Attachment H

Feasibility Level Slurry System Design

May 13, 2003

Mr. Doug Chitwood
U.S. Army Corps of Engineers, Geotechnical Branch
911 Wilshire Blvd., 13107
Los Angeles, CA. 90017

Mr. Chitwood:

I would like to thank you and the Corps of Engineers for the opportunity to again provide assistance to the Matilija Dam Project.

The following report relates to the observations made during the visit to your offices and the site on April 8 and 9, 2003. Furthermore, it reflects the current thinking with regards to the slurry option. It is based on a review of the documents provided by you and work performed by myself.

This work was performed under U.S. Army Corps of Engineers Contract # DACW09-03-P-0042.

I would like to express my personal appreciation for your hospitality during my recent visit.

Respectfully submitted:

A. R. Thabit, President

EXECUTIVE SUMMARY:

A visit to the Los Angeles branch and the Matilija dam was conducted during April 8 and 9, 2003. The purpose of the visit was to review the proposed design with respect to current project alternatives, review the slurry option in an attempt to reduce water consumption and review constructability of the slurry option.

The remaining slurry option has been refined to reflect current thinking and reflect changes associated with reducing water consumption. Additional costs have been added to reflect those items identified with constructability, items not originally covered and reduction of water consumption.

The slurry scenario involves transporting roughly 2.1 MM cubic yards of sediment to a land based disposal facility, 4 miles distant from the dam. This scenario is still technically feasible. The capital cost estimate for the transport portion of this scenario is roughly $2.7 million. It does not consider the costs of dredging, operating costs, power supply and development of the pipeline right of way to include any acquisition or remediation costs. Additionally, the costs of constructing a tailings storage facility are not included in this estimate. Furthermore, additional costs would be involved in removing the remaining sediments. No parameters were given as to how this would be accomplished and it is, therefore, not considered in this report. The Corps of Engineers will develop the complete cost estimate for this scenario.

Several recommendations are made with respect to additional test work required to more fully develop the slurry transport scenario. Also, it is strongly recommended that a stringent review of the test work and design be conducted prior to construction of the slurry option.

INTRODUCTION:

At the request of Mr. Doug Chitwood, U.S. Army Corps of Engineers, Geotechnical Branch, I visited the offices of the Los Angeles branch, on April 8 and 9, 2003, for a series of meetings on the Matilija Dam Project. I also had the opportunity to visit the site to review constructability issues. The discussions centered around the current thinking with respect to the slurry option, and a desire to minimize the use of water in the event that the slurry option is utilized. These items are discussed in detail in the body of this report.

DISCUSSION:

I have been advised that the various options still under consideration include:

> Slurry transport of the fine fraction (approximately 2.1MM cubic yards) to a land based storage facility.
>
> Upstream storage of all or part of the material behind the dam.
>
> Notching the dam to permit natural removal of the sediments from behind the dam.
>
> Selling the coarse fraction material.

The slurry transport option will be explored in greater detail in the following sections. I do, however, want to briefly discuss the next two options.

Upstream storage of all or part of the material is an attractive option. There is a flat area on the north east side of the dam where material can be stored. The only concern would bank stability. I had suggested to Doug Chitwood that a soil-cement mixture might provide the necessary stability. The material would still have to be dried to a moisture content suitable for mixing with the cement. This would be a very economical method if sufficient stability can be achieved.

Mr. Chitwood indicated that the current thinking with respect to notching the dam is to bring it down in two lifts. This would be accomplished by moving material presently against the upstream face further up stream to a sufficient depth to remove the upper half of the dam. My concern is that during a storm event this could send a large uncontrolled volume of slurry down the river channel. It had always been my impression that, in this scenario, the dam would be taken down in multiple lifts with sufficient time in between to allow the slurry to move downstream in a more or less controlled fashion. It is my understanding that others are in the process of studying this option so I will not comment further.

SLURRY TRANSPORT:

It is my understanding that there is only one slurry option still under consideration. It was described as Alternative #2 in my report dated November 27, 2002. It will be expanded on and discussed further in this report. The revised capital cost estimate for the slurry transport portion of this option is shown in Appendix A.

The slurry option would utilize several dredges to slurry roughly 2.1 million cubic yards (ultra-fine fraction) of sediment in 9 months. Fresh water from Lake Casitas would be used as the slurrying media. The slurry would then pass through a stationary screen and enter a thickener. The thickener would be used to increase the solids concentration of the slurry and provide recycle water for the dredging operation. A make up water pump would be required to pump water to the dredges. A 60,000 gallon water storage tank would also be required for surge capacity.

The slurry would then be transported via pipeline to a land based disposal facility approximately 4 miles away. An 8 mile long pipeline and pumping system from Lake Casitas will supply the fresh water. The fresh water pipeline will be carbon steel and the slurry pipeline will be HDPE.

A tailings storage facility will be needed for this option. This facility can be an earthen embankment with an HDPE liner at the dam toe to catch the water that is liberated from the slurry and a sump pipe for transporting the clarified water into the canal that feeds Lake Casitas. The pipeline would be approximately 2000 feet long and could be 16” diameter CMP. It will probably take several years to drain the entrained water sufficiently to stabilize the sediments.

TECHNICAL DISCUSSION:

In the process of developing the parameters for this option numerous calculations, decisions and assumptions were made.

The calculations included pipe wall thickness, friction losses, horsepower requirements and limiting velocity of the slurry.

Decisions included such things as selection of a d_{50} particle size for the slurry. Also, line size selection was based on economic analysis using an assumed power cost of $0.15/kw. The decisions may not be completely correct but were based on experience and logic. In most cases they are believed to be conservative and would result in lower project costs once more data comes available and the design work proceeds.

The assumptions were made, primarily, due to a lack of information. They are based on past practice but are considered less reliable than the decisions. For example it was assumed that the dredges would produce a slurry that was 15% solids by volume and 50% of the water volume could be removed by thickening. Also, the thickener vendor assumed a settling rate for the solids in the slurry. These, like the other assumptions made, are based on experience but will need to be proven for the design to go forward.

The fresh water pipe line could follow the canal to Lake Casitas for much of the distance to the dam. However, some consideration must be given to the numerous road crossings. The slurry pipeline right of way should probably be 24 feet to accommodate movement of the HDPE pipeline.

A concrete vault can be used to house the fresh water pump at Lake Casitas. It could be buried on shore with a suction pipe from the lake to the vault at a sufficient depth to bring the water to the pump. The fresh water would then be pumped 8 miles through a 16” diameter by 0.375” wall thickness, carbon steel (A 53 gr. B) pipe. The elevation from Lake Casitas to the base of the Matilija Dam is rising by 412 feet. The motor horsepower required to pump 3,000 gallons per minute is 800 horsepower and will require one pump at Lake Casitas.

The slurry pipeline is designed to be 4 miles long with a 400 foot down gradient. This down gradient exceeds the friction loss in the pipeline by 57 feet. In order to maintain the pipeline at positive pressure and maintain the velocity above the limiting velocity a choke will have to be installed on the end of the line. As currently envisioned, the pipeline is 18” diameter, SDR 11, HDPE pipe with an inside diameter of 14.532 inches. The motor is 400 horsepower, comprised of 1 pump. The assumed d_{50} for the solids in the slurry is 0.040 mm, that plus the specific gravity of 2.65 and a slurry of 30% solids by volume were used to determine the limiting velocity. The limiting velocity for the pipe diameter selected is 8.82 fps. The calculated velocity at 4,500 gpm is 8.7 fps. The limiting velocity should always be 10% lower than the line velocity. However, experience has shown that ultra-fine sediments will stay in suspension at velocities of 6 fps. In a subsequent discussion with Mr. Doug Chitwood he indicated that current test work has yielded a weighted average d_{50} of 0.015mm. The limiting velocity was calculated for this average size and is 6.579 fps. This is well within the operating parameters for the pipe and pump selected for slurrying the fine material. These values must be verified by test work as it may affect the current selection of pump, pipe diameter and horsepower. Also, an additional 20% friction head was added to the horsepower calculation to compensate for slurry viscosity and other unknowns. Testing must be conducted to determine the extent to which the viscosity of the slurry will increase friction losses in this pipeline. The literature suggests that friction losses due to viscosity of ultra-fine, homogenous slurries can be negligible. In fact, the calculation indicates only a 2% loss due to viscosity in the 4 mile long pipeline.

During the site visit the location for the thickener was reviewed. The thickener is now proposed to be 115 feet in diameter. The size of the thickener has been increased from the 105 feet in diameter in the original report due to the smaller d_{50} of 0.015mm. The finer particles will take longer to settle. There is not an acceptable location for this size of equipment below the dam. It has therefore, been relocated above the dam some 3,500 feet further away from the disposal site and 108 feet higher in elevation. The slurry is fed to the center well of the thickener from the dredges, the thickened slurry settles to the bottom center cone, into the slurry pump and pipeline. The semi-clear water flows into a channel on the outside perimeter of the thickener. The thickener overflow will be piped to the water storage tank located below the dam. The pipe will be 3,600 feet long and be a 14” diameter carbon steel pipe. A rake mechanism rotates in the thickener itself. Flocculant is a polymer that is added to the thickener to aid in settling. Test work will be required to determine the correct flocculant, injection rate and the solids settling rate to select the correct thickener size.

A significant portion of the effort of this report is devoted to reducing the amount of water supplied from Lake Casitas. Mr. Chitwood indicated that the cost to purchase the water would be $1,000 per acre foot. This cost combined with the ever present drought in the West and new restrictions on minimum water flows to be maintained in streams make recycling the water important. If there was no attempt to recycle the water, assuming the dredges discharge the slurry at 15% solids by volume the cost of purchasing the water would be $7,376,033. The addition of the thickener will reduce the cost of the water purchased to $3,688,016 at a capital cost of roughly $2.7MM. However, it must also be recognized that slurrying the less dense slurry (15% vs 30%) will require a higher line velocity and as such will consume more power, increase abrasion in the pipeline and require a larger impoundment. The added costs associated with pumping a less dense slurry are not reflected in the cost analysis. If half of the water can be recovered from the slurry at the tailings impoundment and returned to Lake Casitas an additional $1.5MM could be realized; assuming that they will credit the project for the water that is returned to them. Furthermore, water may be recovered from upstream of the dam or from the stream bypass. This water could, very economically be piped into the water storage tank; although its cost benefit is considered quite small.

Other options were investigated to reduce water consumption. These included, providing additional tank storage capacity for the water coming from upstream and filter presses to squeeze all available water from the slurry at the tailings impoundment. These options were found to be uneconomic and are not deserving of consideration.

Based on the analysis of reducing water consumption a fresh water storage tank is still warranted for surge capacity. The water storage tank and make up water pump are, therefore, still included in this design. The water storage tank has a 60,000 gallon capacity, is 22’ in diameter by 22’ tall and is carbon steel. It would receive water from Lake Casitas and from the thickener overflow. Water will be pumped from this tank to the dredges. For pricing purposes it was assumed that the pumps would be capable of 9,000 gpm and a head of 590 feet giving a discharge pressure of 150 psi at the dredges. The total distance to be pumped was assumed to be 1 mile at the farthest point with a vertical rise of 115 feet. It was assumed that a 20” diameter carbon steel pipeline would be used and the horsepower required would be 2700 hp.

During the site visit, it was observed that there is three phase power available reasonably close at both Lake Casitas and the dam. The available voltage was not, however discernable. The cost of power is an extremely important component of the slurry transport alternative. At a cost of $0.15/kwh the power cost will exceed $3 million over the 9 months of operation. Capital cost to get the power supply to where it is needed and operating cost will have an impact on the viability of the slurry transport scenario. These costs are not included in the cost estimate; the estimated power cost of $0.15/kwh was only used in the economic analysis for pipe diameter selection.

COST ANALYSIS:

Present day pricing was obtained by reputable vendors for the pipe, pumps and thickener. The cost of the water storage tank was calculated in house. Competitive bidding was not used for this exercise as time was of the essence. Also, the carbon steel pipe is of foreign manufacture, which may be of some political concern. The vendor quotes may be found in Appendix C.

For this aspect of the project (pipelines, pumping and tankage) it can be assumed that the installed cost will be on the order of 2-3 times the cost of the materials and equipment. As this is a short term operation, it is assumed that no significant infrastructure will be constructed to provide services to this operation.

Equipment and pipe cost for this option is $2.678 MM. The capital cost estimate for the slurry transport portion of this scenario is shown in Appendix A. A comprehensive cost for this scenario will be developed by the Corps of Engineers.

Operating and maintenance staffing was considered for this scenario. Some level of automation is considered a necessity to achieve reasonable system utilization. With this in mind it is felt that 4 crews of 3 operators and one electrical/instrumentation technician would be capable of the sustaining the continuous operation. Additionally, contract maintenance would be needed on a sporadic basis to replace wear components. The single slurry pump will probably require one set of wear components during the life of this project.

