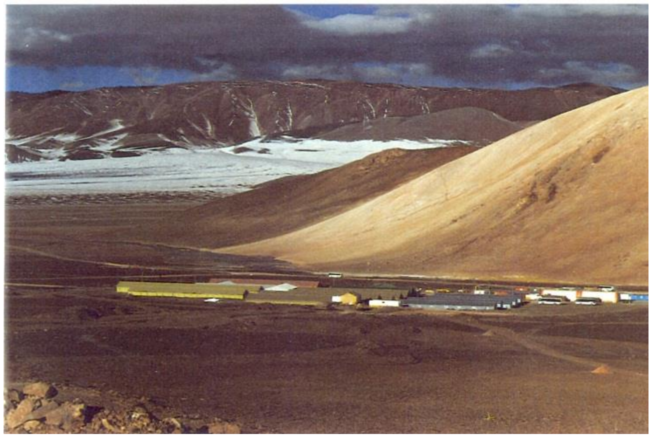
MAXIMUM REACH ENTERPRISES
1853 Wellington Court
Henderson, NV 89014
Phone: 702 547 1564
kent.goodman @ cox.net
www.maximumreach.com

05 October 2012

DESIGN OF JACKING POCKETS
& A
1,600 TON JACKING SYSTEM
FOR
LEVELING A RECIRCULATION BIN

In January of 1995, Fluor Daniel received a contract to construct the Verde Gold Mine up on the Chilean Andes next to the Argentina border. The best way to get to it was to fly in to Santiago from the States, take a smaller plane for a 2 hour flight up the coast to Copiapo and from there drive in a 4x4 pickup 156 km (97 mile) up to a 3,962 m (13,000’) elevation to the support camp.



And then on up to 4,572 m (15,000’) elevation to the mine site.

Background Information on the mine:

Pictorial Drawing Of The Mine Site

In the drawing above, the open pit mine is in the upper left hand corner. In the lower left corner is shown a large excavator loading a 250 ton rock truck. Next to it is shown a 250 ton rock truck dumping ore into a grizzly or trap. The ore then falls down into a large crusher which crushes it from a 4′ ϕ (1.22 m) down to a 1′ ϕ (0.3 m). It then falls down on to an 8′ (2.44 m) wide x 6 mile (9.66 km) long conveyor (the conveyor was acutely made up of three conveyors each two miles long for maintenance reasons). Note that the conveyor runs across a deep canyon on the way to the crushing plant where the ore is either stock piled or feed into the primary crusher, depending on demand.

The crushing plant is made up of a primary crusher that will reduce the ore down to approximately 4″ ϕ (100 mm). The ore is then dumped on to a four deck vibrating screen and any ore that passes thru the bottom screen, which is made up of ½″ (12.7 mm) sq. openings, falls on to a bottom belt and is conveyed to a stock pile ready to be transported to the leaching area. The ore that is larger than ½″ is conveyed on to secondary crushers and more screens that eventually reduce it down to where most of it will fall thru a ½″ screen. Any ore that does not fall thru a ½″ screen at this point is conveyed to the **recirculation bin** where it is then sent back to the primary crusher to go thru the crushing cycle again. By this method, all of the ore eventually ends up passing thru a ½" screen and is sent to the leaching stock pile. Photos of the recirculation bin will be shown later.

The original leaching area was approximately 6 miles square. See the area in the center of the right side of the photo with the crushing plant on the west side. It was graded from east to west so that it sloped down to the center. It was also graded so that the whole 6 miles was sloped from north to south. A separation plant was placed at the center on the south side of the area. 1.5" thick rubber liners were laid out over the whole area and were vulcanized together so they overlapped like the tiles on a roof to keep any liquid from seeping into the ground underneath them.

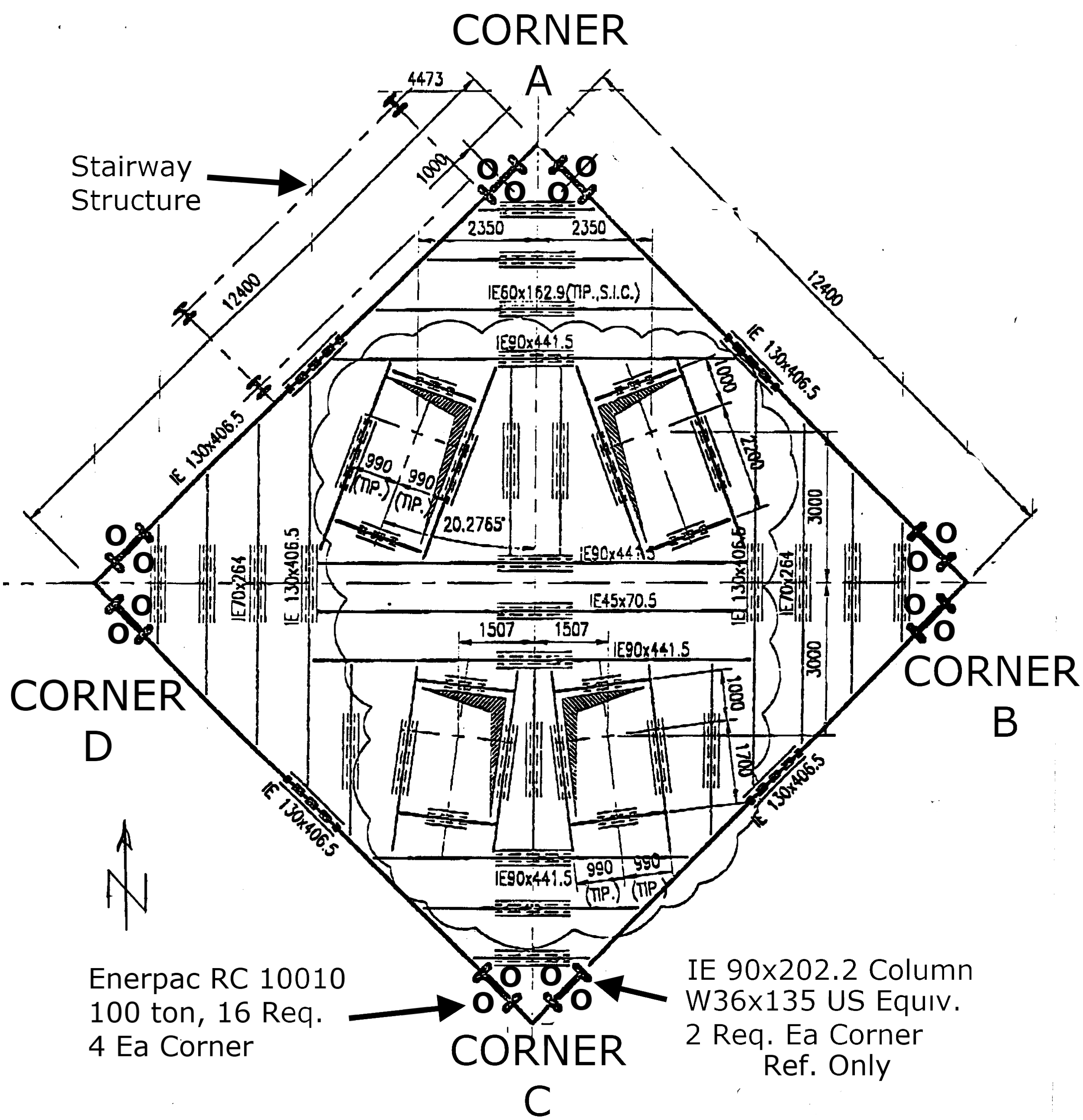
160 ton rock trucks hauled the ½" minus ore to the leaching site and started dumping it at the west edge. Dozers started spreading it out, making a 10' fill over the rubber liner. See the second bottom insert from the right. The 10' fill was continued until an area large enough to work with was obtained and then another area was started or another 10' fill was started over a lower one. 4" ϕ pipe equipped with sprinkler heads was then laid down in rows on the 10' fill. Liquid cyanide was then pumped thru the pipes and sprinklers until the area was thoroughly saturated. The cyanide penetrated the ½" ore, separated the gold from the ore and carried the gold down and across the rubber liner into the separation pond. There the gold was allowed to settle out and the cyanide was pumped back up to the leach area. The gold was pulled from the separation pond and made into gold bars.

