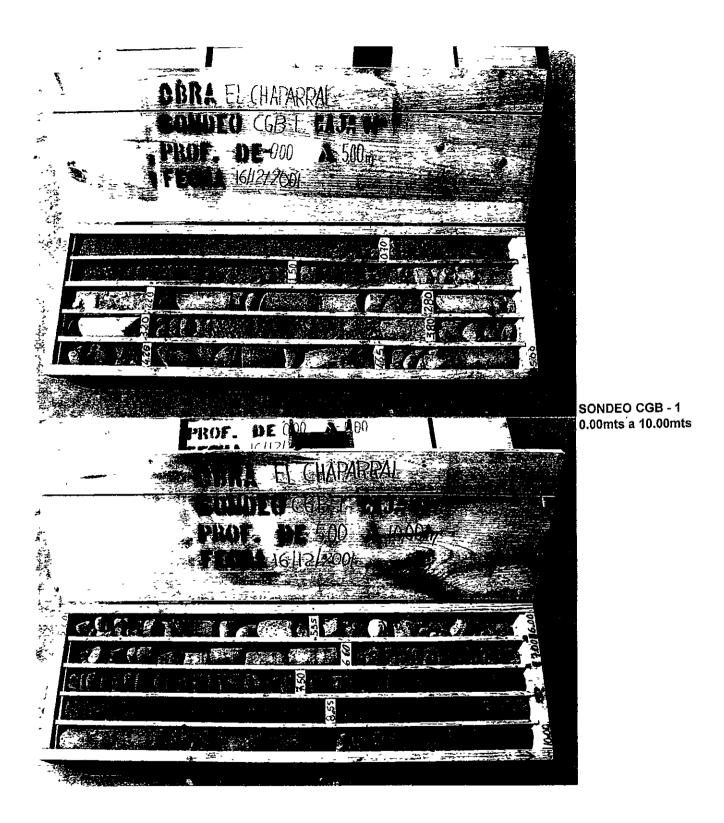
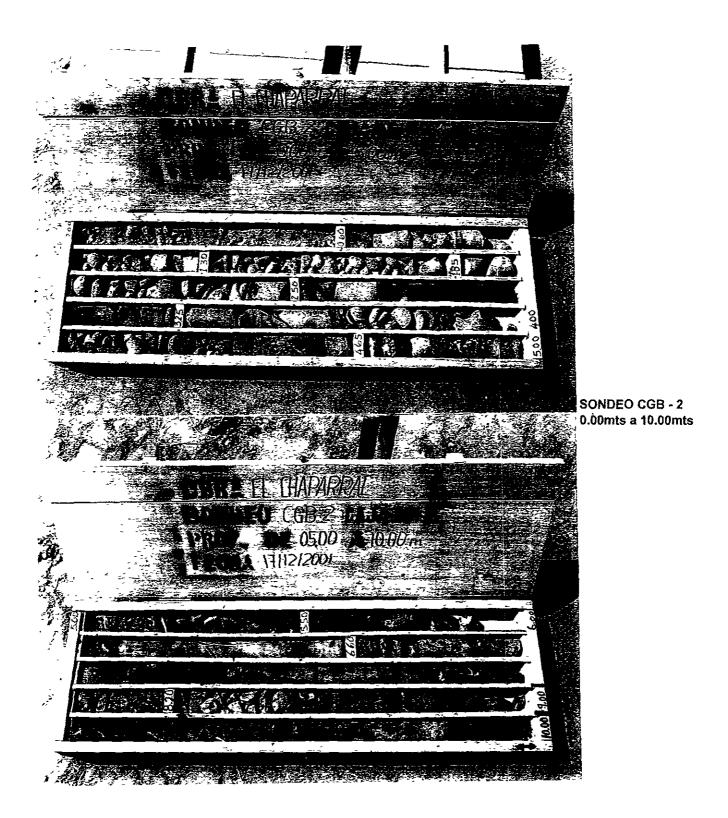
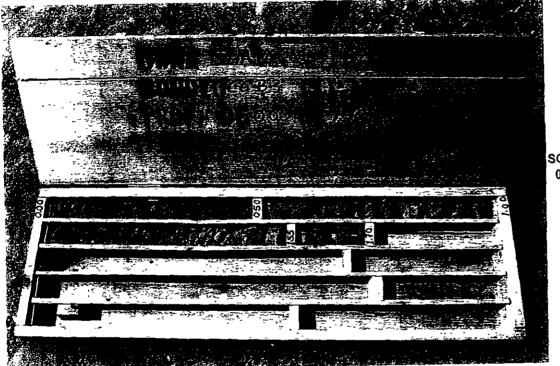
## **BORROW AREA**