RECOMMENDATIONS:

If slurry transport is determined to be the preferred method of sediment removal additional test work must be performed. This test work should be performed prior to commencing the design phase. Solids settling rate, flocculant addition rate, limiting velocity and the effect of slurry viscosity on friction losses must all be determined. Statistically significant samples of the sediment, to be transported, will need to be prepared in order have a high level of confidence in the test results.

A stringent review of the test work and design should be conducted by the Corps of Engineers prior to any construction activities.

Most of the assumptions relating to the dredging operation are unsupported. It is very important that dredge requirements for water supply (pressure and flow) and dredge performance relating to percent solids by volume discharged be determined.

APPENDIX A:

CAPITAL COST ESTIMATE

SLURRY TRANSPORT PORTION

MATILIJA DAM COSTS

SLURRY OPTION

DESCRIPTION	NUMBER	UNITS	UNIT	TOTAL
			COST	COST
FRESH WATER PIPE LINE, 8 MILES LONG 16"X.357" WALL, A53 C.S. PIPE	42240	FEET	14.93	630643.20
SLURRY PIPE LINE, 4 MILES LONG 18" SDR 11, HDPE PIPE, 14.532" I.D.	21120	FEET	18.65	393888.00
MAKE UP WATER LINE, 1 MILE LONG 20"X.357" WALL, A53 C.S. PIPE	5280	FEET	20.93	110510.40
THICKENER OVERFLOW LINE, 3600LF LONG 14" X.375" WALL C.S. PIPE	3600	FEET	13.02	46872.00
FRESH WATER SUPPLY PUMP, 800HP GOULDS VERTICAL TURBINE	1	EACH	105875.00	105875.00
CONCRETE VAULT FOR FRESH WATER SUPPLY PUMP	1	EACH	30000.00	30000.00
SLURRY PUMP, 400HP WARMAN SLURRY PUMP	1	EACH	75000.00	75000.00
MAKE UP WATER PUMPS, 900HP EACH GOULDS CENTRIFUGALS, IN SERIES	3	EACH	91903.00	275709.00
THICKENER, 115' IN DIA., INCLUDES FLOC. PKG. 40 HP RAKE MOTOR	1	EACH	900000.00	900000.00
WATER STORAGE TANK, 60,000 GALLONS 22'X22' CARBON STEEL	1	EACH	110000.00	110000.00
TOTAL COST, SLURRY OPTION				$2,678,497.60

APPENDIX B:

REFERENCES

REFERENCES:

1. **Slurry Pumping Manual** – Warman International Ltd., 2002
2. **Cameron Hydraulic Data** – Ingersoll Rand, 1981
3. **Standard Handbook for Mechanical Engineers** – Baumeister & Marks, 1967
4. **Introduction to Mineral Processing** – Kelly & Spottiswood, 1982

APPENDIX C:

SUPPORTING DOCUMENTATION

Attachment H – Appendix A

Slurry System Design Cost Estimates

MATILIJA DAM COSTS

DESCRIPTION	NUMBER	UNITS	UNIT	TOTAL
			COST	COST
FRESH WATER PIPE LINE, 8 MILES LONG 16"X.357" WALL, A53 C.S. PIPE	42240	FEET	14.93	630643.20
SLURRY PIPE LINE, 4 MILES LONG 18" SDR 11, HDPE PIPE, 14.532" I.D.	21120	FEET	18.65	393888.00
MAKE UP WATER LINE, 1 MILE LONG 20"X.357" WALL, A53 C.S. PIPE	5280	FEET	20.93	110510.40
FRESH WATER SUPPLY PUMP, 800HP GOULDS VERTICAL TURBINE	1	EACH	105875.00	105875.00
SLURRY PUMP, 400HP WARMAN SLURRY PUMP	1	EACH	75000.00	75000.00
MAKE UP WATER PUMPS, 900HP EACH GOULDS CENTRIFUGALS, IN SERIES	3	EACH	91903.00	275709.00
THICKENER, 105' IN DIA., INCLUDES FLOC. PKG. 40 HP RAKE MOTOR	1	EACH	800000.00	800000.00
WATER STORAGE TANK, 60,000 GALLONS 22'X22' CARBON STEEL	1	EACH	110000.00	110000.00
TOTAL COST, ALTERNATIVE 2				$2,501,625.60

Attachment H – Appendix B

Slurry System Design Calculations

MATILIJA DAM DATA ANALYSIS

ALTERNATIVE 1

WATER SUPPLY

DISTANCE MILES	FLOW RATE GPM	PIPE ID. INCHES	NOMINAL DIA. TYPE/INCHES	VELOCITY FT/SEC	TOTAL HEAD FEET	PRESSURE PSI	ELECT POWER HORSEPOWER	COSTS	PIPE $/LFT	PIPE TOTAL	PUMPS NUMBER	PUMPS EA. COST	PUMPS TOTAL	THICKENER COST	TANK COST	POWER $/KW	ELECT. TOTAL
8	6500	19.25	A53GRB/20"	7.165	972.51	421	2000		20.93	884083.20	2	125535	251070			0.07	578340.00
8	**6500**	**23.25**	**A53GRB/24"**	**4.912**	**635.25**	**275**	**1600**		**25.19**	**1064025.60**	**2**	**106057**	**212114**			**0.07**	**462672.00**

SLURRY DISCHARGE

DISTANCE MILES	FLOW RATE GPM	PIPE ID. INCHES	NOMINAL DIA. TYPE/INCHES	VELOCITY FT/SEC	TOTAL HEAD FEET	PRESSURE PSI	ELECT POWER HORSEPOWER	COSTS	PIPE $/LFT	PIPE TOTAL	PUMPS NUMBER	PUMPS EA. COST	PUMPS TOTAL	THICKENER COST	TANK COST	POWER $/KW	ELECT. TOTAL
16	9500	16.146	SDR11/20"	14.89	2788.5	1207	15600		23.38	1975142.40	13	220000.00	2860000.00	900000.00	142000.00	0.15	9666540.00
MAKE UP WATER PUMPS																	
1	12000	23.25	A53GRB/24"	9.068	549	238	2700		25.19	133003.20	3	93751	281253.00			0.15	1673055.00

ALTERNATIVE 2

WATER SUPPLY

DISTANCE MILES	FLOW RATE GPM	PIPE ID. INCHES	NOMINAL DIA. TYPE/INCHES	VELOCITY FT/SEC	TOTAL HEAD FEET	PRESSURE PSI	ELECT POWER HORSEPOWER	COSTS	PIPE $/LFT	PIPE TOTAL	PUMPS NUMBER	PUMPS EA. COST	PUMPS TOTAL	THICKENER COST	TANK COST	POWER $/KW	ELECT. TOTAL
8	**3000**	**15.25**	**A53GRB/16"**	**5.27**	**829**	**359**	**800**		**14.93**	**630643.20**	**1**	**105875**	**105875**			**0.07**	**231336.00**
8	3000	13.25	A53GRB/14"	6.98	1238	536	1302		13.02	549964.80			0			0.07	376499.34

SLURRY DISCHARGE

DISTANCE MILES	FLOW RATE GPM	PIPE ID. INCHES	NOMINAL DIA. TYPE/INCHES	VELOCITY FT/SEC	TOTAL HEAD FEET	PRESSURE PSI	ELECT POWER HORSEPOWER	COSTS	PIPE $/LFT	PIPE TOTAL	PUMPS NUMBER	PUMPS EA. COST	PUMPS TOTAL	THICKENER COST	TANK COST	POWER $/KW	ELECT. TOTAL
4	4500	14.532	SDR11/18"	8.705	142.5	62	400		18.65	393888.00	1	75000.00	75000.00	800000.00	110000	0.15	247860.00
MAKE UP WATER PUMPS																	
1	9000	19.25	A53GRB/20"	9.92	590	255	2700		20.93	110510.40	3	91903	275709.00			0.15	1673055.00

Attachment H – Appendix C

Supporting Documentation

INBOX: 3 of 5

Delete | Reply | Reply to all | Forward | Bounce | Resume | Save as   Back to INBOX

Date Mon, 18 Nov 2002 15:26:36 -0600

From bob.vanderpan@weirslurry.com

To Althabit@fgn.net

Cc tony.przybylek@weirslurry.com, jim.metsa@weirslurry.com

Subject Slurry Problem

Parts

	[no description]	multipart/mixed	7113.46 KB
2	Weir Slurry Pumping Handbook.pdf	application/pdf	7074.89 KB
3	slurry.doc	application/msword	34.90 KB
	Message Source		

Hi Al,

Jim Metsa asked me to look at this and respond.

1. I don't find where our slurry handbook indicates 36 feet/second for d50 of 300 microns at 30% CV. Maybe you were looking at a metric version of the Handbook and that it is meters/second. A 10" line would require about 10.8'/s, 20" line about 15'/s and a 30" line 18'/second for conservative figures depending on type of pipe used/actual ID. Here is the latest recently released version of our Handbook .(See attached file: Weir Slurry Pumping Handbook.pdf)

2. For dewatering purposes it is the best to pump at least the two smaller fractions.
   A. Use a Warman "Recyclone" to split out the +200 microns.
   B. Use smaller Warman "CAVEX" cyclones to split the +20/38 microns from the -200 from A.
   C. Use a thickener to a vacuum beltpress filter to press the -20/38 microns from B.

I spoke to our Tony Przybylek regarding the materials separation/dewatering. 608-221-5834. Tony is our Product Manager for Process Equipment (non-pumps).

3. We could pump the -2mm in a rubber high pressure pump but 16 miles would tentatively require 13-14 pumps (total) separated in two pump stations to keep the line pressure under 1000 psi. I calculated a year, a half year, and three months to pump the product at 2306 gpm, 4612gpm, and 9224 gpm (under 700 psi), respectively. I'm sure these figures are conservative depending on how loose/dry your materials is per cubic yard.

Pumping -64mm would require a metal lined pump. This would shorten the wear life considerably over pumping -2mm with a rubber pump.

I'll give you a call tomorrow to discuss after you've had some time to digest the above.
---------------------- Forwarded by Bob I Vanderpan/US/WAR/Weir on 11/18/2002 01:57 PM ---------------------------

Jim P Metsa
11/18/2002 08:40 AM

To: Bob I Vanderpan/US/WAR/Weir@WINET
cc:

Subject: Slurry Problem

Bob,

Please see the attachment from Al Thabit. He needs some assistance on pump selection for this dredging application. Could you please give him a call and provide him the information he requires.

Thanks!
---------------------- Forwarded by Jim P Metsa/US/WAR/Weir on 11/18/2002 07:38 AM ---------------------------

althabit@fgn.net on 11/18/2002 08:32:09 AM

To: Jim Metsa <jim.metsa@weirslurry.com>
cc:

Subject: Slurry Problem

Jim:

It was good talking with you the other day. Attached is a MS Word document describing the issues I am working on. I'm sure there will be some questions
and discussion after you have had some time to digest it.

Please give me a call 970 625-3457 when you are ready to talk about this. I'm
working on pre-feasability costs for the various scenarios and would like to
wrap this up this week if possible.

Regards,

Al
(See attached file: slurry.doc)

Regards
Bob I Vanderpan, P.E.

Senior Technical Support Engineer
Weir Slurry TM
North America

2701 S Stoughton Rd
Madison WI 53716 USA

Tel :   001 608 221 5841
Fax :   001 608 221 5810
Bob.Vanderpan@weirslurry.com
http://www.Weirslurry.com

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This project has three potential slurrying alternatives. The final design may be a combination of the three but ultimately will be determined by cost, technical feasibility and environmental constraints.

Total volume to be slurried is estimated at, between 5-6 million cubic yards with a specific gravity of 2.65 and grading from 0.035mm to 10mm. Approximately 2.1 million cubic yards is graded from 0.035mm to 0.062mm. Approximately 2.6 million yards is graded from 0.062mm to 2.00mm. The balance grades from 2 to 64mm and only the smaller fraction of this material will be considered for slurrying.

The maximum distance being considered to slurry the material is 16 miles away, to the ocean. My concept here, was to combine the coarse to fine fractions, increase the solids content to roughly 30% by volume so that the coarse fraction will stay in suspension at lower than normal line velocities needed for the coarse fraction. The elevation drops approximately 1,000 feet in the 16 miles. Using the Warrman Slurry Handbook and a d_{50} of 0.30mm yielded a line velocity of 36 feet per second. It is my opinion, based on previous experience that this is extremely high. I would like to have a discussion on various methods for extracting the material, increasing the percent solids, determining line velocities based on the d_{50} of the material, friction losses due to viscosity and required horsepower.

The second option being considered is to slurry the 2.1 MM yards of the fine material approximately 4 miles and down grade approximately 300 feet to a land based storage facility. I would like to have a discussion as in the above paragraph. Additionally what dewatering techniques may be used to stabilize this material once transported to the disposal facility.

The third option would be to slurry the midlings fraction (0.062 to 2.00mm) to the beach 16 miles away. This material may or may not have to be dewatered. A discussion of the parameters of this option is also desired.

Lastly I would like to discuss what tests Weir would propose to determine the most realistic values for the final system design.