I asked a Verde Gold Mine executive how they knew that there was "gold in them thar hills" at this remote location up at the top of the Andes. He told me that a company who specialized in using satellite imaging approached his company and told them that they had information that indicated where a gold deposit existed. They wanted 5 million dollars for the information. The mine accepted their offer and pioneered a 96 km (59 mile) road up to the proposed mine site and brought in large boring rigs to verify the satellite information. When it panned out, they paid the 5 million dollars.

Background Information on the jacking operation:

Fluor Daniel completed the mine project in May of 1996 and the mine went into operation. On 01 July 1996, I received a call from a Fluor Daniel Construction Manager at the Verde Gold Mine site. He said they required our rigging engineering services immediately because the crushers and the recirculation bin were settling and consequently the mine was shut down. Fluor Daniel was liable for liquidated damages in the amount of $250,000 a day. The mine had already been shut down for two weeks.

He explained that when FD constructed the mine in early 1995, they hired a Construction Manager from another company and unknown to FD management, he made some short cuts to save money so that he would receive a larger bonus. Two of the short cuts that really lead to the settlement problem were 1) the elimination the QC department and 2) the drawings for excavation and back filling under the recirculation bin were not followed correctly. The dimensions of the concrete foundation for the recirculation bin were 10' (3 m) thick x 60' (18.3 m) square. The original area under the bin was mostly in a little valley with corner A at grade and with the other three corners about 35’ (10.7 m) over the bottom of the valley. See the plan view of the bin below. The drawings called for the original soil under corner A to be excavated down to the level of the soil under the other three corners and then the whole area to be back filled in 6” (150 mm) lifts. This was not done and the crew merely started down in the valley and back filled the area up to the elevation of the concrete foundation. To compound matters, witness said that as it was winter when the back fill operation was going on, the crew used 3’ (0.9 m) lifts and included ice and trash in the backfill material. So when the bin foundation was poured, corner A was setting on original soil while the other three corners were setting on approximately 35’ of fill. The original CM had received his bonus, quit the company after the mine was turned over to the owner and before settlement had started to occur.



The mine owner realized something was wrong when the top of the recirculation bin rotated out from under the large return conveyor that feed oversized ore into it, resulting in large pieces of ore being scattered over the whole area. At the time we were called, corner A had settled 3″ (76 mm) and corner C had settled 12″ (305 mm). The new CM's crew on site was busy injecting grout under the bin foundation to stop the settlement.

Looking South At The Recirculation Bin, Stairway & Conveyors

Note the two W36x135 columns at each corner

Looking Southwest At The Recirculation Bin, Stairway & Conveyors

The CM said he needed us to do three things.

1. Design a jacking system for leveling the bin.
2. Design jacking pockets for jacking the bin level.
3. Send a Rigging Engineer to the site to supervise the field jacking operation.

NOTE: The design of the jacking system, the design of the jacking pockets, the load testing of the jacking system and the field operations will be given below in an abbreviated form. For the full design considerations, go to **Appendix A:** DESIGN CONSIDERATIONS

Design Of The Jacking System:

NOTE: As a matter of definition, Enerpac and other manufactures call out their jacks as cylinders. Each cylinder contains a ram with a piston attached to the bottom. As oil is forced into the bottom of the cylinder under the piston, the piston moves up and the ram is extended out of the top of the cylinder. When the oil is allowed to move back out of the bottom of the cylinder to a reservoir, the piston and the ram retract. They do this with the help of a spring that is located between the top of the piston and the top of the cylinder. The spring provides just enough force to push the oil back to the reservoir and retract the ram. So in this document, the jacking system will be made up of 16 cylinders.

The initial requirements for the design were:

1. Keep the load to around 60 % of the capacity of each cylinder.
2. The recirculation bin was made up of two W36x135 columns at each corner. See the plan view of the bin above. A jacking pocket will be installed on each side of each column. Therefore use 16 cylinders in the design, four at each corner.
3. Purchase a new jacking system for $150,000 in lieu of renting a system for $75,000 for three months. I convinced the CM to buy a new system that we could load test at the factory so that we would know that it would be in good working order when we used it at the mine site.
4. Purchase a larger than normal amount of spare parts and ship them with the jacking system. This would be due to the 15,000' elevation and remoteness of the mine up in the Andes.
5. Purchase jack oil that will be compatible with the winter temperature at the mine of -15 degrees Fahrenheit.
6. The design will be such that either a three or four point hydraulic support system can be used. A three point support system will initially be used, but if the influence of the attached stairway and conveyors prevents the ore bin structure from floating and leveling during jacking, then the system will be switched to a four point system.

Total Weight To Be Jacked:

1. Per the structural drawings, the bin weighs 800 tons empty and 1,300 tons

loaded. The above weights do not include the weight of the West stairway, the shared weight of the connecting conveyors or any ore left in it. A conservative weight of 50 tons was chosen to cover these weights.

2. Based on daily settlement figures, it was estimated that the load during jacking at the South corner would be 15% more than the other corners.
3. The approximate jack load at each corner of the structure would be (800 tons +50 tons)/4) = 212.5 tons.
4. The approximate jacking load at the South corner would be 212.5*1.15 = 244.4 tons.
5. The approximate load per cylinder at the South corner would be 244.4/4 = 61.0 tons.
6. Therefore use 100 ton cylinders. See the Enerpac cut sheet below.