1



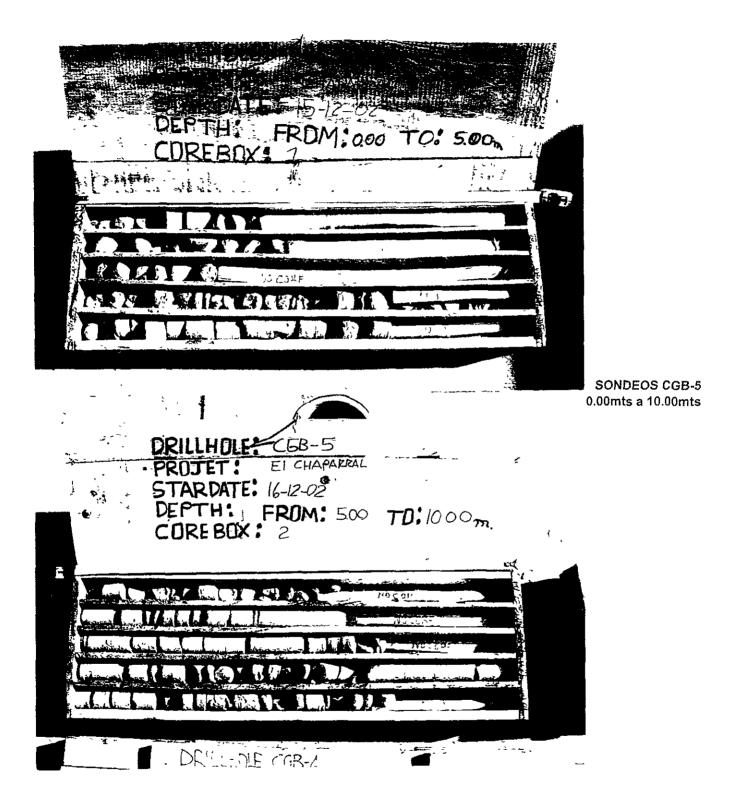




SONDEO CGB - 3 0.00mts a 1.70mts

DRILLHOLE:CGB-4. PROJECT EL CHAPARRAL START DATE: 18-12.02 F DATE =DEPTH: FROM 000 m TO: 5.00 m EOREEOX 1. 3 24 0.00mts a 10.00mts 1.6 DRITH PRIJE STABEDATE: 18-12=02 FROM: 500 TD: 10.000 DEPTH: 2 CORE BOX: ŧ 17 20 [X# AT OF ST Sec. 2 5 5 6 e  $\sum \sum_{i=1}^{n}$ N 1000 ς,