C. H. Spencer and Company

(775) 753-8088 | **Elko, Nevada Office** | (775) 753-8186 fax

551 West Main Street . Elko, Nevada 89801

Court Kimball | Email: chselk@citlink.net | Cindi Nolan

" QUOTATION"

TO:	**Al Thabitt**	**DATE:**	**Wednesday, November 27, 2002** **7:13:56 AM**
QUOTE #	**AL Thabitt**	**TERMS**	**NET 30**
P.O. #		**FOB**	
DELIVERY		**SHIP VIA**	

QUANTITY	DESCRIPTION	PRICE EA
Pump #1 2ea	3250 Gpm @ 635.25 TDH w/ 24" Discharge Line Gould's Vertical Turbine Model 18CHC (5stage) 300# Construction US Electric Motor 800 HP 1800 RPM Solid Shaft WP-2	$ 106,057.00
Pump # 2 2 ea	3250 Gpm @ 972 TDH W/ 20" Discharge line Gould's Vertical Turbine Model 18 CHC (7 Stage) 300 # Construction US Electric Motor 1000 HP 1800 RPM Solid Shaft WP-2	$ 125,535.00
Pump #3 1ea	3000 GPM @ 829 TDH w/ 15.25" ID Pipe Gould's Vertical Turbine Model 18 BLC (7 Stage) US Electric Motor 800 HP 1800 RPM Solid Shaft WP-2	$ 105,875.00
	Al, these Prices are Budget if you would need closer Numbers Take off 20% The Thickener pumps are Quoted separate.	
	Thank's Don Canepa 775-846-2132	

C H SPENCER AND COMPANY
JOHN KIMBALL

15.25" ID.

Goulds Turbine Pump Selection ver: 6.042
11/26/02

PUMP DATA SHEET

Turbine 60 Hz

Selection file: (untitled)

Catalog: TURB60.MPC v 2.03

Curve: E6418BEPCI

Design Point: Flow: 3000 US gpm
Head: 829 ft

Pump: **TURBINE - 1800** **Size: 18BLC (7 stages)**
Speed: 1770 rpm Dia: 12.3125 in

Limits: Temperature: 120 °F Sphere size: 1.12 in
Pressure: 350 psi_g Power: — bhp

Specific Speed: Ns: 2334 Nss: —

Vertical Turbine: Bowl Size: 17.5 in Max Lateral: 0.75 in
Thrust K Factor: 27.5

Motor: — hp NEMA Standard WPI Enclosure
sized for Max Power on Design Curve

Fluid: Water
Temperature: 60 °F
SG: 1
Viscosity: 1.122 cP
Vapor pressure: 0.2568 psi_a
Atm pressure: 14.7 psi_a

NPSHa: — ft

Piping:
System: —
Suction: — in
Discharge: — in

Discharge Sizes-12",14",16"

---- Data Point ----

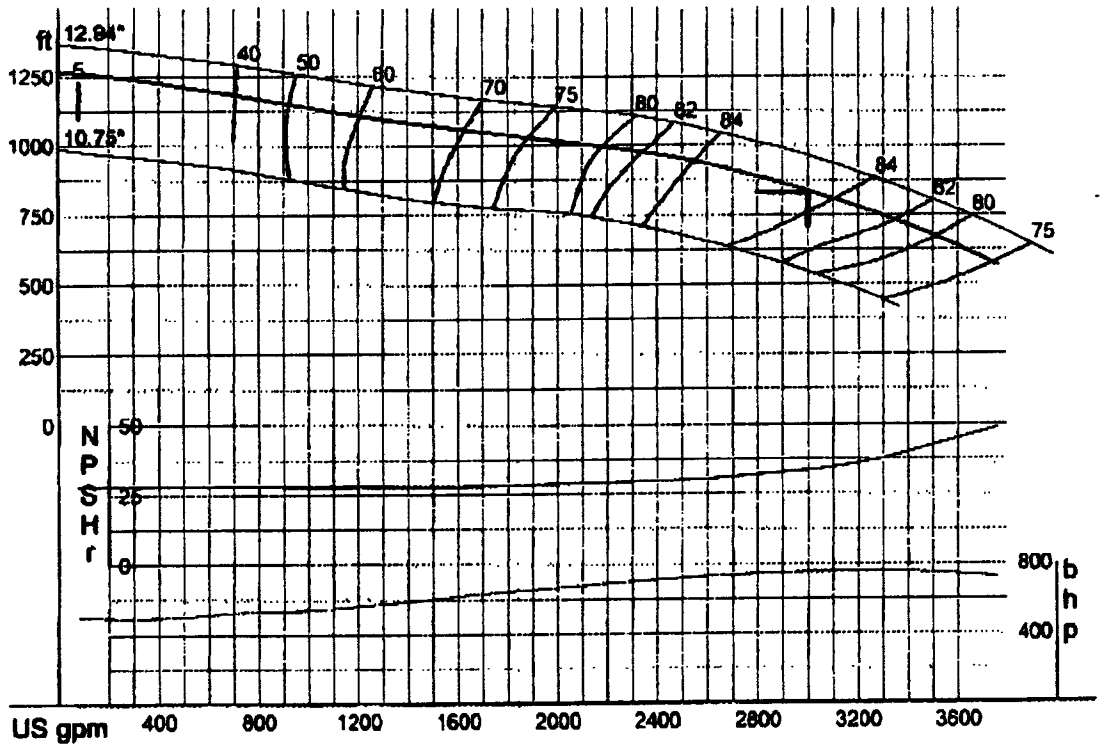
Flow: 3000 US gpm
Head: 835 ft
Eff: 84.3%
Power: 749 bhp
NPSHr: 33.8 ft

-- Design Curve --

Shutoff Head: 1267 ft
Shutoff dP: 549 psi
Min Flow: - US gpm
BEP: 84.8% eff
@ 2826 US gpm
NOL Pwr: 756 bhp
@ 3350 US gpm

-- Max Curve --

Max Pwr: 868 bhp
@ 3268 US gpm



--- PERFORMANCE EVALUATION ---

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
3600	1770	637	78.1	739	44.9				
3000	1770	835	84.3	749	33.8				
2400	1770	967	82.5	710	29.8				
1800	1770	1038	73.4	642	28.3				
1200	1770	1110	59.7	563	28				

C H SPENCER AND COMPANY
JOHN KIMBALL

24" line

Goulds Turbine Pump Selection ver: 6.042
11/26/02

PUMP DATA SHEET

Turbine 60 Hz

Selection file: (untitled)

Catalog: TURB60.MPC v 2.03

Curve: E6618CCPCO

Design Point: Flow: 3250 US gpm
Head: 635.25 ft

Pump: **TURBINE - 1800** **Size: 18CHC, (5 stages)**
Speed: 1770 rpm Dia: 11.65 in

Limits: Temperature: 120 °F Sphere size: 1 in
Pressure: — psi_g Power: — bhp

Specific Speed: Ns: 2232 Nss: ---

Vertical Turbine: Bowl Size: 17.5 in Max Lateral: 0.75 in
Thrust K Factor: 18.5

Motor: — hp NEMA Standard WPI Enclosure
sized for Max Power on Design Curve

Fluid: Water Temperature: 60 °F
SG: 1
Viscosity: 1.122 cP
Vapor pressure: 0.2568 psi_a
Atm pressure: 14.7 psi_a

NPSHa: — ft

Piping: System: —
Suction: --- in
Discharge: --- in

---- Data Point ----

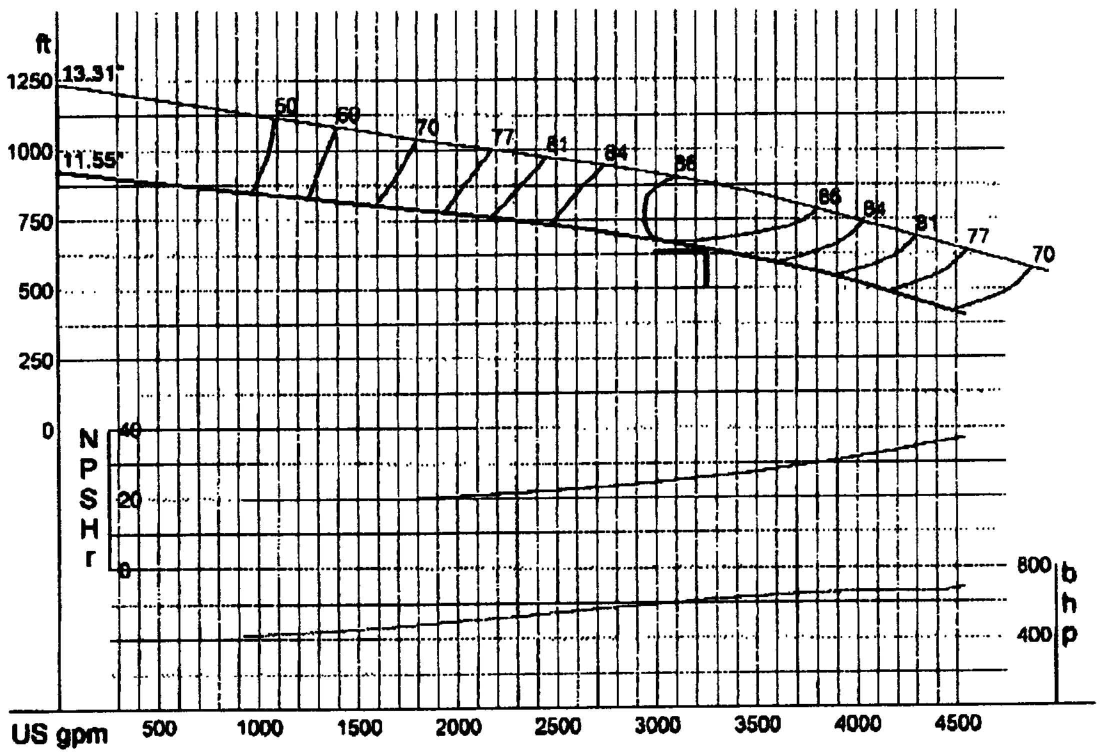
Flow: 3250 US gpm
Head: 642 ft
Eff: 85.2%
Power: 616 bhp
NPSHr: 25.9 ft

-- Design Curve --

Shutoff Head: 928 ft
Shutoff dP: 402 psi
Min Flow: - US gpm
BEP: 86% eff
@ 3034 US gpm
NOL Pwr: 686 bhp
@ 4537 US gpm

-- Max Curve --

Max Pwr: 1029 bhp
@ 4966 US gpm



--- PERFORMANCE EVALUATION ---

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
3900	1770	544	80.9	661	30.6				
3250	1770	642	85.2	616	25.9				
2600	1770	720	84.5	558	22.7				
1950	1770	779	77.2	496	20.4				
1300	1770	828	61.3	442	19.9				

C H SPENCER AND COMPANY
JOHN KIMBALL

Goulds Turbine Pump Selection ver: 6.042
11/26/02

PUMP DATA SHEET
Turbine 60 Hz

Selection file: (untitled)
Catalog: TURB60.MPC v 2.03

Curve: E6618CCPCO

Design Point: Flow: 3250 US gpm
Head: 972.5 ft

Pump: TURBINE - 1800 — **Size: 18CHC, (7 stages)**
Speed: 1770 rpm — Dia: 11.9375 in

Limits: Temperature: 120 °F — Sphere size: 1 in
Pressure: --- psi_g — Power: --- bhp

Specific Speed: Ns: 2232 — Nss: ---

Vertical Turbine: Bowl Size: 17.5 in — Max Lateral: 0.75 in
Thrust K Factor: 18.5

Motor: --- hp — NEMA Standard — WPI Enclosure
sized for Max Power on Design Curve

Fluid: Water — Temperature: 60 °F
SG: 1
Viscosity: 1.122 cP
Vapor pressure: 0.2568 psi_a
Atm pressure: 14.7 psi_a