RC-Series, Single-Acting Cylinders

ENERPAC
Hydraulic Technology Worldwide

Shown from left to right: **RC-506, RC-50, RC-2510, RC-154, RC-10010, RC-55, RC-1010**

The Industry Standard General Purpose Cylinder

- Collar threads, plunger threads and base mounting holes enable easy fixturing (on most models)
- Designed for use in all positions
- Removable strap handles for unobstructed fixturing (RC-5013, RC-7513 and both 100 ton models)
- High strength alloy steel for durability
- Nickel plating available on most models (contact Enerpac for details)
- Heavy-duty return springs
- Baked enamel finish for increased corrosion resistance

Saddles
All RC cylinders are equipped with hardened removable grooved saddles. For tilt and flat saddles, see the RC-Series accessory page.
Page: 10

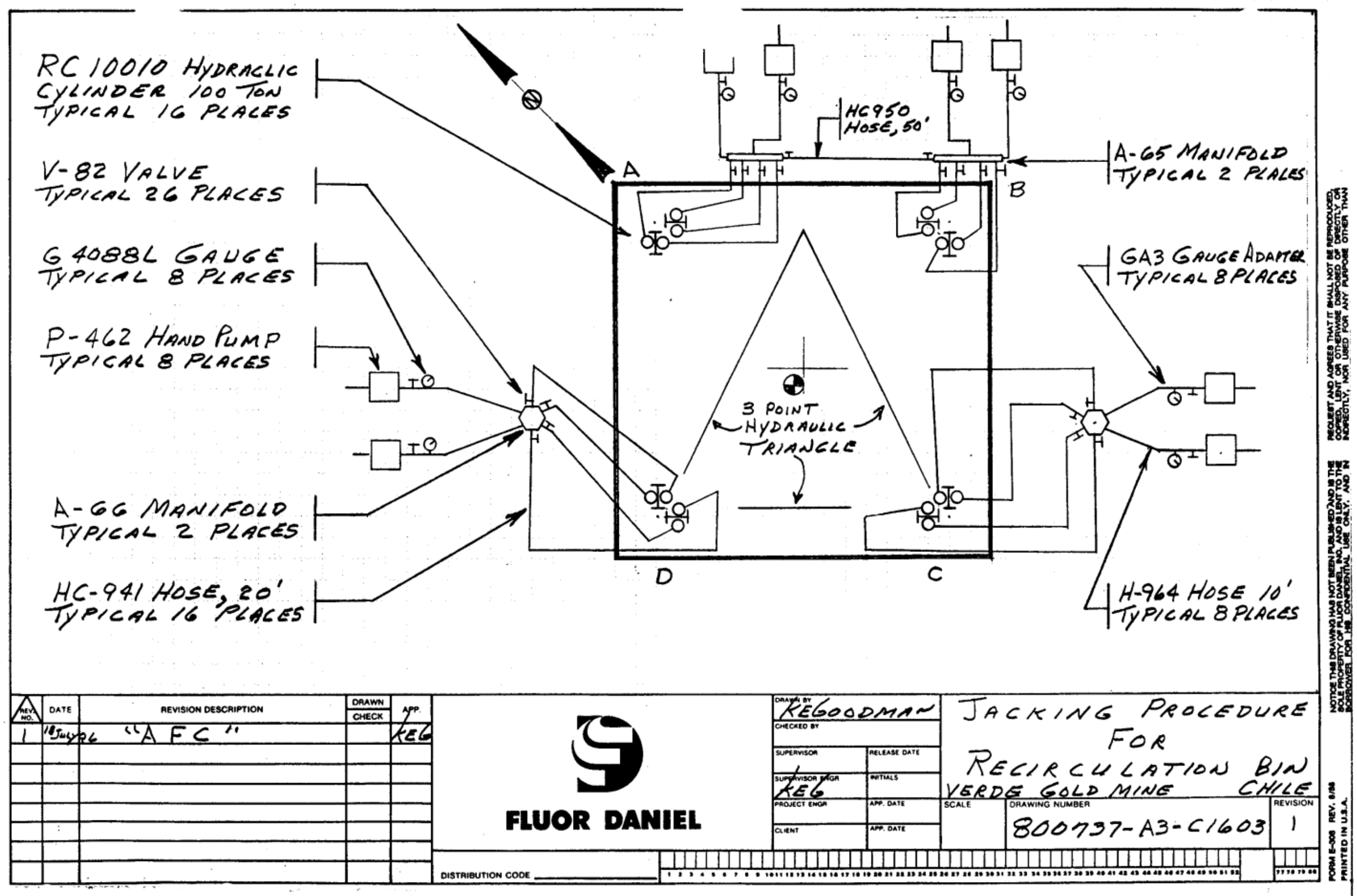
Base Plates
To ensure the stability of cylinders for lifting applications, base plates are available for 10, 25 and 50 ton RC cylinders.
Page: 10

Specialty Attachments
For solving all kinds of application problems, specialty attachments are available for 5, 10 and 25 ton RC cylinders.
Page: 170

In the jacking schematic below, note:

1. That the four cylinders at each corner are one hydraulic support point as the oil is free to equalize between the cylinders when all four V-82 valves are open that connect to the manifolds.
2. If the two V-82 valves located at the end of the 50’ HC 950 hose are closed, then the whole system is in a four point hydraulic support system.
3. If the two V-82 valves at the end of the 50’ HC 950 hose are open, then the

jacking system is in a three point hydraulic support system with corner C as one point, corner D as one point and corners A & B as one point. The location of the hydraulic point for corners A & B is half way between them so that a triangle is formed as shown on the schematic.