SONDEOS CGB-4

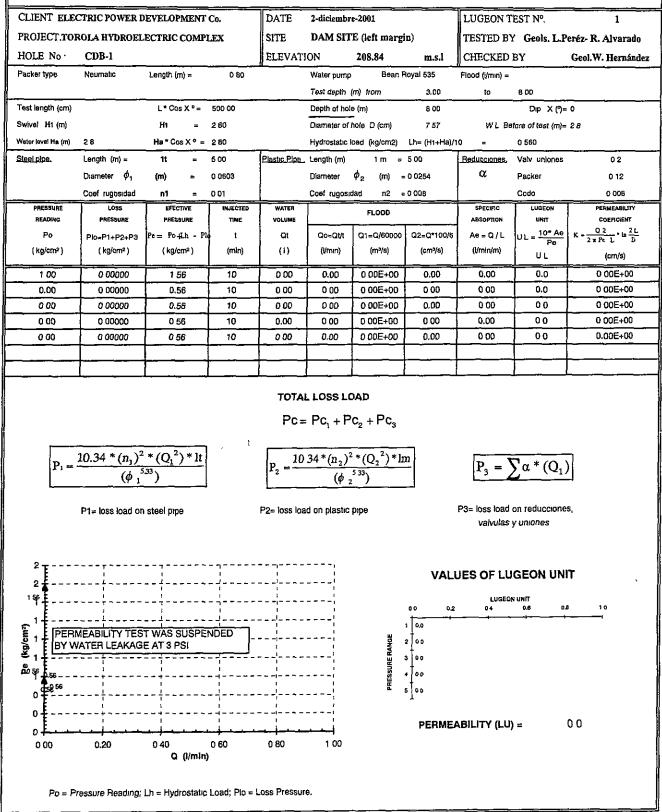


Appendix 7.5

Result of Permeability Test

.

### swissboring



## swissbering

CLIÈNT ELE	CTRIC POWER I	DEVELOPMENT	Co.	DATE	2-diciembr	e-2001		LUGEON T	EST №	2
PROJECT TO	ROLA HYDROEL	ECTRIC COMPI	LEX	SITE	DAM SIT	E (left margi	n)	TESTED BY	Geols. L.P	eréz- R. Alvarado
HOLE No	CDB-1			ELEVATI	ON	208.84	m.s.)	CHECKED	BY:	Geol.W. Hernánde
Packer type	Neumatic	Length (m) =	0 80		Water pump	Bean F	loyal 535	Flood (l/min) =		
					Test depth	(m) from.	5 00	to	10 00	
Test length (cm)		L * Cos X ° =	500 00		Depth of hol	e (m)	10 00		Dıp X(®)∝	0
Swivel H1 (m)		H1 =	0 60		Diameter of	hole D (cm)	7 57	W L Be	fore of test (m)=	2 55
Water level He (m)	2 55	Ha*CosX* =	2 55		Hydrostatic I	oad (kg/cm2)	Lh= (H1+Ha)/1	i0 <del>≂</del> 0	0 315	
Steel pipe,	Length (m) ≈	1t =	5 00	Plastic Pipe .	Length (m)	1 m =	5 00	Reducciones.	Valv uniones	02
	Drameter $\phi_1$	(m) =	0 0603		Diameter	φ <sub>2</sub> (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	n1 =	0 01		Coef rugosi	dad n2 =	0 008		Codo	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	r	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME		12005		ABSOPTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe= Po+Lh - Pl	d t	Or	Q0=Q1/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	$UL = \frac{10^* A_0}{B_0}$	$K = \frac{Q 2}{2 \pi P c L} + \frac{2 L}{D}$
( kg/cm² )	(kg/cm²)	( kg/cm² )	(៣រោ)	(1)	(l/min)	(m²/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1.00	0.00000	1.32	10	0 00	0.00	0 00E+00	0.00	0.00	00	0 00E+00
3 00	0 00019	3 31	10	8.00	0.80	1 33E-05	13 33	0 16	0.5	6 25E-06
<u>5 00</u> 3 00	0 00306	5 31 3 31	10	32 00	3 20 0 70	5 33E-05	53 33 11 67	0 64	04	1 56E-05 5 47E-06
1 00	0 00000	1 32	10	0 00	0.00	0 00E+00	0.00	0 00	00	0 00E+00
	1									
<b>P</b> <sub>1</sub> =	$\frac{10.34 * (n_1)}{(\phi_1)}$ P1= loss load o			P2= loss los		<sup>2</sup> * (Q <sub>2</sub> <sup>2</sup> ) * li <sup>5 33</sup> ) pipe		P3≖ loss load	$\sum_{n} \alpha * (Q_1)$	
6 <b>-</b>					531		VAL:		IGEON UN	<b>1T</b> 1.2 1.4
£4 <b>∔</b>	331		1		¦		1 00		<b>;</b> — · · · · · · · · · · · · · · · · · · ·	
Pe (kg/cm <sup>2</sup> )		- I I 	,         	<b>_ _ _</b> -				0.5		
<u> </u>				1	1	1				1.2
<sup>a</sup> 2			· +	·				04		
				i	i	1	\$ 5 00			
1.32 462			1 · · · · · · · · · · · · · · · · · · ·	·						
o <u>E</u>	I I						PERME	ABILITY (LU	) =	1.2
0 00	0.50 1 00	150 2 Q(i/mir	200 25 1)	50 3 00	3.50					
		Q (i/mir	i)							