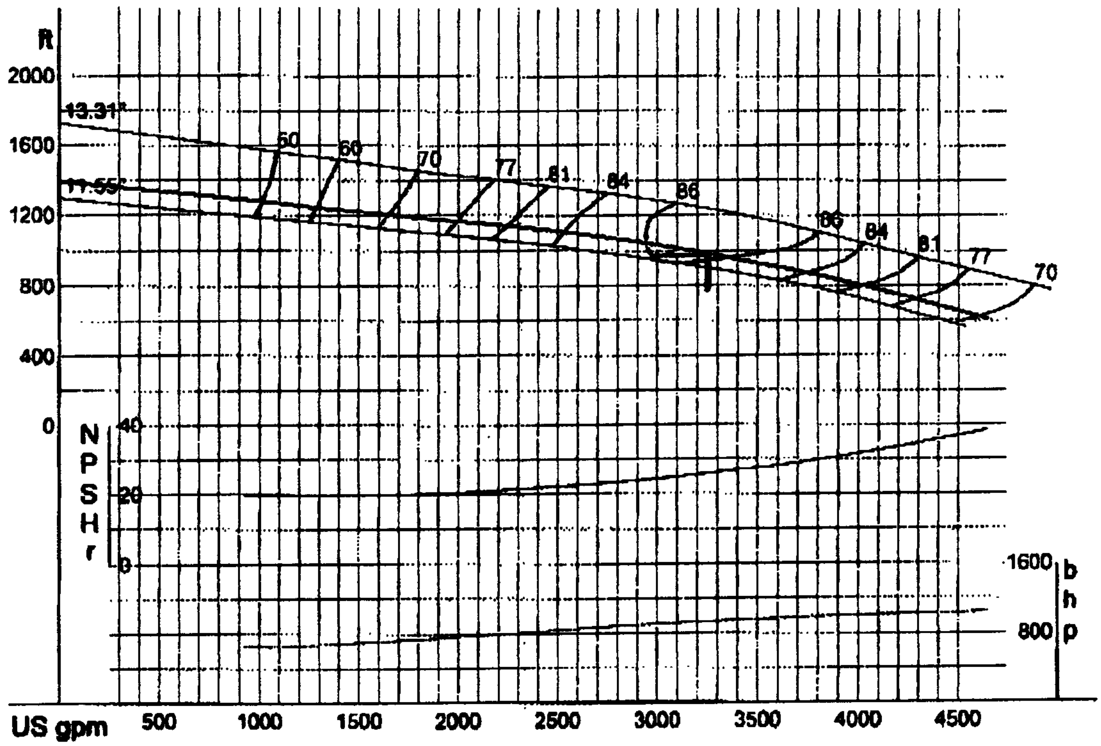
NPSHa: --- ft

Piping: System: ---
Suction: --- in
Discharge: --- in

---- Data Point ----
Flow: 3250 US gpm
Head: 983 ft
Eff: 86.1%
Power: 936 bhp
NPSHr: 25.9 ft

-- Design Curve --
Shutoff Head: 1394 ft
Shutoff dP: 604 psi
Min Flow: - US gpm
BEP: 86.2% eff
@ 3136 US gpm
NOL Pwr: 1054 bhp
@ 4848 US gpm

-- Max Curve --
Max Pwr: 1441 bhp
@ 4986 US gpm



-- PERFORMANCE EVALUATION --

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
3900	1770	834	82.3	996	30.7				
3250	1770	983	86.1	936	25.9				
2600	1770	1095	84.3	851	22.6				
1950	1770	1173	76.1	758	20.5				
1300	1770	1244	60.4	676	19.9				

Goulds Pumps

ITT Industries

Court Kimball
C. H. Spencer and Company
Elko Nevada Office
561 West Main Street
Elko, Nevada 89801
Phone:775-753-8088
Fax 775-753-8186

C. H. SPENCER & COMPANY

Proposal No: ELCK211005

Item No: ITEM001

Nov 26, 2002

MODEL:3409 Size: 8x12-27 M QTY: 3

Operating conditions

SERVICE	*THICKENER UNDERFLOW*
LIQUID	*, SP.GR 1.050*
CAPACITY Norm./Rate	*4000.0 / 4000.0 gpm*
HEAD	*549.0 ft*

PRICES in USD	
Pump Unit	54,901
Driver	38,850
Subtotal 3 Units	281,253
Boxing	
Testing	
Freight	
Accessories	
Total 3 Units	**281,253**

Performance at 1785 RPM

PUBLISHED EFFY	*71.0% (CDS)*
RATED EFFY	*71.0%*
RATED POWER	*820.1 hp (Run out 890.4 hp)*
NPSHR	*25.0 (available NPSH is 28.0) (ft)*
DISCH. PRESSURE	*249.5 (318.2 @ Shut off) (psi g)*
PERF.CURVE	*A-8271-7 (Rotation CW viewed from coupling end)*
SHUT OFF HEAD	*700.0 ft*

Materials

CONSTRUCTION	*Cast iron / 316SS*
CASING	*Ductile iron max.casing.pres.@ rated temp.400.0psi g*
CASING WEAR RING	*Nitronic 60*
IMPELLER	*316SS - Enclosed (24.5000 rated (in) max=27.0000 min=20.0000)*
IMPELLER WEAR RING	*316SS*
CASING GASKET	*Vellumoid 505*
SHAFT	*17- 4PH*
SHAFT SLEEVE	*316SS*
LUBRICATION	*Grease*
GLAND	*Cast Iron Split*
COUPLING	*Falk-1000G G10 1035-*
COUPLING GUARD	*Steel*
BASEPLATE	*Channel steel*

Sealing Method

PACKING *Acrylic yarn impregnated with petroleum lubricants and graphite*

Flanges

250# flat face

Liquid end features

Impeller dynamic balance to ISO G6.3

Frame features

Inpro VBX Labyrinth Seal

Piping

Steel bypass tubing

Baseplate Features

Drip Pan with NPT drain connection

.../

Miscellaneous

Kynar cyclonic separators (2) -mounted

Painting

Goulds Blue water reducible coating (Strathmore)

Driver: Electric motor Manufacturer: US Electric

FURNISHED BY	*Pump mfg*	MOUNTED BY	*Pump mfg*
RATING	*900.00 hp (671.1 KW)*	ENCLOSURE	*WPII*
PHASE/FREQ/VOLTS	*3/60 Hz/4160*	SPEED	*1800 RPM*
INSULATION/SF	*F/1.15*	FRAME	*5810MS*

Weights

TOTAL NET UNIT WEIGHT ***7390.0lb***

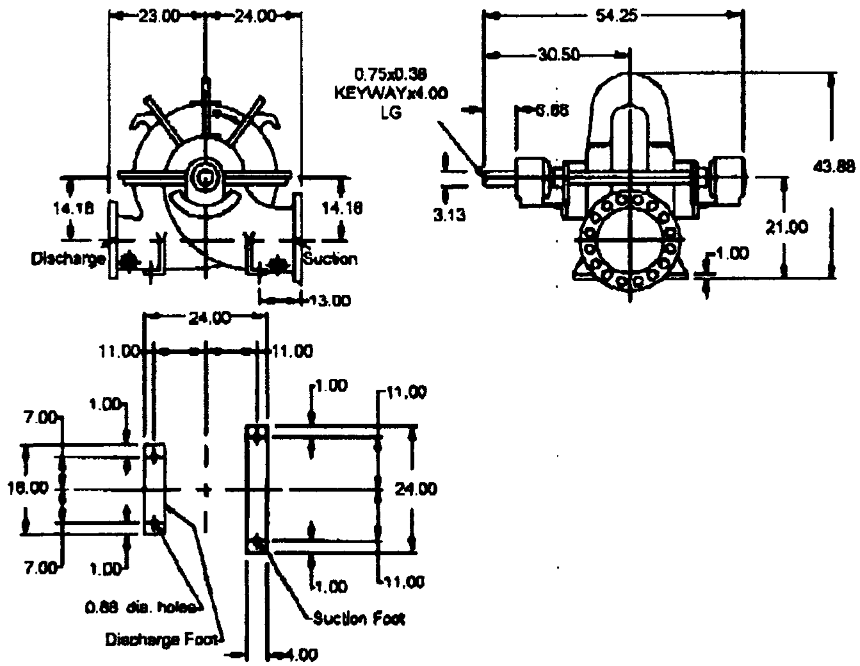
Program Version 2.3.0.0

Goulds Pumps

ITT Industries

BARE PUMP DRAWING

Model 3409 M 8x12-27



Pump specification

SUCT.FLANGE SIZE *12"*	DRILLING *ANSI 250#*	FACING *FF*	FINISH *SMOOTH*
DISCH.FLANGE SIZE *8"*	DRILLING *ANSI 250#*	FACING *FF*	FINISH *SMOOTH*
PUMP ROTATION (LOOKING AT PUMP FROM MOTOR) *CW*			
TYPE OF LUBRICATION *GREASE*			COOLED *NO*
TYPE OF STUFFING BOX *N/A*			COOLED *NO*
TYPE OF SEALING *PACKING*			

Weights and Measurements

PUMP	2940.0 lb
MOTOR/CPLG	4300.0/150.0 lb
BASEPLATE	lb
TOTAL	7390.0 lb
GR.VOLUME w/BOX	N/A
GR.WEIGHT w/BOX	N/A

Motor specification

MOTOR BY *PUMP MFG*	MOUNT BY *PUMP MFG*	MFG. *US ELECTRIC*	
FRAME *5810MS*	POWER *900.00 hp*	RPM *1800*	
PHASE *3*	FREQUENCY *60 Hz*	VOLTS *4160*	
INSULATION *F*	S.F. *1.15*		
ENCLOSURE *WPII*			

Notes and References

-Tolerance for all pump dimensions is +-0.13 in. unless otherwise specified

FOR PUMP TAPPED OPENINGS REFER TO DWG.: TELCK211005/ITEM001

Auxiliary specification

COUPLING BY *PUMP MFG*	CPLG TYPE *FALK 1000G G10 1035*
CPL GUARD BY *PUMP MFG.*	CPLG GUARD MATL *STEEL*
BASEPLATE *CHANNEL STEEL*	
PACKING *ACRYLIC YARN IMPREGNATED WITH PETROLEUM LUBRICANTS AND GRAPHITE*	

Customer: C. H. SPENCER and COMPANY
Serial No:
Customer P.O. No:
Item No: ITEM001
Service: THICKENER UNDERFLOW

All dimensions are in inches.
Drawing is not to scale
Weights (lbs) are approximate

DRAWING NO ELCK211005/ITEM001

FORM # ED1135

Program Version 2.3.0.0

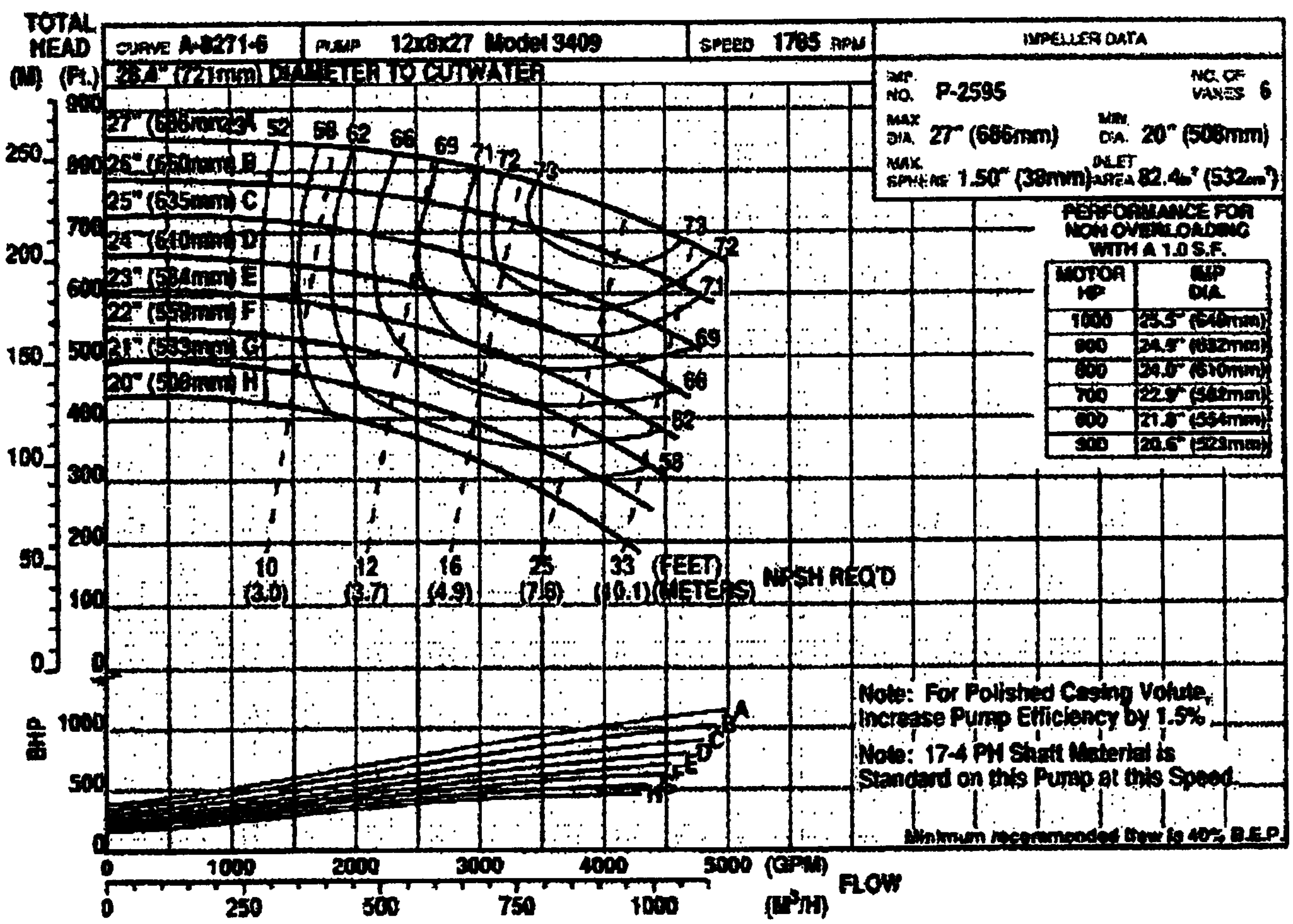
Model:3409	Size:12X8X27	Group:	60 Hz	RPM:1785	Stages:1

Job/Inqu. No.
Purchaser:
User: Issued by: COURT KIMBALL
Item/Equip.No: Quotation No. Date: 11/26/02
Service: Order No. Certified By:

Operating Conditions		Pump Performance			
Liquid:	Water	Actual Pump Eff.:		Suction Specific Speed:	0 (gpm(US) , ft
		Actual Pump Power:		Min. Cont. Stable Flow:	
Temp.:	70 °F	Mech. Seal Loss:	0 hp	Min. Cont. Thermal Flow:	
Sp. Heat:		Dyn. Seal Loss:	0 hp		
S.G./Visc.:	1.05/1 cp	Other Power Loss:	0 hp	Non-Overloading Power:	
Flow:	4000 gpm(US)	Rated Total Power:		Imp. Dia. Addt'l Stg	781HP
TDH:	549 ft	Imp. Dia. First 1 Stg			
NPSHa:	28 ft	NPSHr:		Mag. Drive Circuit Flow:	848 120
Req. solid size:		Shut off Head:		Max Drive Power:	
% Solids:				Max Drive Temp:	900
Vapor Press:				Max Motor Size:	

Notes: 1. The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above. 2. Magnetic drive eddy current and viscous effect on power and efficiency is not included. 3. Elevated temperature effects on performance are not included.