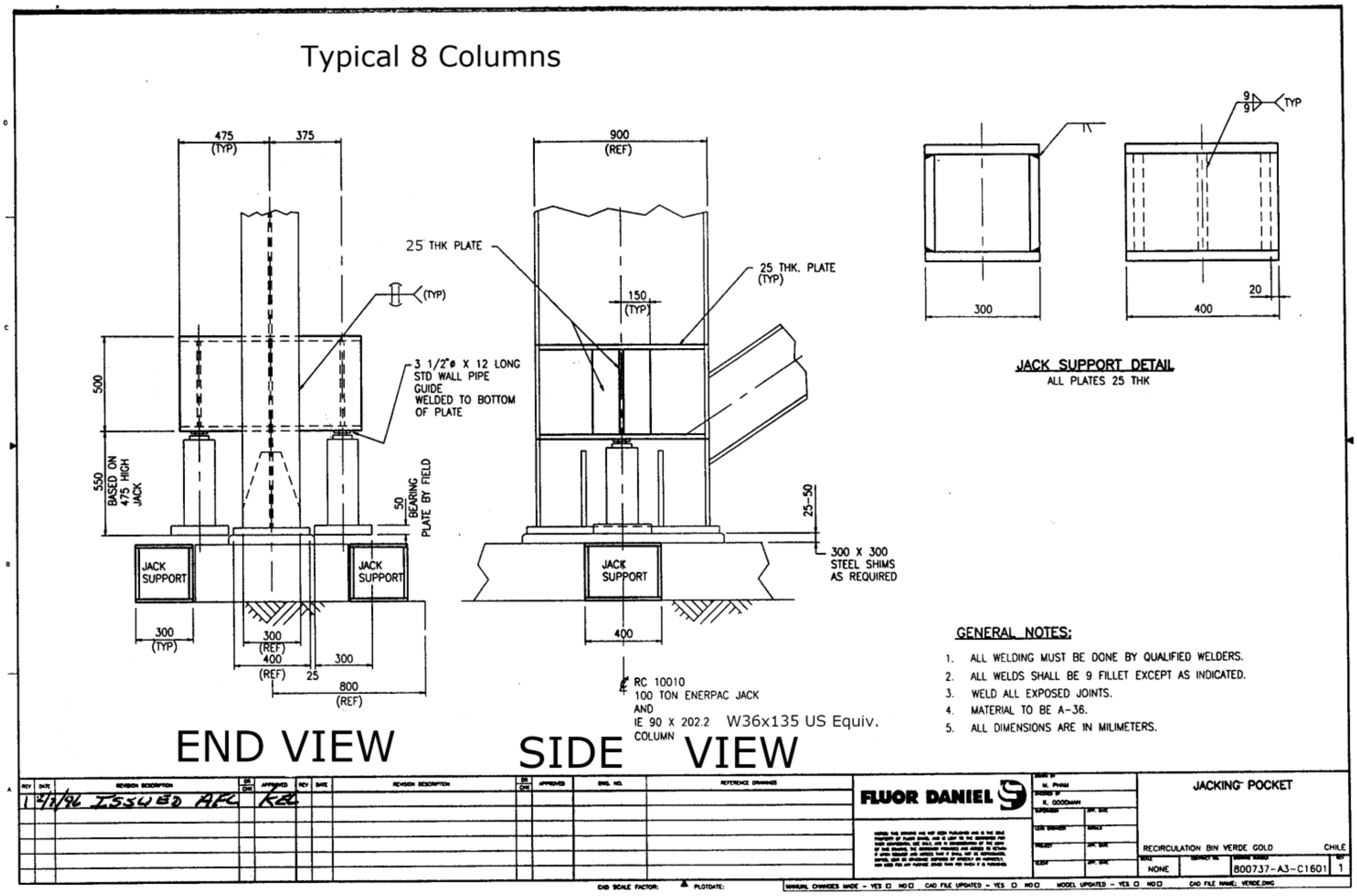


4. As an electric pumping unit wired for 220 volts was not available on short notice, two hand pumps were used at each corner, for a total of 8 hand pumps. Special precautions had to be taken to make sure that the hand pumps always had enough oil in their reservoirs.

The above schematic was sent to Enerpac Engineers for their review and approval.

Design Of The Jacking Pockets:

The design of the recirculation bin was basically made up of four frames, one on each side, with two W36x135 wide flange columns at each corner. To prevent bending in the columns, I decided to weld a jacking pocket to both sides of each column. Each jacking pocket was designed for a 100 ton load. Now, unlike the jacking pocket design that I sent out showing how to size the vertical gusset plates to prevent buckling when used on a saddle, I decided to design the two jacking pockets for each column as a simple beam that extended from the centerline of jacking point on one side of the column to centerline of jacking point on the other side. See the end view in the jacking pocket drawing. This way, only a beam section would be required that was strong enough to prevent over stressing the beam in bending & shear due to the 200 ton design load at the center, and enough weld length to weld it all together.



Note that the W36x135 columns sat on a 300 mm high x 800 mm wide grade beam so jack support boxes had to be design to provide support under the cylinders. Note that a 50 mm base plate was used under each cylinder with steel shims as required between it and the support boxes. The jack support boxes rested on the bin foundation.

The above jacking pocket design was sent to the field within a few days after the field asked for our help, so they could fabricate and install the jacking pockets at the same time as the grouting operation was going on. The CM figured that bin settlement would stop by the second week of August and we could then jack it level.

Load Testing The Jacking System In Enerpac's Plant:

After the jacking pocket design was sent to the field and Enerpac's Engineers gave their approval for the jacking schematic, I flew to Madison, WI to witness the load testing of the jacking system. This was in the third week of July.

An Enerpac Engineer and two technicians assembled the cylinders into four 400 ton systems. They then tested each 400 ton system up to 10,000 psi to make sure that all of the fittings, valves, hoses and seals were structurally sound and not leaking. Another reason for having the jacks load tested in the shop was to make certain that all of the hydraulic hoses were full of oil when they were shipped. Each one of the hoses had hydraulic couplers (for quick disconnecting) and dust caps on each end. When the pressure was off, the hoses were uncoupled from the jacks and manifolds and the dust caps installed. The ball check in each coupler seated its self and prevented any oil from leaking out. This way, the hoses were full of oil when we hooked up the entire hydraulic system in the field. The cylinders were fitted the same way with couplers and dust caps.

Note in the spare parts list that I ordered two extra 100 ton cylinders and six seal kits for the pistons. The reason for the extra cylinders was in case of a cylinder failure, we could simply lower the columns on that corner of the bin down on the shim packs and change out the damaged cylinder. The seal kits were in case we had a piston seal that was leaking but not so bad that we couldn’t finish the jacking operation before changing the seal. The two spare cylinders were load test as well.

Then all of the components of the jacking system, the spare parts and the jack oil were placed on pallets and vacuum wrapped for shipment to the Verde Gold Mine. It took about two weeks for the jacking system to clear customs and reach the Mine site. It arrived in the first week of August.

Below are photos of the jacking system being load tested by Enerpac personnel. As most of them had never been involved in assembling and load testing their own product, they were very excited to be doing so.

Load Testing Two 400 Ton Jacking Systems

Different View Of The Same Load Testing

See **Appendix B:** BILL OF MATERIALS for the jacking system
See **Appendix C:** SPARE PARTS LISTS
See **Appendix D:** TOOL LIST required for assembly

Field Training:

I flew to the Verde Gold Mine during the first week of August, and arrived soon after the jacking system did. The recirculation bin was still settling when I arrived, so we spent the next 2 weeks training the riggers who would serve as hand pump jackers, jack oil fillermen, shimmers for the cylinders and the columns, engineers taking level readings, monitors, communications, etc. We also went over the jacking procedure in great detail. See **Appendix E:** JACKING PROCEDURE

As the entire crew did not speak any English, the CM assigned a local staff member to be my constant companion and translator.

As I didn't know if the bin could be jacked up using a three point support system, I wrote a computer program during the training period that would give information for using a four point system. Using Corner A as the datum, I could enter an elevation of the two columns there and then enter an elevation for the columns at corner C. The program would output the corresponding elevation of the columns for corners B & D that would keep the bottom of all of the columns in the same plane. The columns for corners B & D would always be at the same elevation. Keeping them in the same plane would keep the bin from being overstress by some columns having more force on them than others. Or in other words, the bin columns would be loaded the same as if they were connected to the foundation. Thankfully, we didn't have to use a four point because it would have taken quite a bit more time to level the bin, ie, taking elevation readings of the columns on an ongoing basis and then adjusting the cylinders as required.

Actual Jacking:

When the bin finally stopped settling on the 24th of August, the grouting crew had pumped 3 million liters of grout under the bin foundation. We decided to start leveling the bin the next morning on the 25th of August. At that time, corner A had settled 190 mm (7.48”), corner B had settled 240 mm (9.5”), corner C had settled 480 mm (18.9”) and corner D had settled 330 mm (13.0”).

On the 24th of August, we had a pre-jacking meeting, went over the Jacking check list the last time and installed the jacking system so that the cylinder rams were snugged up against the jacking pockets. See **Appendix F:** JACKING CHECK LIST and see **Appendix G:** PRE-JACKING MEETING.

The next morning at 6:00, the cylinders were pumped up to predetermined pressures, the columns were cut lose from the base plates and we started the jacking process using a three point support system. We did not have to go to a four point system and the jacking was completed about 3:00 pm.