# SWISSDORING Swissboring Overseas Corporation Ltd,

CLIENT EL	ECTRIC POWER I	DEVELOPMENT	Co.	DATE	2-dictemb	re-2001		LUGEON T	EST №:	3
PROJECT TO	OROLA HYDROEI	LECTRIC COMP	LEX	SITE:	DAM SIT	TE (left margi	in)	TESTED B	Y Geols. L.P	eréz- R. Alvarado
HOLE No	CDB-1			ELEVATI	ON∙	208.84	m.s.l	CHECKED	BY	Geol.W. Hernánd
Packer type	Neumatic	Length (m) =	0 80		Water pump	b Bean F	Royal 535	Flood (I/min) =	<u> </u>	
					Test depth	(m) from	10 00	to	15 00	
Test length (cm	)	L*CosX°=	500 00		Depth of ho	le (m):	15 00		Dip X(9)≂	: 0
Swivel H1 (m)		H1 =	1 70		Diameter of	- hole D (cm)	7 57	WL Be	fore of test (m)=	45
Water level Ha (m)	45	Ha*CosXº ≠	4 50		Hydrostatic	load (kg/cm2)	Lh= (H1+Ha)/1	iD =	0 620	
Steel pipe.	Length (m) =		5 00	Plastic Pipe		1 m =		Reducciones,	Valv uniones	0.2
	Diameter $\phi_1$	(m) =	0 0603			L	0 0254	α	Packer	0 12
	Coet rugosidad	,, - n1 =	0 01		Coef rugosi	• •	0 00B		Codo	0.008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER				SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME		FLOOD		ABSOPTION	UNIT	COERCIENT
Po	Plo⊧P1+P2+P3	Pe= Po+Lh - Ple	τ	Qt	Qo=Qt/t	Q1=Q/60000	Q2±Q*100/6	Ae=Q/L	$UL = \frac{10^* Ae}{2}$	$K = \frac{Q}{2\pi} \frac{2}{\pi} \frac{1}{P_{\pi}} \frac{1}{L} \cdot \ln \frac{2L}{D}$
(kg/cm²)	(kg/cm <sup>2</sup> )	(kg/cm²)	(mìn)	(1)	(l/min)	(m³/s)	(cm³/s)	(l/min/m)	UL UL	(tm/s)
1 00	0 00686	1.61	10	48.00	4 80	8 00E-05	80 00	0 96	60	7 71E-05
5 00	0 07604	5.54	10	160 00	16 00	2 67E-04	266 67	3 20	58	7 48E-05
10 00	0 39982	10.22	10	367 00	36.70	6.12E-04	611 67	7 34	72 52	9 30E-05 6.71E-05
<u> </u>	0 06160	5 56	10	144 <u>00</u> 0 00	14.40 0 00	2 40E-04 0 00E+00	240 00	2 88	00	0 00E+00
1.00		1 02				0 002,00				0.002100
P1 =	$=\frac{10.34*(n_1)}{(\phi_1)}$	$\frac{2^{2} * (Q_{1}^{2}) * lt}{5^{33}}$		$P_2 = \frac{10}{2}$	.34*(n <sub>2</sub> ) <sup>2</sup>	$\frac{2^{2} * (Q_{2}^{2}) * \ln Q_{2}}{\frac{5^{33}}{2}}$	<u>n</u>	$P_3 = \sum_{i=1}^{n}$	$\sum \alpha * (Q_1)$	
L	1	<u></u>		Ŀ		<u> </u>				
	P1≈ loss load o	n steel pipe		P2= loss loa	d on plastic	рре		P3= loss load valvulas	on reduccione y uniones	S,
<sup>12</sup> T					,		VALI	JES OF LU	GEON UN	T
- F					10.22			LUGEO	4 UNIT	
10 =			1							70 80
Ē					1 1 		00 10 ;	20 30 40	++	
8					1 1 	ш	00 10 :		6.0	
8		-5.54				RANGE :			++	
8		5.56			1 1 2 2 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1	IURE RANGE			5.8 	72
(cm <sup>3</sup> )	×	-5,54				IRESSURE RANGE			6.0	
Pe (kg/cm²)	*	5,54				PRESSURE RANGE			5.8 	
8 (kil/cm.) 8	81	5,54				PRESSURE RANGE			6.0 <b>1 1 1 1 1 1 1 1 1 1</b>	72
8 (kil/cm.) 8		5,54				PRESSURE RANGE			6.0 <b>1 1 1 1 1 1 1 1 1 1</b>	
B (KR)(cm)		5,54 5,56 15,56 15,00 20,00 Q ((/min)		0 00 35 00		PRESSURE RANGE			6.0 <b>1 1 1 1 1 1 1 1 1 1</b>	72