11-17-95



Goulds Pumps

ITT Industries

Court Kimball
C. H. Spencer and Company
Elko Nevada Office
551 West Main Street
Elko, Nevada 89801
Phone:775-753-6086
Fax:775-753-8186

C. H. SPENCER & COMPANY

Proposal No: ELCK211005

Item No: ITEM002

Nov 26, 2002

MODEL:3409 Size: 8x12-27 M QTY: 3

Operating conditions

SERVICE	*THICKENER UNDERFLOW*
LIQUID	*, SP.GR 1.050*
CAPACITY Norm./Rate	*3000.0 / 3000.0 gpm*
HEAD	*590.0 ft*

PRICES in USD	
Pump Unit	54,901
Driver	37,002
Subtotal 3 Units	275,709
Boxing	
Testing	
Freight	
Accessories	
Total 3 Units	275,709

Performance at 1785 RPM

PUBLISHED EFFY	*71.0% (CDS)*
RATED EFFY	*71.0%*
RATED POWER	*661.0 hp (Run out 831.6 hp)*
NPSHR	*16.0 (available NPSH is 28.0) (ft)*
DISCH. PRESSURE	*268.2 (300.0 @ Shut off) (psi g)*
PERF.CURVE	*A-8271-7 (Rotation CW viewed from coupling end)*
SHUT OFF HEAD	*660.0 ft*

Materials

CONSTRUCTION	*Cast iron / 316SS*
CASING	*Ductile iron max.casing pres.@ rated temp 400.0psi g*
CASING WEAR RING	*Nitronic 60*
IMPELLER	*316SS - Enclosed (24.2000 rated (in) max=27.0000 min=20.0000)*
IMPELLER WEAR RING	*316SS*
CASING GASKET	*Vellumoid 505*
SHAFT	*17-4PH*
SHAFT SLEEVE	*316SS*
LUBRICATION	*Grease*
GLAND	*Cast Iron Split*
COUPLING	*Falk-1000G G20 1035-*
COUPLING GUARD	*Steel*
BASEPLATE	*Channel steel*

Sealing Method

PACKING *Acrylic yarn impregnated with petroleum lubricants and graphite*

Flanges

250# flat face

Liquid end features

Impeller dynamic balance to ISO G6.3

Frame features

Inpro VBX Labyrinth Seal

Piping

Steel bypass tubing

Baseplate Features

Drip Pan with NPT drain connection

.../

Miscellaneous

Kynar cyclonic separators (2) -mounted

Painting

Goulds Blue water reducible coating (Strathmore)

Driver: Electric motor Manufacturer: US Electric

FURNISHED BY	*Pump mfg*	MOUNTED BY	*Pump mfg*
RATING	*900.00 hp (671.1 KW)*	ENCLOSURE	*WPII*
PHASE/FREQ/VOLTS	*3/60 Hz/4160*	SPEED	*1800 RPM*
INSULATION/SF	*F/1.15*	FRAME	*5810SS*
RTD's	*Yes*		
SPACE HEATER	*Yes*		

Driver Features

RTD's
Space heater

Weights

TOTAL NET UNIT WEIGHT **7390.0lb**

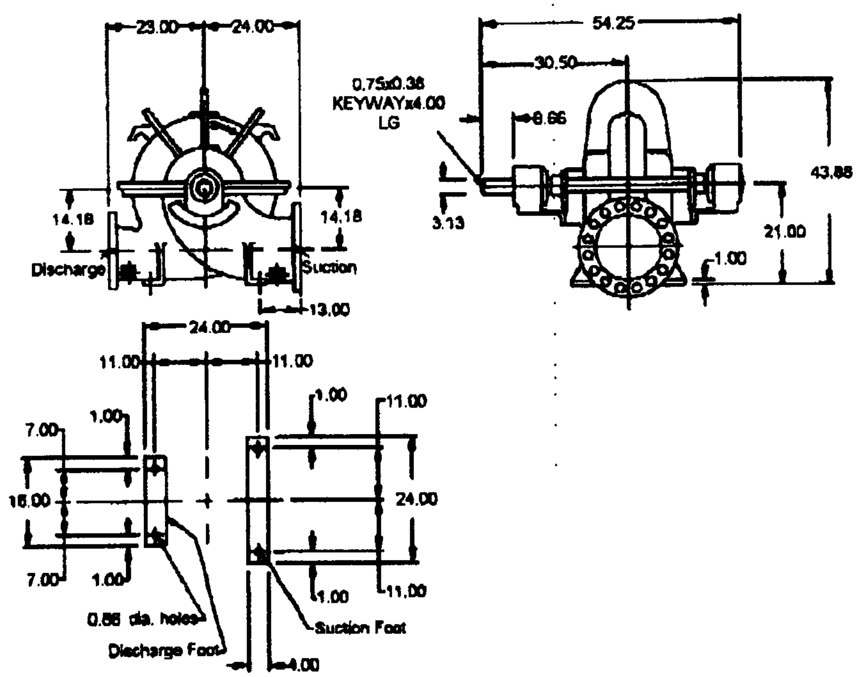
Program Version 2.3.0.0

Goulds Pumps

ITT Industries

BARE PUMP DRAWING

Model 3409 M
8x12-27



Pump specification

SUCT.FLANGE SIZE *12"*	DRILLING *ANSI 250#*	FACING *FF*	FINISH *SMOOTH*
DISCH.FLANGE SIZE *8"*	DRILLING *ANSI 250#*	FACING *FF*	FINISH *SMOOTH*
PUMP ROTATION (LOOKING AT PUMP FROM MOTOR) *CW*			
TYPE OF LUBRICATION *GREASE*			COOLED *NO*
TYPE OF STUFFING BOX *N/A*			COOLED *NO*
TYPE OF SEALING *PACKING*			

Weights and Measurements

PUMP	*2940.0 lb*
MOTOR/CPLG	*4300.0/150.0 lb*
BASEPLATE	*lb*
TOTAL	*7390.0 lb*
GR.VOLUME w/BOX	*N/A*
GR.WEIGHT w/BOX	*N/A*

Motor specification

MOTOR BY *PUMP MFG* MOUNT BY *PUMP MFG*	MFG. *US ELECTRIC*	
FRAME *5810SS*	POWER *900.00 hp*	RPM *1800*
PHASE *3*	FREQUENCY *60 Hz*	VOLTS *4160*
INSULATION *F*	S.F. *1.15*	
ENCLOSURE *WPII*		

Notes and References

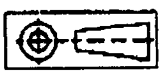
-Tolerance for all pump dimensions is -+0.13 in, unless otherwise specified

FOR PUMP TAPPED OPENINGS REFER TO DWG.: TELCK211005/ITEM002

Auxiliary specification

COUPLING BY *PUMP MFG*	CPLG TYPE *FALK 1000G G20 1035*
CPL GUARD BY *PUMP MFG.*	CPLG GUARD MATL *STEEL*
BASEPLATE *CHANNEL STEEL*	
PACKING *ACRYLIC YARN IMPREGNATED WITH PETROLEUM LUBRICANTS AND GRAPHITE*	

Customer: C. H. SPENCER and COMPANY
Serial No:
Customer P.O. No:
Item No: ITEM002
Service: THICKENER UNDERFLOW



All dimensions are in inches.
Drawing is not to scale
Weights (lbs) are approximate

DRAWING NO ELCK211005/ITEM002

FORM # ED1135

Program Version 2.3.0.0

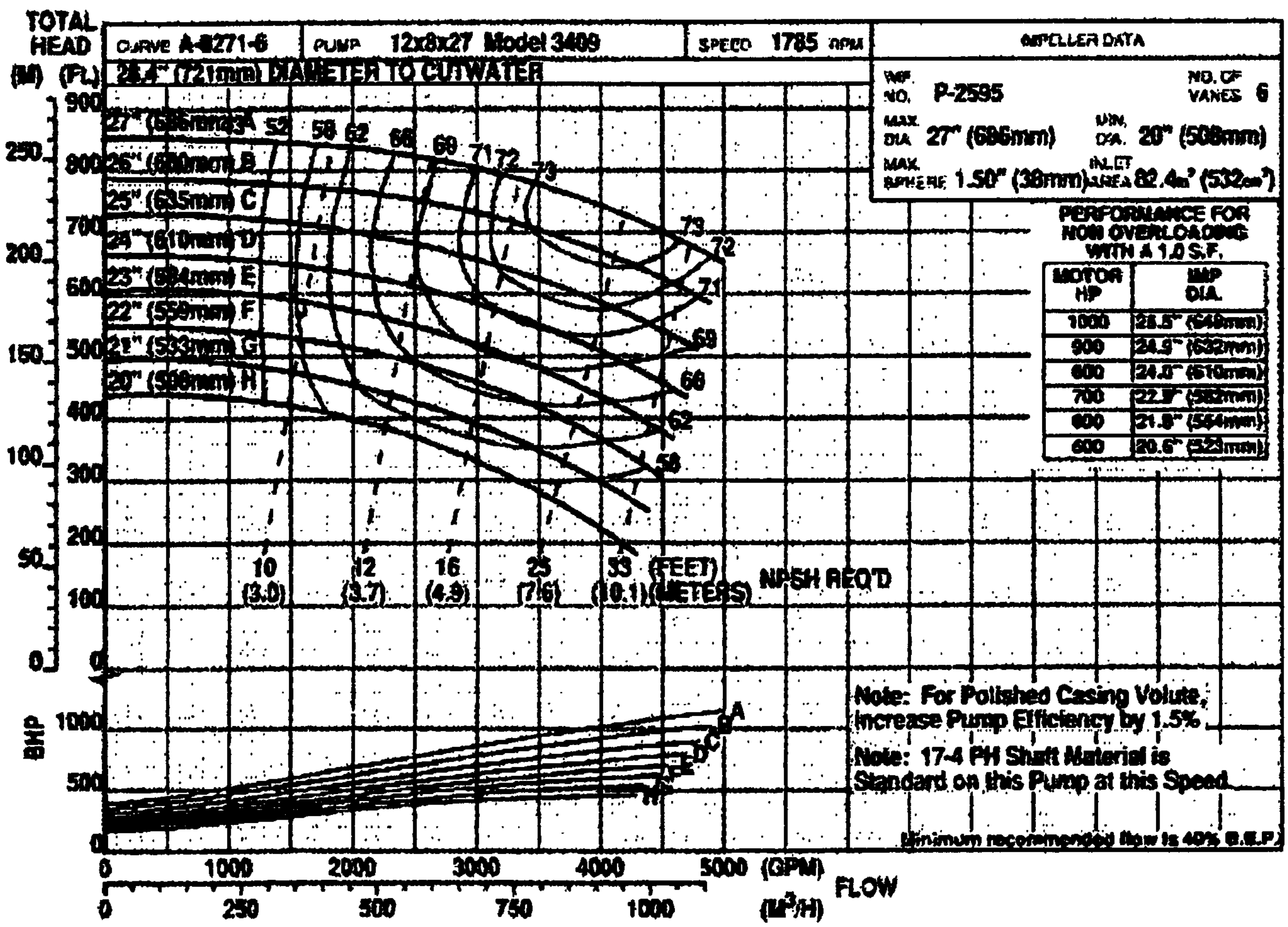
Model:3409	Size:12X8X27	Group:	60 Hz	RPM:1785	Stages:1

Job/Inqu. No.
Purchaser:
User: | Issued by: COURT KIMBALL
Item/Equip.No: | Quotation No. | Date: 11/26/02
Service: | Order No. | Certified By:

Operating Conditions		Pump Performance			
Liquid:	Water	Actual Pump Eff.:		Suction Specific Speed:	0 (gpm(US) . ft
		Actual Pump Power:		Min. Cont. Stable Flow:	
Temp.:	70 °F	Mech. Seal Loss:	0 hp	Min. Cont. Thermal Flow:	
Sp. Heat:		Dyn. Seal Loss:	0 hp		
S.G./Visc.:	1.05/1 cp	Other Power Loss:	0 hp	Non-Overloading Power:	
Flow:	3000 gpm(US)	Rated Total Power:		Imp. Dia. Addt'l Stg	
TDH:	590 ft	Imp. Dia. First 1 Stg			629 HP
NPSHa:	28 ft	NPSHr:		Mag. Drive Circuit Flow:	774 Ro
Req. solid size:		Shut off Head:		Max Drive Power:	
% Solids:				Max Drive Temp:	
Vapor Press:				Max Motor Size:	800

Notes: 1. The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above. 2. Magnetic drive eddy current and viscous effect on power and efficiency is not included. 3. Elevated temperature effects on performance are not included.