When initial jacking started, all of the columns were jacked up until they cleared their base plates by 12 mm. Then corners C & D were jacked up while the columns at corners A & B were monitored to make sure that they stayed clear of their base plates. When they started to touch, we stopped jacking at corners C & D and jacked corners A & B until they again cleared their base plates by 12 mm. Remember that corners A & B were one hydraulic point and they raised together or could be individually rotated over their hydraulic point by jacking corner C to lower the columns at corner A or by jacking corner D to lower corner B. As pointed out above, our goal was to jack up corners C & D as needed so that the columns at corners A or B did not touch the base plates.

The bin was first jacked up so that it was level, then the whole bin was raised the 190 mm to its original elevation. At that time, the CM decided to over jack the bin by 10 mm at corner A and 35 mm at corner C just as insurance against any possible future settlement. We used the computer program to determine the elevations of corners B & D. To see a log of the actual oil pressures for the cylinders during the whole jacking process, see **Appendix H:** JACKING PRESSURES

As the bin was being jacked up, safety shims were installed under each corner of each column so that there was never more than a ¼” gap. The training really paid off as the jacking operation went very smoothly and the only incident was when one hand pumper inadvertently put his control valve in the lower down position and the columns on his corner settled down ¼”onto the safety shims. Everyone got excited for a minute until we found out what he had done. We placed the handle back in the hold position, stroked his pump until it raised the columns clear of the safety shims and then continued jacking with all pumps.

When the bin was at the designated elevation, all gussets were welded to the column webs. The stub columns were only half width, ie, only a flange and half the web, so that the safety shims on one corner of a column could be removed and the stub column could be slid into place between the gussets and welded. Then the safety shims on the other corner were removed and the other half of the stub column was slid into place and welded. This made the installation and welding of the stub columns very safe and efficient.

Looking At Corner C From The Inside

Note the large amount of shims under the two cylinders and also at both corners of each column. The cylinders at both corners C & D had to be retracted and shims placed under them to raise the bin back up to its original level.

Looking At Corner C From The Outside

Looking South At Corner A

One of the things that we had to look out for during jacking was to make sure that the hand pumps had plenty of oil in their reservoir at all times, and to make sure that during cylinder retractions that the reservoirs did not run over. Therefore, in addition to the two riggers running the two hand pumps at each corner, we had a hand pump monitor. Riggers with sealed cans of jack oil, funnels in plastic bags, and siphons in plastic bags would rove between the hand pumps and fill or remove oil per the hand pump monitors. It all worked out very well.

END OF DESIGN:

Appendix A: DESIGN CONSIDERATIONS

VERDE GOLD MINE, CHILE

Leveling of the recirculation ore bin

DESIGN CONSIDERATIONS

On 01 July 1996, the Irvine Rigging Group was contacted to develop a plan and a design to level the recirculation ore bin at the Verde Gold Mine once it stopped settling. The ore bin was settling uneven due to poor compaction. At the time, the North corner had settled 3", the East corner 6", the South corner 12" & the West corner 5" (See the plan view in the design package). The design needed to be completed and transmitted as soon as possible as the liquidated damages to the company were $250,000 per day.

Before starting the design of the jacking system to level the recirculation ore bin, the following items were considered necessary:

Jacking System:

1. Design a jacking system for an initial maximum jack load of 60%. This would leave some spare capacity in case the total weight to be jacked is indeed higher than expected.

2. Purchase a new jacking system (opposed to renting an existing one) and test it at the factory before shipping to Chile.

3. Purchase a larger than normal amount of spare parts and ship them with the jacking system. This is due to the 15,000' elevation and remoteness of the mine up in the Andes.

4. Purchase jack oil that will be compatible with the winter temperature at the mine of -15 degrees Fahrenheit.

5. 16 each 100 ton cylinders will be used as each corner of the ore bin structure is made up of two 36" wide flange columns (a frame for each side of the structure). A jacking pocket will be installed on each side of each column.

6. The design will be such that either a three or four point hydraulic support system can be used. A three point support system will initially be used, but if the influence of the attached stairway and conveyors prevents the ore bin structure from floating and leveling during jacking, then the system will be switched to a four point system.

Total Weight To Be Jacked:

1. Per the structural drawings, the bin weighs 800 tons empty and 1,300 tons loaded. The above weights do not include the weight of the West stairway or the shared weight of the connecting conveyors. A conservative weight of 50 tons was chosen to cover these weights.

2. Based on daily settlement figures, it was estimated that the load during jacking at the South corner would be 15% more than the other corners.

3. The approximate jack load at each corner of the structure would be (800 tons +50 tons)/4) = 212.5 tons.

   The approximate jacking load at the South corner would be 212.5*1.15 = 244.4 tons

   The approximate load per jack at the South corner would be 244.4/4 = 61.0 tons.

4. Therefore, 100 ton jack cylinders would be used.

Jacking Pockets:

1. Jacking pockets will be placed on both sides of the eight columns for a total of 16 pockets. Each pocket will be designed for a 100 ton jack load. Installing

them on both sides of each column will eliminate any bending in the columns and also provide the require jacking capacity so the jacks will be working at about 60%.

2. A 0.5" x 3.5" std. wall pipe guide will be welded on the underside of each jacking pocket to keep the jack ram centered under the jacking pocket during jacking.

Jack Support Boxes:

1. As the column base plates are anchored to the top of a 300 mm raised grade beam which sets on top of the 10' x 60' x 60' foundation, 16 jack support boxes would be required to level under each jack cylinder.

2. A leveling layer of grout will be placed over the jack support boxes and the grade beams such that the 50 mm thick x 300 mm sq. jack base plates will be level and centered under the jacks.

Shims:

1. An assortment of metal shims will be provided for each jack cylinder to provide additional height during re-stroking.

2. An assortment of metal shims will be provided for the corner of each column to provide safety cribbing during jacking.

Column Splicing:

1. A study of the structural drawings showed that the base plates of the 36" WF columns were held in place by short vertical beams embedded in the concrete foundation. These beams were welded to the bottom of the base plates and tied to the rebar in the foundation. There are also three gussets on each side of the each web that are welded to both the web and the baseplate.

2. It was decided to cut the six vertical gussets (three on each side of the web) lose from the web of each column but leave them welded to the base plate. The gussets are 24" high and will provide horizontal stability during jacking. When the bin is raised and leveled, the top of the gussets will be welded to the columns to act as safety cribbing during stub column installation. The reason for this is that the column safety shims must be removed for stub column installation.

3. It was decided that the 36" columns would then be cut off just above the base plates before jacking and stub columns would be welded to the base plates and the bottom of the columns after the ore bin was leveled.

4. Before jacking, the gussets on the South columns will be extended vertically so that they will have at least 12” of contact with the original webs once the bin is raised and level. This will provide continued horizontal stability of the bin during jacking and will also provide 12" of the gussets to be welded to the original webs to act as safety cribbing during installation of the stub columns.

ACTUAL DESIGN, TESTING, TRAINING AND JACKING

Design Of The Jacking Pockets:

1. The jacking pockets were designed for a 100 ton cylinder with a pocket on each side of the 8 columns. The pockets were also designed so that the cylinder bases set outside the column base plates and were located high enough up on the column to allow about 2" between the bottom of the cylinders and the grade beam.