## swissbering

PROJECT TO	CINCTOWERD	EVELOPMENT	Co.	DATE:	3-diciembr	e-2001		LUGEON T	EST Nº:	4
	ROLA HYDROEL	ECTRIC COMPI	EX	SITE.	DAM SIT	E (left margi	n)	TESTED BY	Geols. L.P	eréz- R. Alvarado
HOLE No .:	CDB-1			ELEVATI	ON	208.84	m.s.l	CHECKED I	BY:	Geol.W. Hernánde
Packer type	Neumatic	Length (m) =	0 80		Water pump	Bean A	loyal 535	Flood (l/min) =		
					Test depth	(m) from	15 00	to	20 00	
Test length (cm)		L* Cos X ° =	500 00		Depth of hol	e (m)	20 00		Dip X(°)≓	0
Swivel H1 (m)		Hı =	2 80		Diameter of	- hole D (cm)	7 57	WL Be	fore of test (m)≂	4 B
Water level <b>He</b> (m)	48	Ha*CosX° =	4 80		Hydrostatic I	oad (kg/cm2)	Lh= (H1+Ha)/1	0 =	0 760	
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe	Length (m)		5 00	Reducciones:	Valv uniones	02
	Dlameter $\phi_1$	(m) =	0 0603		Diameter	φ <sub>2</sub> (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	n) =	0 01		Cost rugosi	dad n2 =	0 008		Codo	0 008
PRESSURE	Loss	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME		FLOOD		ABSOPTION	UNIT	COERCIENT
Po	Plo=P1+P2+P3	Pe= Po+Lh - Ph	1	Qt	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	$UL = \frac{10^* \text{ Ae}}{\text{Pe}}$	$K = \frac{Q 2}{2 \pi P \epsilon} \frac{1}{L} \cdot \ln \frac{2 L}{D}$
(kg/cm²)	(kg/cm²)	( kg/cm² )	(min)	(1)	(I/min)	(m³/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1.00	0 00120	1 76	10	20.00	2 00	3.33E-05	33 33	0 40	23	2 95E-05
5 00	0 05576	5.70	10	137 00 693 00	13 70 69 30	2 28E-04 1 16E-03	228 33 1155 00	2 74 13 86	48 148	6 22E-05 1 92E-04
10 00 5 00	0 15436	9 33 5 61	10	228 00	22 80	3.80E-04	380.00	4 56	81	1 05E-04
1 00	0 00087	1 76	10	17 00	1 70	2 83E-05	28 33	0 34	19	2 50E-05
P1 =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$				.34*(n <sub>2</sub> ) (\$	$PC_{2} + PC_{3}$ $\frac{2^{2} * (Q_{2}^{2}) * L}{2^{5} 3^{3}}$ pipe	m	P3= loss load	$\sum_{n=1}^{\infty} \alpha * (Q_1)$	
10 9 8 7 6 5 3 2 2						PRESSURE RANGE	00 20 1 23 2 23 3 23 4 4 5 00000 1.0	UES OF LU 40 60 80 48 48 ABILITY (LU	N UNIT 100 120 	IT 140 160 14.8 14.8
f 761.76	<del>────────────────────────────────────</del>									