11-17-95



P.O. Box 1089 Colorado Springs,
Colorado 80901
Phone: 1-719-471-7200
Fax: 1-719-447-1238
E-mail jimf@rampartsupply.com

Rampart Supply

Fax

To: AL FABBIT From: Jim Fry

Attn:

Fax: 970-625-3465 Pages:

Phone: Date: 11/22/02

Re: CC:

☐ Urgent ☒ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

HI AL:

ENCLOSED ARE PRICES FOR PIPE CHANGES AND SAMPLE MILL TEST REPORTS FOR A53B ERW PIPE - CALL ME IF I CAN HELP

Thank you
MIKE T.

검 사 증 명 서 (A)
MILL INSPECTION CERTIFICATE

현대강관주식회사
HYUNDAI PIPE CO.,LTD.
• 본사 · 공장: 울산광역시 동구 염포동 265번지
ULSAN PLANT: 265, YUMPO-DONG, DONG-KU, ULSAN METROPOLITAN, KOREA
TLX: HDPIPE K 53776
• 서울사무소: 서울특별시 중구 무교동 77번지
SEOUL OFFICE: # 77, MUKYO-DONG, JUNG-KU, SEOUL, KOREA
TEL: 773-0822 FAX: 773-3085
TLX: HDPIPE K 24656, K 22956

증명서번호 CERTIFICATE NO: B-6-08-469 — 페이지 PAGE: 1
발행일자 DATE OF ISSUE: SEP. 1, 1998. [illegible]
계약번호 CONTRACT(P/O)NO:
품명 COMMODITY: E.R.W. STEEL PIPE
적용규격 SPECIFICATION: API 5LB/ASTM A53B
수요가 CUSTOMER:

관종 TYPE OF PIPE END ※1	※2	치수 DIMENSION 외경×두께×길이 (OUTDIA. × THICK. × LENGTH) ※3 ※4	수량 QUANTITY (PCS)	중량 WEIGHT (KG)	수압시험 HYDROSTATIC TEST (Mpa kg/cm² PSI)	※4–※13 Tests	도막시험 COATING TEST	제강번호 HEAT NO.	항복강도 YIELD STRENGTH (PSI)	인장강도 TENSILE STRENGTH B ※14 (kg/mm²)	인장강도 TENSILE STRENGTH W ※15 (N/mm²)	연신율 ELONGATION (%)	C (×100)	Si	Mn	P (×1000)	S	Cu (×100)	Ni	Cr	Mo	V	충격시험 IMPACT	비고 REMARK
BPEB	OD	20" x .250" x42.000'	20	20,209	37	G G G G G G		A40050	35.8	48.8	51.5	34	16	1	72	16	8	6	1	2	1	Tr		
		(508.0mm x 6.35mm x 12.802M)			530				50800	69800	73300													
BPEB	OD	20" x .375" x42.000'	25	37,370	50	G G G G G G		A41532	30.7	48.9	51.8	28	18	1	75	16	8	6	1	1	1	Tr		
		(508.0mm x 9.53mm x 12.802M)			800				43700	69600	73700													
								A42085	29.5	46.7	50.0	40	17	1	75	14	9	6	1	2	1	Tr		
									42000	66400	71100													
BPEB	OD	20" x .500" x42.000'	9	17,872	74	G G G G G G		A42695	29.5	46.7	50.0	40	17	1	75	14	9	6	1	2	1	Tr		
		(508.0mm x12.70mm x 12.802M)			1050				42000	66400	71100													
		TOTAL ->	54	75,511																				

G : GOOD

Sample

비고—NOTES ※1 Type of pipe End 관종

BPE	:Black Plain End Square-cut	GPE	:Galvanized Plain End Square-cut
BPEB	:Black Plain End Beveled	GPEB	:Galvanized Plain End Beveled
BTC	:Black Threaded & Coupled	GTC	:Galvanized Threaded & Coupled
BVJ	:Black Victaulic Joint	GVJ	:Galvanized Victaulic Joint
ETC	:Enameled Threaded & Coupled		

※2 NB : Nominal Bore호칭경, OD : Outside Diameter
※3 Unit 단위(M : mm, I : Inch)
※4 Unit 단위(M : Meter, F : Feet, I : Inch)
※5 G : Good
※6 Visual & Dimension Test외관 및 치수검사
※7 Flattening or Bending Test 편평 또는 굽힘시험
※8 Weld Ductility Test 용접부 연성시험
※9 Nondestructive Test 비파괴검사
※10 Drift Test 확관시험
※11 Flaring Test 압확시험
※12 Crush Test 충전시험
※13 Reverse Flattening Test 전개시험
※14 B : Base Metal 모재부
※15 W : Weld Part 용접부
※16 H : Heat (Ladle) Analysis 용강분석, P : Product Analysis 제품분석

본 제품은 관련규격에 합격되었음을 보증합니다.
WE HEREBY CERTIFY THAT THE MATERIAL DESCRIBED HEREIN HAS BEEN

H. G. Lee

Paragon Industries, Inc.
Rt.3 Box 331A
Sapulpa, Oklahoma, 74066
Phone: (918) 291-4459
Fax: (918) 291-0618

PLANT
Highway 117
5 Miles East of
Sapulpa, OK

MATERIAL TEST REPORT

Certificate Number 4305
Customer PO 5719

Melted and Manufactured in the USA

Manufactured by Electric Resistance Weld (Type E)

Results relate only to items tested. Test report not to be reproduced without written approval of Quality Assurance.

Customer		Product	Specifications
Customer	RESOURCE PIPE 8000 EAST 96TH AVENUE HENDERSON, CO 80640-	14 x .375 54.62# A53B/SA53B	ASTM A53-99B ASME B36.10M-1996

Heat Number	Steel Order No.		Yield Strength Psi	Tensile Strength Psi	Elongation % in 2 inches	Test Type Orientation/Tensile	Test Condition	Gauge Width
715968	3464		67220	78290	35.5%			0.0

Heat Number	Mill Control	C	MN	P	S	Si	Cr	Ni	Mo	Cu	V	Al	Cb
715968	Heat	0.200	0.840	0.013	0.006	0.013	0.032	0.051	0.018	0.105	0.005	0.025	0.002
	Product	0.189	0.873	0.014	0.005	0.038	0.041	0.053	0.019	0.122	0.003	0.023	0.000

TEST / INSPECTION		
Hydrostatic Test PSI	1120	@ 5 secs
Flattening Test	YES	
Ultrasonic weldline (NDT)	YES	.125 DH
Full Length Visual	YES	
Full Length Drift	N/A	size
Heat Treat Min. Temperature	1000	degrees

Comment

We certify that the product described above has been manufactured, Sampled, Inspected and tested in accordance to the referenced specification and / or order, and is in compliance with all requirements. QA Department

P.MTR. 11/01

Sample

PLANT
Highway 117
8 Miles East of
Sapulpa, OK

Paragon Industries, Inc.
Rt.3 Box 331A
Sapulpa, Oklahoma, 74066
Phone: (918) 291-4459
Fax: (918) 291-0018

MATERIAL TEST REPORT

Certificate Number: 7270
Customer PO:

Melted and Manufactured in the USA
Results relate only to items tested. Test report not to be reproduced without written approval of Quality Assurance.

Manufactured by Electric Resistance Weld (Type E)

Customer	Product	Specifications
RESOURCE PIPE 8000 EAST 96TH AVENUE HENDERSON, CO 80640-	16 x .375 62.640 A53B/SA53B	ASTM A53-98B ASME B36.10M-1996

Heat Number	Steel Order No.		Yield Strength Psi	Tensile Strength Psi	Elongation % in 2 Inches	Test Type Orientation/Tensile	Test Condition	Gauge Width
716814	3491		54590	73010	43.6%	Strip/Transverse/Body	As Rolled	1.5

Heat Number	Mill Control	C	MN	P	S	Si	Cr	Ni	Mo	Cu	V	Al	Ca
716814	Heat	0.200	0.680	0.007	0.003	0.034	0.037	0.005	0.005	0.053	0.002	0.031	0.002
	Product	0.165	0.678	0.008	0.004	0.073	0.035	0.033	0.011	0.062	0.002	0.033	0.001

TEST / INSPECTION		
Hydrostatic Test PSI	980	@ 5 secs
Flattening Test	YES	
Ultrasonic weldline (NDT)	YES	.125 DH
Full Length Visual	YES	
Full Length Drift	N/A	size
Heat Treat Min. Temperature	1900	degrees

Comment
PER CUSTOMER REQUEST

We certify that the product described above has been manufactured, Sampled, Inspected and tested in accordance to the referenced specification and / or order, and is in compliance with all requirements.
QA Department

P.MTR.

05/02

Sample

DESCRIPTION	SIZE	QTY	PRICE/FT	TOTAL
A53B CS ERW PEB BLK DRL	24"X.250" WALL	85,000	$17.94	$1,524,900.00
A53B CS ERW PEB BLK DRL	24"X.375 WALL	85,000	$25.19	$2,141,150.00
A53B CS ERW PEB BLK DRL	24"X.500 WALL	85,000	$33.41	$2,839,850.00
POLYETHYLENE, HDPE, SDR 11	14"X50'	85,000	$11.31	$961,350.00
POLYETHYLENE, HDPE, SDR 11	18"X50'	85,000	$18.65	$1,585,250.00
POLYETHYLENE, HDPE, SDR 11	18"X50'	22,000	$18.65	$410,300.00

PIPE PRICES ARE FOB: SHIP PT

ADDITIONS

DESCRIPTION	SIZE	QTY	PRICE/FT	TOTAL
POLYETHYLENE, HDPE, SDR 11	20"X50'	85,000	$23.38	$1,987,300.00
A53B CS ERW PEB BLK DRL	20"X.375 WALL	85,000	$20.93	$1,779,050.00 – ? dist.
A53B CS ERW PEB BLK DRL	16"X.375 WALL	42,500	$14.93	$634,525.00
A53B CS ERW PEB BLK DRL	14"X.375 WALL	42,500	$13.02	$553,350.00

PIPE PRICES ARE FOB: SHIP PT

Al Thabit

		Flow	Qty	Pump Pressure rating	Pump Size	Motor HP/RPM	Price +/-25% US$ FOB Fact.	Extended
CASE 1	BASE	9500	13	170	16/14TUAH	1200/1200	$200,000.00	$2,600,000
	ALTERNATE	9500	13	500	16/14TUAHP	1200/1200	$220,000.00	$2,860,000
CASE 2	BASE	4500	1	170	10/8STAH	400/1200	$75,000.00	$75,000

WEIR SLURRY GROUP, INC.