2. The design of the jacking pockets was completed first and sent to the field for fabrication and installation.

Design Of The Jacking System:

1. The 1600 ton jacking system was designed per the above requirements and was made up of four 400 ton systems. To use it as a three point support system, hosing and valves would connect two of the 400 ton systems. Do to the short lead time, a hydraulic pump wired for 220 volts was not available so it was decided to use 8 hand pumps, 2 for each 400 ton system. Lifting speed wasn't a concern but oil capacity of the pumps lifting the lowest comer was. Steps were taken to ensure that the hand pumps did not run out of oil during jacking or run over during lowering or re-stroking.

2. A schematic of the jacking system was made and reviewed with the Enerpac engineers.

Actual Testing Of The Jacking System:

1. American Equipment Company purchased the 1,600 ton jacking system from Enerpac in Madison, Wisconsin. Part of the purchase package was that they would completely assemble the jacking system per the schematic and test each 400 ton system to 10,000 psi: This was to be done under the supervision of a Fluor Daniel Supervisor. At first Enerpac management balked at the testing part claiming that 1) They didn't have space in the plant for testing something this large and 2) their people designed, fabricated and packaged the jacking components but they did not have experience in putting them together as an assembly. Finally, they agreed to the testing due to the $150,000 price tag.

2. Enerpac assigned one engineer and two technicians to assemble and test the jacking system. It wasn't long before other people became interested in the assembly and wanted to help. We finally ended up with about 10 people helping and the rest of the plant assisting with whatever we needed. As their management said" most of them did not have any experience in assembling components, but all of them wanted to learn. They took pictures of each other with the completed system, etc.

3. The assembled jacking system along with the spare -parts and jack oil was palletized, vacuum wrapped and shipped directly to American Equipment in Santiago, Chile.

Field Training:

1. While waiting for the ore bin to stop settling, training for the jacking crew was carried out. Mocked up training was given to the workers who would serve as: hand pump operators, jack oil fillermen, shimmer for the hydraulic cylinders, safety shimmer for the columns, engineers taking level readings at the four corners, stairway monitors, conveyor belt monitors and communication between jacking superintendent and column monitors.

2. This training really paid off as the jacking operation went very smoothly and the only incident was when one hand pumper inadvertently put his control valve in the lower position and the columns on his corner settled down on the cribbing. Everyone got excited for a minute until we found out what he had done. We placed the handle back in the hold position, stroked his pump until it raised the columns clear of the safety cribbing and then continued jacking with all 8 pumps.

Actual Jacking:

1. The jacking system was installed the night before we intended to start jacking and the jacks were snugged up.

2. The next morning at 6:00, we started the jacking process using a three point support system. We did not have to go to a four point system and the jacking was completed about 3:00 pm.

3. All gussets were welded to the column webs at that time and the safety shims were removed as required for stub column installation.

END OF JACKING OPERATION:

Appendix B: BILL OF MATERIAL

BILL OF MATERIAL – CHILE LIFT PROJECT

QTY	ENERPAC PART NO.	DESCRIPTION
16ea	RC10010	CYLINDER
16ea	CAT-100	SADDLE
2ea	A66	MANIFOLD, 6 PORT
2ea	A65	MANIFOLD, 7 PORT
26 ea	V82	VALVE
8 ea	P462	HAND PUMP
8 ea	H964	10' HOSE
16ea	HC941	20' HOSE
1 ea	HC950	50' HOSE
26ea	FZ1617	HEX NIPPLE
2 ea	CR400	COUPLER, FEMALE
25 ea	C604	COUPLER SET
8ea	GA3	GAUGE ADAPTOR
8 ea	G4088L	GAUGE

ITEMS ARE EITHER SHIPPED SEPARATE, OR AS AN ASSEMBLED UNIT.

Appendix C: SPARE PARTS LIST

SPARES - CHILE PROJECT

FOLLOWING SHOULD BE PACKAGED AND SHIPPED AS SPARE PARTS

QTY	ITEM	DESCRIPTION
2ea	RC10010	CYLINDER
4ea	CAT-100	SADDLE
10ea	FZ1617	HEX NIPPLE
2ea	A66	MANIFOLD, 6 PORT HEX
2ea	A64	MANIFOLD, 7 PORT
6ea	V82	VALVE
10ea	C-604	COUPLER, SET
4ea	~~[illegible]~~ H964	10' HOSE
8ea.	HC941	20' HOSE
1ea	HC950	50' HOSE
1ea	P462	HAND PUMP
2ea	G4088L	GAUGE
2ea	GA3	GAUGE ADAPTOR
6ea	RC106K	SEAL KIT, 100 TON
3 ea 50 GALLON		LX OIL
AS REQ'D 8		3/8 PLUGS
	C-80044 NO PART NO.	STOP RING WRENCH #42

Appendix D: TOOL LIST

CHILE PROJECT

PLEASE LIST ALL TOOLS IN THE ASSEMBLY OF THE SYSTEM.

2	1/4" ALLEN WRENCH	
2	ROLLS TEFLON	
2	11/16" COMB. WRENCH	
2	3/4" DEEP SOCKET,	
	THIN WALL	
2	7/8 COMB WRENCH	
2	12" CRESCENT WRENCH	
2	16" FUNNELS	
1	RING WRENCH FOR	
	JACK DIS ASSEMBLY	

Appendix E: JACKING PROCEDURE

FLUOR DANIEL

Fluor Daniel
3353 Michelson Drive
Irvine CA 92698
714-975-4953

<u>FACSIMILE LEAD SHEET</u>

DATE:	*20 July 1996*	***NO. OF PAGES:***	*5.00*
SENT TO:	*Tom Ethridge*	***FROM:***	*Kent Goodman*
CO. NAME:	*Fluor Daniel*	***CO. NAME:***	*Fluor Daniel*
LOCATION:	*Verde Gold Mine, Chile*	***LOCATION:***	*Irvine*
FAX NO:	*011 562 340 8881*	***FAX NO:***	*714-975-6048*
PHONE NO:	*011 5652 222 841 or 853*	***CHARGE NO:***	*04 800737*
RE:	*Jacking system utilizing 100 ton hydraulic cylinders*		
cc:	*Dick Gey, Fax 011 562 233 1177*		
	Lloyd Warren, Fax 011 562 739 0237		

Attached is drawing 800737-A3-C1603 rev 1 showing the schematic for the jacking system using hand pumps in a three point hydraulic support system. A four point system can be obtained by simply shutting off the V-82 valves located on each end of the A-65 manifolds. Note that these manifolds are connected by a 50' hose to make the three point system complete. This makes corners A and B have a common pressure. For reference, corner A is the high corner with the least amount of settlement.

As the hand pumps are very labor intensive and as the jacking of the recirculation bin will not take place until approximately, 15 Aug 96, I recommend that Lloyd Warren rent a local electric pump to augment the hand pumps. The electric pump would not have to be an Enerpac pump and the only requirements would be that the output port in the manual 3 way valve be a female 3/8" NPTF, that it put out 10,000 psi pressure, and have as large a reservoir size as possible. We have enough fittings and couplers to plumb this pump into the jacks on corners C and D. Corners A & B would still be lifted by the hand pumps.

Attached is the jacking procedure for a three-point lift of the recirculation Bin using all hand pumps.