## SWISSDORING Swissboring Overseas Corporation Ltd.

CLIE	NT ELEC	TRIC POWER D	EVELOPMENT	 Co.	DATE:	3-diciembi	re•2001		LUGEON T	'EST №.	
PROJ	ECTTOR	OLA HYDROEL	ECTRIC COMP	LEX	SITE	DAM SIT	E (left marg	(in)	1		Peréz- R. Alvarado
HOLE	E No.	CDB-1			ELEVATI	ON:	208.84	m.s.l	CHECKED		Geol.W. Hernández
Packer	type	Neumatic	Length (m) =	0.80		Water pump	Bean	Royal 535	Flood (l/min) =	-,	- <u></u>
						Test depth	(m) from	20 00	to	25 00	
Test for	ngth (cm)		L * Cos X º =	500 00	· · · ·	Depth of hol	le (m)	25 00		 Dıp X(")=	= 0
Swivel	H1 (m)		ff1 ≖	0 80		Diameter of	− holə D (cm)	7 57	Wl. Be	elore of test (m)=	• 77
Water lev	ve) He (m)	77	Ha*CosX° ≠	7 70		Hydrostatic	load (kg/cm2)	i.h= (Ht+Ha)/	10 =	0 850	
Steel pi	QB:	Length (m) =	1t ≠	5 00	Plastic Pipe .	Length (m)	ĭm ⊭	5 00	Reducciones.	Valv uniones	02
		Diameter $\phi_{\mathfrak{t}}$	(m) =	0 0603		Diameter	$\phi_2$ (m) :	<b>=</b> 0 0254	α	Packer	0 12
		Coef rugosidad	n1 ≖	0 01	1	Coef rugosi	dad n2 :	= 0 008	l	Codo	0 008
PAI	ESSURE	LOSS	EFECTIVE	INJECTED	WATER	[	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
RÉ	ADING	PRESSURE	PRESSURE	TIME	VOLUME	└───	<del></del>	<del></del>	ABSOPTION	UNIT	COEFICIENT
	Po	Plo=P1+P2+P3	Pe = Po4Lh - Pla	t	Qt	Qo≂Q1/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	UL = 10* Ae Pe	$K = \frac{Q 2}{2\pi Pe L} \cdot \ln \frac{2L}{D}$
( kę	g/cm <sup>2</sup> )	( kg/cm² )	(kg/cm <sup>2</sup> )	(min)	(1)	(I/min)	(m³/s)	(cm²/s)	(Vmin/m)	UL	(cm/s)
1	00	0 00868	1 84	10	54 00	5 40	9 00E-05	90 00	1 OB	5.9	7 60E-05
	5.00	0 52610	5 32	10	421 00	42 10	7 02E-04	701 67	8 42	15 8	2.05E-04
_	0.00	1 92313	8 93	10	805 00	80 50	1 34E-03	1341.67	16 10	180	2 34E-04
	5.00 1 00	0 55395	<u>5 30</u> 1.81	10	432 00	43 20 12 30	7 20E-04 2 05E-04	720.00	<u> </u>	16.3	2 11E-04 1 77E-04
									[		
	P1 =	$\frac{10.34 * (n_1)^2}{(\phi_1^5)^5}$	$(Q_1^2) * lt$		$P_2 = \frac{10}{2}$	$34*(n_2)^2$ (\$\phi_2)^2	$(Q_2^2)^*$	B	$P_3 =$	$\sum \alpha * (Q_1)$	)
		P1= loss load on	steel pipe		P2= loss loa	d on plastic	pipe		P3= loss load valvulas	on reduccione y uniones	<b>!</b> 5,
10 9	E		,	,		 !		VAL	UES OF LU	GEON UN	IT
	E					ا ل ـ ـ ـ					
8	E		, , ,		1	1		00	LUGEO) 50 100		20 0
7 ه					, 1	1		1	5,9		
(kg/cm <sup>2</sup> )	F		5 32			1	a di	2			15.8
55	;ŧ		5.30			 !	Pressure range	3			180
e 4	ſ <u>ŧ</u>			!	•		SUR				16.3
3	·+،	.//·×	·¦+	{			PRES			13.6	•
2		<b>K</b>		i				·			
1	<b>1</b> 84	<u>181</u>				J 1		N		۱_	19.0
0	0 00	20 00	40 00 (I/min)			یے۔۔۔۔ 100 ف0		PEHME	ABILITY (LU)	) =	18.0
	Po = Pr	essure Reading;	Lh = Hydrostatic	Load, Plo = 1	Loss Pressur	e.					