TYPICAL PUMP PERFORMANCE CURVES

WPA 1614A01U

ISSUED SEP 1998

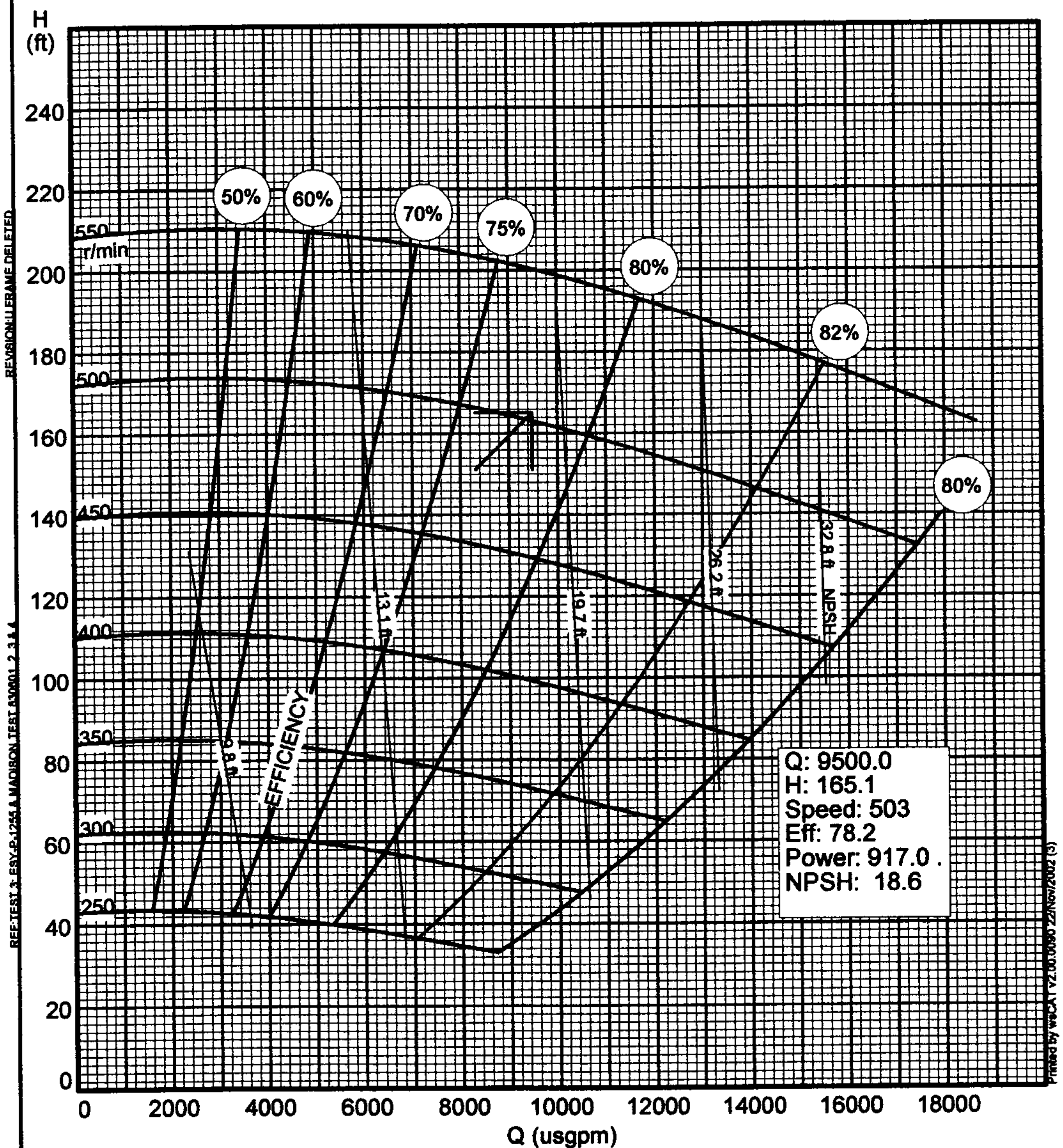
WARMAN PUMP

SIZE	FRAME		TYPE	IMPELLER: H14147, GAM14147				
				VANES	TYPE	IMPELLER MAT'L	VANE ø	LINER MAT'L
16/14	G	GG	AH	5	Closed	Metal	42	Metal/Polymer
	H	TU		GLAND SEALED PUMP				

Frame	G	GG	H	TU			Normal Max.	Metal	550
Rating [HP]	805	1207	1877	1609			[r/min]	Polymer	470

MIN. PASSAGE SIZE 5.3 inch SPHERE

CURVE SHOWS APPROXIMATE PERFORMANCE FOR CLEAR WATER (to International Test Standard ISO2548 Class C). For media other than water, corrections must be made for density, viscosity and/or other effects of solids. WARMAN INTERNATIONAL LTD. reserve the right to change pump performance and/or delete impellers without notice. Frame suitability must be checked for each duty and drive arrangement. Not all frame alternatives are necessarily available from each manufacturing centre.



LAST ISSUE:JUNE 1995

REVISION:U FRAME DELETED

BSY3306/6,BSY3318/7

WEIR SLURRY GROUP, INC.

TYPICAL PUMP PERFORMANCE CURVES

WPA 108A01AU

ISSUED FEB 1988

WARMAN PUMP

SIZE	FRAME		TYPE
10/8	F	FF(X)	**AH**
	G	GG	
	ST(X)	T	

IMPELLER: G8147, FAM8147

VANES	TYPE	IMPELLER MAT'L	VANE ø	LINER MAT'L
5	Closed	Metal	27	Metal/Polymer

GLAND SEALED PUMP

Frame	F	FF(X)	G	GG	ST(X)	T	Normal Max.	Metal	1000
Rating [HP]	349	570	805	1207	751	1609	[r/min]	Polymer	715

MIN. PASSAGE SIZE 3 inch SPHERE

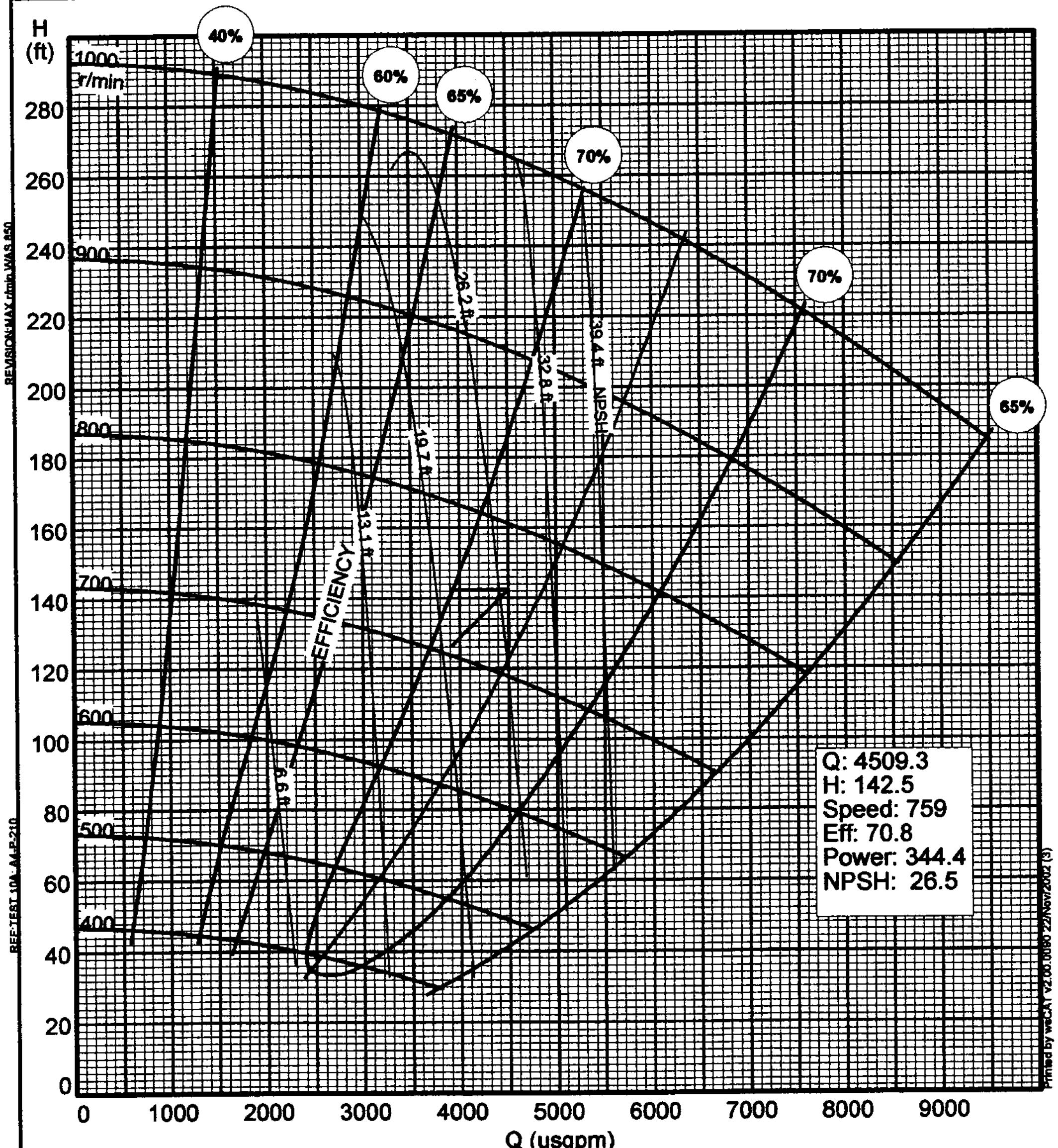
CURVE SHOWS APPROXIMATE PERFORMANCE FOR CLEAR WATER (to International Test Standard ISO2548 Class C). For media other than water, corrections must be made for density, viscosity and/or other effects of solids. WARMAN INTERNATIONAL LTD. reserve the right to change pump performance and/or delete impellers without notice. Frame suitability must be checked for each duty and drive arrangement. Not all frame alternatives are necessarily available from each manufacturing centre.

LAST ISSUE:JUNE 1985

REVISION:MAX r/min WAS 850

BSY5009/6,BSY5011/7

REF:TEST 10A-A4-P-210



Al Thabit
California Dam Project

Given:

	Pipeline (ft)	Static (ft)	Cw	material
Case 1	84,480	-1012	30	Sand/tails
Case 2	21,120	-312	30	Sand/tails

	TPD	cw	cv	Solids SG	GPM	HR	ER
CASE 1							
Solids	35,611	53.5%	30.3%	2.65	2,878.8		
Slurry	66,518			1.50	9,500.0	0.86	0.83
CASE 2							
Solids	16,868	53.5%	30.3%	2.65	1,363.6		
Slurry	31,509			1.50	4,500.0	1	1

	Flow (gpm)	Pipeline (m)	Pipe ID (in)	Vcl	Actual V	FI (fig.)	d50 (mm)	Friction Head	C Factor	Static (ft)	TDH	Stages	feet/stage	HR	Corr. Feet/stage
CASE 1	9,500.0	84480	16.146	12.51593	14.88627	1.05	0.188	2858.0	140	-1012	1846.0	13	142.0	0.86	165.1
CASE 2	4,500.0	21120	14.532	8.82061	8.7047	0.78	0.04	343.3	130	-312	31.3	1	31.3	1	31.3

NOTE: Calculated numbers in BLUE. Do not change these numbers or the algorithms will be lost.

Al Thabit
California Dam Project

Given:

	Pipeline (ft)	Static (ft)	Cw	material
Case 1	84,480	-1012	30	Sand/tails
Case 2	21,120	-156.86	30	Sand/tails

CASE 1	TPD	cw	cv	Solids SG	GPM	HR	ER
Solids	35,611	53.5%	30.3%	2.65	2,878.8		
Slurry	66,518			1.50	9,500.0	0.86	0.83
CASE 2							
Solids	16,868	53.5%	30.3%	2.65	1,363.6		
Slurry	31,509			1.50	4,500.0	1	1

	Flow (gpm)	Pipeline (m)	Pipe ID (in)	Vcl	Actual V	Fl (fig.)	d50 (mm)	Friction Head	C Factor	Static (ft)	TDH	Stages	feet/stage	HR	Corr. Feet/stage
CASE 1	9,500.0	84480	16.146	12.51593	14.88627	1.05	0.188	2858.0	140	-1012	1846.0	13	142.0	0.86	165.1
CASE 2	4,500.0	21120	14.532	8.82061	8.7047	0.78	0.04	299.4	140	-156.86	142.5	1	142.5	1	142.5

NOTE: Calculated numbers in BLUE. Do not change these numbers or the algorithms will be lost.

outokumpu

Thickener/Clarifier Budget Case Study for Al Thabit
Tel. 970 625 3457
Fax. 970 625 3465

Dear Al,

A summary of our preliminary findings based on information you provided by telephone today is given below:

Case 1.

Underflow rate = 9500 gpm (2160 m3/h)
Solids SG = 2.65
Underflow density = 30% by volume = approx. 53% by weight
Therefore dry solids rate = approx 1710 mtph (1880 stph)

Feed from dredges approx. 10-15% solids by volume = say 30% by weight
Assume all solids reports to underflow therefore feed rate of dry solids = 1880 mtph
Feed size d50 = 200 microns, topsize 6 mm (1/4")
Feed rate = calculates to approx. 4635 m3/h (20,400 gpm)

Overflow rate (return water) = approx. 2475 m3/h (10,885 gpm)

Assume settling rate of 2 mt/m2/h
Therefore thickener area = 1880/2 = 940 m2
and diameter = 35 m (115 ft.)

Budget Price for Supaflo High Rate Thickener complete with elevated tank = USD 850,000
Budget Price for installation (site prep and concrete by others) = USD 400,000
Budget price for flocculant mixing and dosing system = USD 50,000
Rough Estimate for site prep and concrete = USD 400,000

Total = USD 1,700,000 estimate installed.

Case 2.

Underflow rate = 4500 gpm (1020 m3/h)

Outokumpu Technology Inc., 109 Inverness Dr. E., Suite F
Englewood, Colorado 80112
Tel. 303-792-3110 Fax. 303-799-6892

outokumpu

Solids SG = 2.65
Underflow density = 30% by volume = approx. 53% by weight
Therefore dry solids rate = approx 810 mtph (890 stph)

Feed from dredges approx. 10-15% solids by volume = say 30% by weight
Assume all solids reports to underflow therefore feed rate of dry solids = 810 mtph
Feed size d50 = 40 microns, topsize 100 microns (0.10 mm)
Feed rate = calculates to approx. 2195 m3/h (9658 gpm)

Overflow rate (return water) = approx. 1175 m3/h (5170 gpm)

Assume settling rate of 1 mt/m2/h (for the finer sized feed)
Therefore thickener area = 810/1 = 810 m2
and diameter = 32 m (105 ft.)