If you have any questions, please let me know.

Best Regards,

Kent
The Rigging Group
Construction Technology

JACKING PROCEDURE

Project: **Verde Gold Mine, Chile**
Item: **Recirculation Bin**
Prepared by: **Kent Goodman**
Preparation Date: **18 July, 1996**

<u>**Steps:**</u> **For a three point hydraulic support system.**

1. Make sure that all six vertical gussets (three on each side) are cut free from the web of each column but left in place to provide horizontal stability.
2. These gussets will have to be monitored during the lift to insure that there is adequate clearance for the columns to rotate during leveling without binding up on both sides. Some trimming may have to be done during jacking to prevent binding of the columns. Bearing of the columns against the gussets is expected and allowed but only on one side.
3. Install the jacking support boxes at each jacking pocket.
4. Install a leveling course of grout approximately 400 mm x 400 mm centered under the 3.5" diameter pipe guide that is welded to the underside of each jacking pocket (the center of the 3.5" pipe guide is the vertical center line of the 100 ton jacks).
5. Place the 50 mm x 300 mm square base plate on the cured grout and center it under the 3.5" pipe guide.
6. Assemble the jacking system per drawing 800737-A3-C1603 and place a 100 ton jack under each jacking pocket. Make sure each jack is vertical and is supported firmly on the grout, base plate.
7. Place 300 mm x 300 mm shims under each jack so that the tilt saddle is sticking up into the 3.5" pipe guide.
8. Check the oil in all hand pumps. They must be full before starting to lift. The level in each pump must be monitored and kept at least half full during the jacking operation.
9. Open all of the V-82 valves on the pumps and the V-82 valves located on the manifolds.
10. Place the handles of the holding valves on all the hand pumps so that they are in line with the GA3 gauge adapters and the hoses. This is the holding and pumping position for the holding valve on each pump. Oil is allowed to pass out of the pump during pumping but is held in the system during re-stroking of the pump handle by a check valve and not allowed to return to the tank.
11. **The column webs and flanges will now be cut free from the base plate.**
12. The jacking pressures for the four corners, A, B, C & D will be respectively, 5300 psi, 5300 psi, 5500 psi & 5400 psi. Note that these are anticipated pressures for each corner and will have to be adjusted up or down for the actual loads.
13. Each corner can be cut individually, depending on the fields requirements.
14. Pump the two hand pumps at each corner until the appropriate pressure is reached.

15. Close the two V-82 pump valves.
16. Start cutting the web and flanges.
17. Adjust the pressure in the jacks as required to maintain the original elevation of the columns. Do not let the columns settle on to the base plate after they are cut.
18. Make sure that all columns are cut free. Don't pressurize any jack group more than 500 psi without making sure that the column is cut free and that the extra pressure is required for a larger load than anticipated.
19. The columns should now be cut free and the bin should now be floating and suspended on the jacks.
20. **Corner C & D will be lifted simultaneously next.**
21. Pump the four hand pumps until the columns on both corners clear the base plates approximately 12 mm. Keep the clearance under the columns about the same during this operation by slowing down the pumping on one corner until the other corner catches up.
22. Close the four V-82 valves located on the C & D hand pumps.
23. **Corners A & B will be lifted next.**
24. Open the V-82 pump valves and lift with all four pumps until the columns are clearing the base plates by approximately 12 mm.
25. Close the V-82 pump valves.
26. **Corners C & D will be simultaneously lifted next.**
27. Open the V-82 pump valves.
28. Lift with all four pumps.
29. Monitor the columns at corners A & B during this lifting operation and do not let the columns at either corner touch down. For example, if the columns at corner A start to touch, this means the columns at corner B have raised to approximately 12 mm above the base plate. To correct the above situation, stop jacking on corner C and continue jacking on corner D until the columns at corners A & B are each clearing the base plates by about 12 mm. During the lifting of corner D alone, the jack rams at corner A will extend and the jack rams at corner B will retract as they are hydraulically plumbed together.
30. During the remainder of this jacking operation and until the bin is level, install the 150 mm x 300 mm safety shims under the corners of all columns so that there is never more than 6 mm of gap at any time.
31. Continue lifting points C & D until point D is approximately level with point A.
32. Close the V-82 valves on the D pumps.
33. **Corners A & B and C will be simultaneously lifted next.**
34. Open the V-82 pump valves on the A & B pumps.
35. Lift with the four A & B pumps as well as the two C pumps.
36. Monitor the columns at corner A during this lifting operation and keep the clearance between them and the base plates a minimum of 4 mm and a maximum of 12 mm. If the columns at corner A start to touch, stop jacking at corner C and continue jacking on corners A & B until there is 6 to 12 mm of clearance at corner A.
37. Continue jacking until the bin is level.
38. **Corners A & B and C and D will now be simultaneously lifted.**
39. Open the V-82 pump valves on the D pumps.
40. Jack at all four corners (actually three hydraulic support points) until the bin is at the correct elevation.
41. Close all V-82 pump valves.
42. Shim the columns until they are just snug.
43. For safety during stub column installation, weld the existing gussets back to the web of the columns using a minimum of 12 weld size x 75 mm long on each side of the 6 gussets on each column.
44. Install the stub columns and weld them to the columns and the base plates.
45. **Remove the jacks from one corner at a time**.
46. Place the handle of one locking valve in each hydraulic group in the lowering position.
47. Slowly open the V-82 valves on the above pumps and continue lowering until the weigh is off all the jacks.
48. Retract all jack rams.
49. Drain any excess oil that the hand pumps tank won't hold into an empty container.
50. Remove all jacks.
51. End of jacking procedure

Following is a re-stroking procedure for the jacks.

1. If any group of jack reaches the end of their stroke during jacking, say the jacks on corner C for example, close all V-82 pump valves.
2. Shim snug under the corners of all columns with the 150 mm x 300 mm safety shims.
3. Place the handle of one of the C group pump locking valves in the lowering position.
4. Slowly open the V-82 pump valve and let the jacks retract. The jacks are spring loaded and will retract by themselves.
5. Remove the jacks from their pockets and install additional 300 mm x 300 mm shims.
6. Replace the jacks in the jacking pockets.
7. Place the handle of the pump locking valve back in the holding position.
8. Start pumping until the C columns are clearing the shim packs.
9. Open the all the remaining V-82 pump valves that were open before re-stroking took place.
10. Continue lifting

Appendix F: JACKING CHECK LIST

JACKING CHECK LIST

Project:	Verde Gold Mine
Project location:	Maricunga Valley, Chile
Item:	Recirculation bin
Prepared by:	Kent Goodman
Preparation date:	19 August, 1996
Revision date:	24 August, 1996

NOTE: See attached sheet for names of assigned personal and position

PERSONAL REQUIRED FOR PRE JACKING , 6 AM 25 August 96

4 Hand pump operators	
1 Rigging Engineer	
1 Jacking superintendent	
1 Jacking supervisor	
1 Welding Engineer	
4 Cutter / welders for final cutting of webs and column flanges	
1 Safety supervisor	Support
1 Electrician	Support