## SWISSDORING Swissboring Overseas Corporation Ltd.

	ROLA HYDROEL	ECTRIC COMPI	EX	SITE	DAM SITI	E (left margi	in)	TESTED BY	Geols, L.P	eréz- R. Alvarado
HOLE No .:	CDB-1			ELEVATI	ON	208.84	m.s.i	CHECKED	BY.	Geol.W. Hernánd
Packer type	Neumatic	Length (m) =	0 80		Water pump	Bean F	Royal 535	Flood (i/min) =		
					Test depth (r	n) from	25 00	to	30 00	
Test length (cm)		L * Cos X ° =	500.00		Depth of hole	(m)	30 00		Dip X (%)=	0
Swive! H1 (m)		H1 =	0 60		Diameter of h	ote D (cm)	7 57	WL Be	fore of test (m)=	48
Water level He (m)	48	Ha*CosX° =	4 80		Hydrostatic k	ad (kg/cm2)	Lh≃ (H1+Ha)/1	0 ≠	D 540	
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe	Length (m)	tm =	5 00	Reducciones.	Valv uniones	02
	Diameter $\phi_1$	(m) =	0 0603		Diameter	¢₂ (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	= la	100	ł	Coef rugosid	əd n2 =	800 0 B		Codo	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME	( 			ABSOPTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe = Po+Lh - Pla		Ct (1)	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q/L	UL = 10* A0 Pe	$K = \frac{Q2}{2\pi Pr L} \cdot \ln \frac{2L}{D}$
(kg/cm <sup>2</sup> )	( kg/cm <sup>2</sup> )	(kg/cm <sup>2</sup> )	(min) 10	(1)	(l/mìn) 0 00	(m³/s) 0 00E+00	(cm³/s)	(/min/m) 0 00		(cm/s) 0 00E+00
<u>1.00</u> 5 00	0 00000	5,54	10	23 00	2 30	3 83E-05	38 33	0.46	08	1 08E-05
10 00	0 07795	10.46	10	162.00	16 20	2 70E-04	270 00	3.24	31	4 01E-05
5 00	0.00868	5.53	10	54 00 0 00	<u>540</u> 000	9 00E-05 0 00E+00	90 00	1.08	20	2 53E-05 0 00E+00
1.00	00000	1 34	10			0.005+00		0.00		0.002400
	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$ P1= loss load of			$P_2 = 0$		*(Q2 <sup>2</sup> )*b 533) pipe	-	P3= loss load		
								valvulas	y uniones	
12 Ţ	·			10 46			VAL	UES OF LU	GEON UN	Г
10				10 46			VAL			<b>1T</b> 3.0 3.5
10	455	3		10 45		ESSURE RANCE	0.0 0.5 +	LUGEO	NUNIT	
10	4	3		10 45		PRESSURE RANCE	0.0 0.5 1 00 2 4 5 08	LUGEO	N UNIT 20 25 1 1	3.0 3.5

