familiarized the Operators in the controls of the Line-2 equipment.

On February 3, High Pressure Acid Leaching operation was started when 99.8% H_2SO_4 was injected to the Autoclave for the first time. Ore Preparation, HPAL, Counter-Current Decantation (CCD) and Final Neutralization circuits were operated continuously. During this period, the Pregnant Liquor overflow solution of CCD circuits was transferred to Line-1 using the tie-in line since Zn Removal and Sulfurization circuits were not yet ready to receive it.

At that time, Zn Removal and Sulfurization circuits were undergoing 'batch' operations. Since Line-2 H_2S Plant construction was not yet completed, H_2S gas was 'borrowed' from H_2S Plant Line-1 to conduct initial tests on the Zn Removal equipment. Also, NaSH solution was prepared by dissolving NaSH flakes to start the batch reaction operation of Sulfurization reactors. Moreover, MS Slurry was 'borrowed' from Line-1 Sulfurization Circuit to test the MS Pressure Filter Equipment.

When Line-2 H_2S Plant produced its first H_2S gas on February 18, continuous operation of Zn Removal and Sulfurization circuits ensued. The two circuits were made online with other already running circuits making that phase of operation a full plant run. For the first time, Pregnant Liquor was continuously neutralized in the Neutralization circuit and fed to Zn Removal circuit in preparation for the Sulfurization reaction. Flow rate in the Sulfurization was at modest 200 m^3hr or about 50% design capacity yet, thus about 90 m3/hr of Pregnant Liquor was still being transferred to Line-1. This rate was continued until the first scheduled shutdown on that month.

After the 3-day scheduled shutdown on February 24 – 26 to make way for adjustments of the minor troubles encountered in Zn Removal and Sulfurization circuits, operation rate peaked up. One hundred percent (100%) Plant operation rate was achieved at this second continuous run until the next scheduled shutdown on March 14 – 26 to make way for a major modification of the Limestone Slurry Preparation equipment.

For the month of March 2009, 329 Ni-tons were produced. Line-2 Commissioning progressed quickly where it produced 845 Ni-tons in April and 798 Ni-tons in May.

Commissioning Completion was declared at the end of May 2009.

Another shutdown was scheduled after the Commissioning Completion on June 15 – 28 to make way for the JGC Construction Group to conduct repairs and adjustments on some equipment, which were encountered during the previous operation.

After the June scheduled major shutdown, Line-2 operations continued smoothly. In the month of August 2009, Line-2 helped Coral Bay Nickel HPAL Plant to record for the first time at least 2,000 Ni-tons a month. In that year, Line-2 produced 7,487 tons of Nickel overall.

In year 2010, Line-2 production improved to 10,424 Ni-tons. Figure 12 below shows the comparison of operation rate progress of Coral Bay Nickel Plant's two (2) Lines. In terms of design capacity, Line-2 achieved 100% in its 9th month of Operation only.

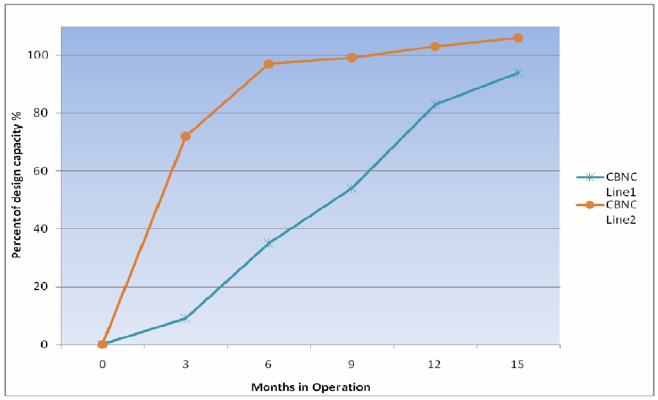

Figure 12: Comparison of Operation Rate Progress of Coral Bay Nickel's two Lines

The rapid pace of Line-2 Commissioning, among various contributing factors, was attributed to the following:

1. Strong Commissioning Team – from the start, Design stage, to Pre-Commissioning stage and finally to Commissioning, the Members are all the same. This set-up ensured efficient flow of information and knowledge because every step was done by the same persons. The Commissioning team had ample time to study the operations of the Plant since they were directly engaged on its design. By knowing even the minor details of the Plant, it became easier to operate.

2. Operators' Training – the Production Operators were previously working in the original Plant. Since the Expansion Plant is basically a mirror-image of Line-1, the Operators' skills and knowledge was top notch. They had most of their 'training' while in operating Line-1. Basically, Line-2 Commissioning became a simple Start-up from Long Shutdown mode for the Operators.

3. Experience in Line-1 Commissioning – the knowledge gained in Line-1 Commissioning and during its Commercial operation made a very significant contribution not only to Line-2's overall design but to its commissioning as well. The mistakes of the past were carefully avoided. Line-2 Commissioning became easier since Line-1 provided the basis – it became easier to imagine.

4. Use of Tie-in Pipelines – The inclusion of the Tie-in pipelines afforded a smoother Commissioning of Line-2 because it provided some flexibility. For instance, MS Slurry was 'borrowed' from Line-1 for the advance commissioning of LAROX Pressure Filter and for the use of MS Seed for start-up. Also, Pregnant Liquor was transferred back and forth between 2 lines depending on the requirements of the downstream Sulfurization Section. Moreover, there was no shortage of H_2S gas, Slaked Lime and other chemicals available in Line-1. As a result, much focus and attention was provided by the Commissioning team to major Line-2 circuits to achieve quick completion.

CONCLUSION

The experience in Line-1 commissioning and commercial operation brought about substantial skills and knowledge that enabled Coral Bay Nickel Corporation to complete the Commissioning of its Expansion Plant in record pace. The improvements made and the introduction of new technologies gave Line-2 an advantage to be more efficient and productive. The installation of tie-in lines between the 2 Plants provided greater flexibility and when properly harnessed, can increase the overall availability of the Plant. Line-1 and Line-2 can operate independently from each other;

therefore the Maintenance procedures can be easily planned out. And since most of the major equipments are similar, spare parts stocking and inventory is simplified.

Moreover, the experience in operating two (2) independent Plants in tandem have given Sumitomo Metal Mining and Coral Bay Nickel Corporation the skills and knowledge that will become valuable for the Commissioning and Operation of the upcoming Taganito HPAL Project in Surigao, Mindanao Island, Philippines. This Project, which has a capital expenditure of US$ 1.3 Billion, is scheduled to be commissioned in year 2012. Commercial operation is projected by year 2013.

Taganito HPAL Project will use CBNC's HPAL and MS technology to produce Nickel/Cobalt Mixed Sulfides, equivalent to 30,000 Ni-tons and 2,600 Co-tons per year. As a sign of good things to come, test operations using Taganito ore in CBNC Rio Tuba Plant conducted on May 2010 were remarkably successful.

Finally, the SMM's Philippine HPAL Project is a testament to a successful collaboration between Japanese and Filipino nations. Japan provided the Capital, Technology and technical knowledge to the project and the Filipinos' hard work and perseverance complemented it. Both peoples are looking forward to more successful collaborative efforts in the future.

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