PERSONAL REQUIRED FOR JACKING , 8 AM 25 August 96

3 Surveyors	
3 Rodmen	
7 Hand pump operators	
1 Electric pump operator	
3 Jack oil fillermen	
4 Column monitors / column shimmers / cutters / welders	
1 Stairway / top conveyor monitor	Luis Beth
1 Bottom discharge conveyor monitor	Tito Salazar
1 Rigging Engineer	In charge of jacking
1 Welding Engineer	Monitoring jacking pockets
1 Jacking superintendent	Directing the jacking
2 Jacking supervisions	Duties as assigned by Omar
1 Translator	
1 Safety supervisor	Support

1 Electrician	Support
1 Welder	Support

PERSONAL REQUIRED AFTER JACKING IS COMPLETE

8 Cutters / welders	
1 Welding specialist	until weld out is complete
1 Welding supervisor	until weld out is complete
l Rigging Engineer	until first pass of stub column weld is complete
1 Jacking supt.	until first pass of stub column weld is complete
4 fit up men	For fitting up the stub columns
4 Helpers	For helping the fit up men and the welders
1 Safety supervisor	Support
1 Electrication	Support

ESTIMATED SCHEDULE FOR JACKING AND WELDING

JACKING

For a three point hydraulic jacking system

Start jacking at 8 AM

Finish jacking at 2 PM

For a four point hydraulic jacking system

Start Jacking at 8 AM

Finish jacking at 5 PM

STUB COLUMN FIT UP

4 hours

WELD OUT OF STUB COLUMNS AND VERTICAL GUSSETS

18 hours

EQUIPMENT REQ. FOR PRE JACKING, JACKING AND WELD OUT ACTION

10 ea	Oxygen and acetylene cutting sets complete	Complete
10 ea	Acetylene bottles, full	Complete
30 ea	Oxygen bottles, full	Complete
16 ea	Welding stingers,	Complete
4 ea	Air arc	Complete
1 ea	Shim pack set for shimming under the jacks consisting of:	Complete 20 ea
	20 mm x 300 mm x 300 mm	
	90 ea 25 mm x 300 mm x 300 mm	
	20 ea 50 mm x 300 mm x 300 mm	
1 ea	Shim pack set for shimming under the columns during jacking consisting of:	Complete
	25 ea 12 mm x 150 mm x 300 mm	
	70 ea 25 mm x 150 mm x 300 mm	
16 ea	Wooden support boxes for safety shims during stub column fit up	Complete
1 ea	Jacking set per FD drawing 800737-A3-C1603 (1)	Omar
1 ea	Electric hydraulic pump	Omar
1 ea	Jacking oil, 55 gallon barrel with hand pump	Duzan
3 ea	Jacking oil, 2 gallon containers	Duzan
6 ea	Plastic funnels in plastic bags	Duzan
6 ea	Siphons in plastic bags (for removing oil from the hand pumps)	Duzan
1 ea	Wrench set for repairing jacking system	Duzan

1 ea	Spare parts jacking set consisting of :		
	1 ea	100 ton jack	Omar
	1 ea	Hand pump	Omar
	1 set	Fittings and hoses	Kent
10 ea	Radios for the following personnel:		Omar
	1	Jacking Supertendant	Omar
	1	Stairway / top conveyor monitor	Luis
	1	Bottom discharge conveyor monitor	Tito
	3	Surveyors	
	2	Jacking supervisors	
	1	Safety supervisor	Miguel
	1	Translator	John Pierre
1 ea	Tape for hard hats signifying a member of the jacking team		Miguel

Appendix G: PRE-JACK MEETING

MEETING AGENDA

Project: Verde Gold Mine
Project location: Maricunga Valley, Chile
Reason: Pre jacking meeting for the recirculation bin
Prepared by: Kent Goodman
Preparation date: 24 August 1996

		STATUS
1.	Pass around a signup sheet for attendance	Daily
2.	Review the attached check list for personnel and jacking equipment	Daily
3.	Update and or fill in the check list as required	Daily
4.	Update on work items in progress	
a.	Locating and welding the four surveyor tabs	Complete
b.	Taking survey shots on the above 4 surveyor tabs	Complete
c.	Cutting the column gussets	Complete
d.	Cutting the column webs	
e.	Verify that all column webs are cut free	At lift time
f.	Verify that all column flanges are cut free	At lift time
g.	Placing shims on the concrete near the columns	Complete
h.	Fabrication of the wooden support boxes for the safety shims	Complete
i.	Install side plates on all jacking pockets	Complete
j.	Install diagonal bracing at all four columns at elevation 4501.394 on the recirculation bin	Complete
k.	Weld existing diagonal bracing at all four columns at elevation 4505.070 on the recirculation bin	Complete
l.	Provide 3 mm clearance between all gussets and columns	In progress
m.	Lift and shim the conveyor bent next to the recirculation bin	In progress
n.	Install short diagonals and gussets in columns	Complete
o.	Install gussets to the column base plates for horizontal stability required for over jacking.	In Progress
p.	Fabricate additional shims for over jacking, both 150 mm x 300 mm and 300 mm x 300 mm	In progress
5.	Discuss the working hours for members of the jacking and welding operation	Daily

6. Safety items
    a. Barricading the jacking area
    b. Tape on hard hats identifying jacking team members
7. Update on the settlement of the bin — Daily
8. Jacking date: — 25 Aug 96
9. Weather forecast — Daily
10. Answer any questions for the jacking operation — Daily
    1. For a three point hydraulic suspension operation
    2. For a four point hydraulic suspension operation
11. Other items
    a. No desconso allowed for jacking team members until after jacking of the recirculation bin.
    b. Lock out on hand pump holding valves
    c. Deenergize the recirculation bin

Appendix H: JACK PRESSURES

JACKING PRESSURE LOG

PROJECT: Verde Gold Mine
LOCATION: Maricunga Valley, Chile
ITEM: Recirculation Bin
JACKING DATE: 25 Aug 96

Conversion from PSI to Te for 100 ton Enerpac Jacks with 20.63 sq. in of piston area:

PSI / 106.64 = Te   Te = metric ton

CORNER A			**CORNER B**			**CORNER C**			**CORNER D**		
ELEV	**PRESSURE**		**ELEV**	**PRESSURE**		**ELEV**	**PRESSURE**		**ELEV**	**PRESSURE**	
meter	**psi**	**Te**	**meter**	**psi**	**Te**	**meter**	**psi**	**Te**	**meter**	**psi**	**Te**
4493.30	0	0	4493.25	0	0	4493.01	0	0	4493.16	0	0
Cutting columns free from the base plates, jacks pressurized for anticipated loads											
4493.30	5200	48.8	4493.25	5200	48.8	4493.01	6000	56.3	4493.16	5400	50.7
Lifting the bin up to the original grade of 4493.49											
4493.49	4900	46.0		4900	46.0		5200	48.8		5000	46.9
Lifting the bin from the original grade to + 35 mm of overjacking. Differences in the jacking pressures was mostly from a strong Northwest wind											
	5100	47.9		5100	47.9		6100	57.3		3700	34.8

The bin was in a three point suspension during the jacking with corners A & B as one common group			
Note: The total weight during lifting was 751 Te, +/- 5% made up of 8 x 47.9 Te + 4 x 57.3 Te + 4 x 34.8 = 826 U.S. tons			

END OF PRESENTATION