Budget Price for Supaflo High Rate Thickener complete with elevated tank = USD 750,000
Budget Price for installation (site prep and concrete by others) = USD 350,000
Budget price for flocculant mixing and dosing system = USD 40,000
Rough Estimate for site prep and concrete = USD 350,000

Total = USD 1,490,000 estimate installed.

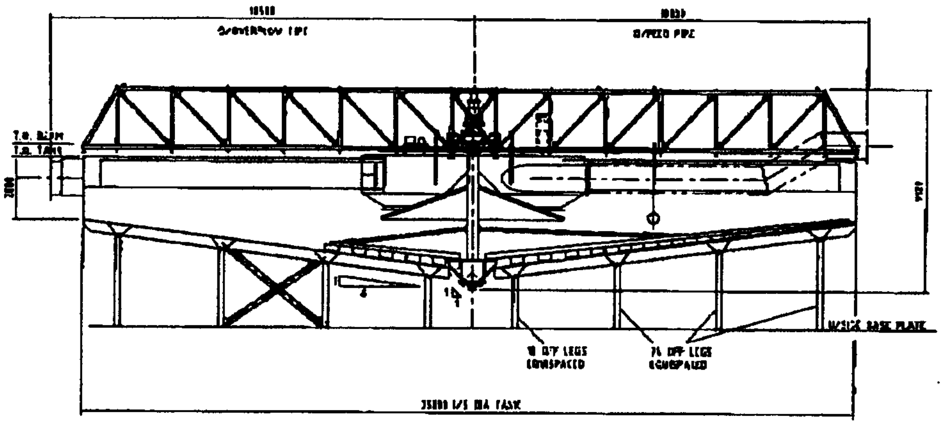
Note: Both of the above thickeners are complete with elevated tanks, mechanical components including drive mechanism (40 HP) with automatic rake lift device, rake arms, bridge support, drive and lift controls and instrumentation. <u>Pumps to deliver feed and to remove underflow and recycle water are not included in any of the pricing above.</u>

Please let us know if we can assist you further.

Yours truly,

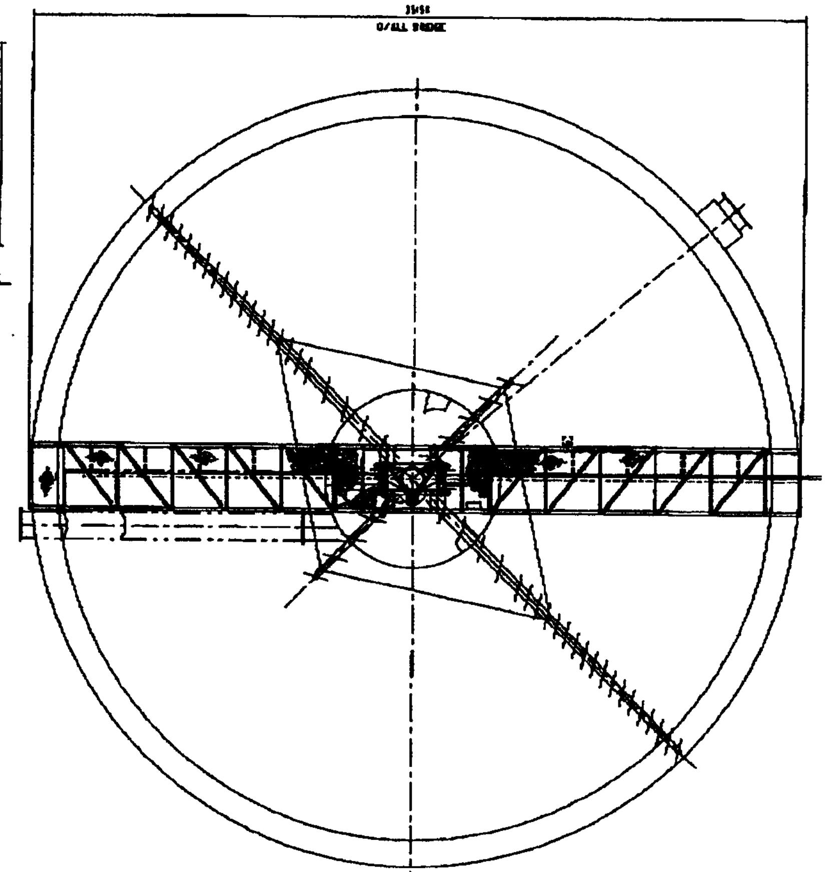
David Green
Outokumpu Technology Inc.

Outokumpu Technology Inc., 109 Inverness Dr. E., Suite F
Englewood, Colorado 80112
Tel. 303-792-3110 **Fax. 303-799-6892**



SECTIONAL ELEVATION

SEE PLAN VIEW FOR TRUE TANK ORIENTATION



PLAN VIEW

SHOWING TRUE ORIENTATION

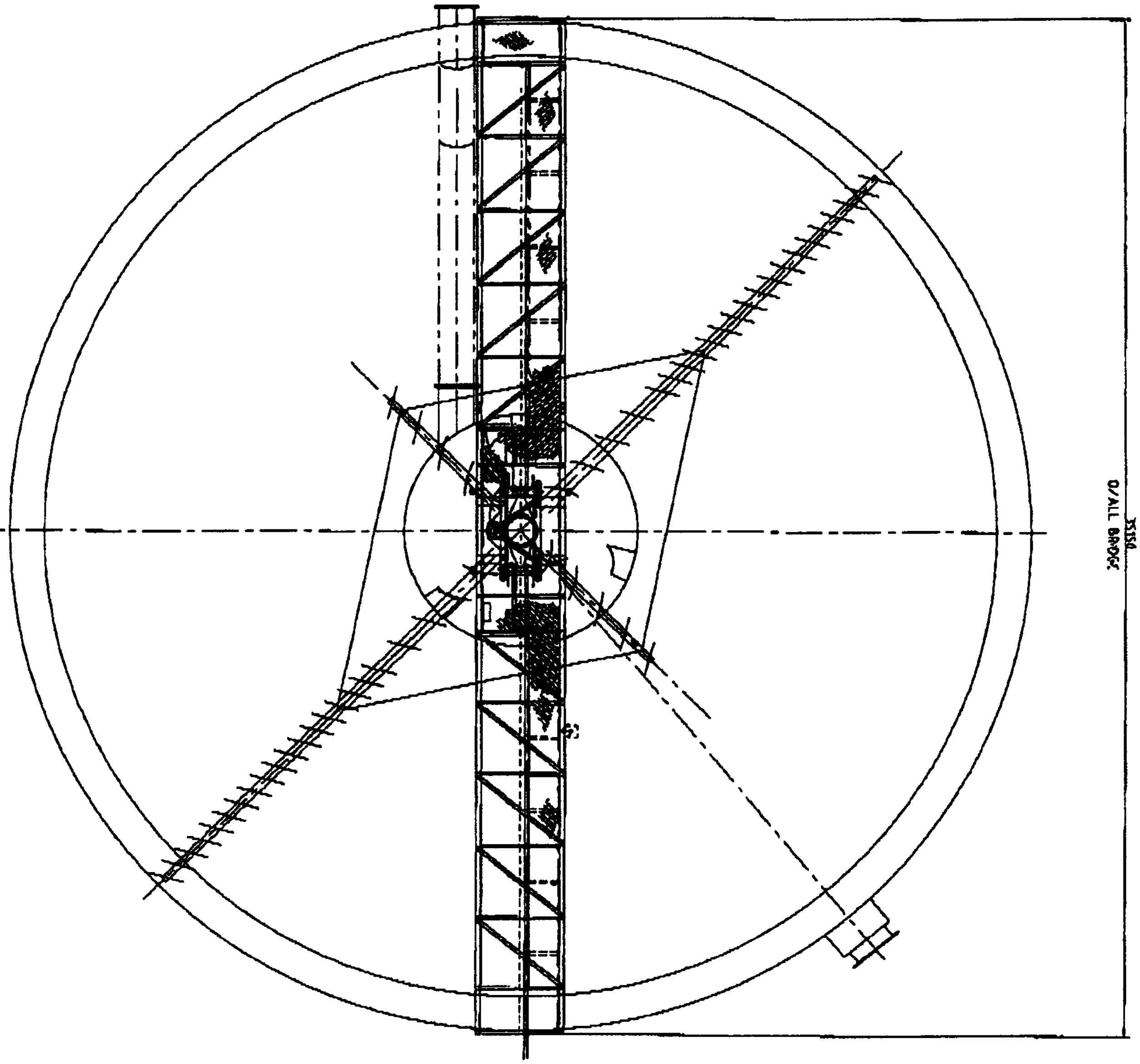
NOTE: DIMENSION ARE METRIC (mm)

NOTE:
TYPICAL DRAWING ONLY - DIMENSIONS MAY CHANGE WITHOUT NOTICE.

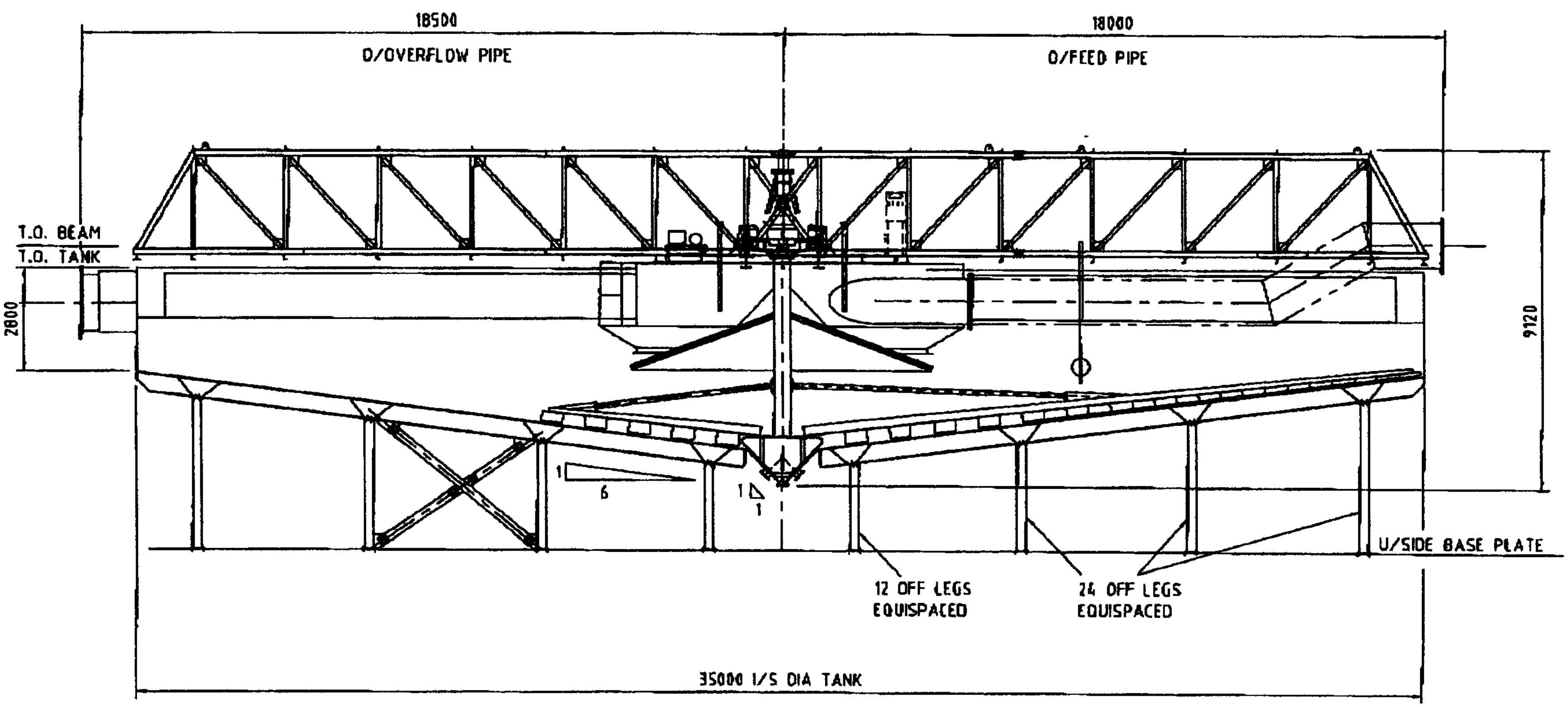
DO NOT SCALE, IF IN DOUBT ASK

outokumpu

35.0M DIA. HIGH RATE THICKENER
GENERAL DIMENSION DRAWING



PLAN VIEW
SHOWING TRUE ORIENTATION



SECTIONAL ELEVATION

SEE PLAN VIEW FOR TRUE TRUE ORIENTATION