# SWISSDORING Swissboring Overseas Corporation Ltd.

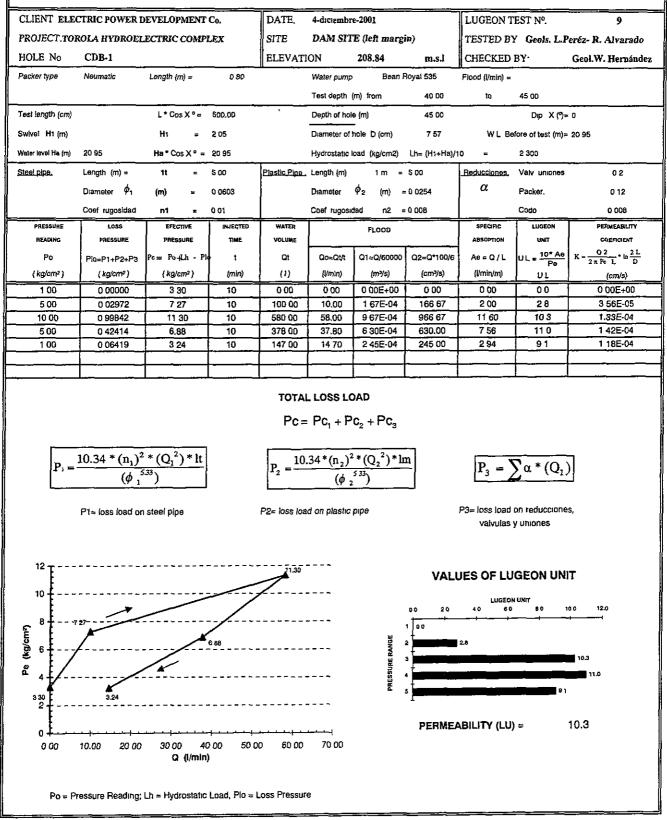
CLIENT. ELE	CTRIC POWER D	E CELOT MELLA	C0.	DATE	• •••••	re-2001		LUGEON T	EST N.	7
PROJECT, TOI	ROLA HYDROEL	ECTRIC COMP	LEX	SITE	DAM SIT	E (left marg	in)	TESTED B	Y Geols, L.F	Peréz- R. Alvarado
HOLE No	CDB-1			ELEVATI	ION-	208.84	m.s.l	CHECKED	BY	Geol.W. Hernánde
Packer type	Neumatic	Length (m) =	0 80		Water pump	a. Bean l	Poyal 535	Flood (l/min) =		
<u> </u>					Test depth	(m) from	30.00	to,	35 00	
fest langth (cm)		L*Cos X°=	500 00		Depth of hol	e (m)	35 00		Dip X (?)=	= 0
Swive: Ht (m)		Ht w	D 90		Diameter of	hole D (cm)	7 57	W∟Be	ofore of test (m)=	4 75
Vater level Ha (m)	4 75	Ha * Cos X ° =	4 75		Hydrostatic	load (kg/cm2)	Lh= (H1+Ha)/1	10 =	0 565	
iteel pipe.	Length (m) =	7t ≈	5.00	Plastic Pipe	Length (m)	ាភ =	5 00	Reducciones.	Valv uniones	02
	Dlameter $\phi_1$	(m) =	0,0603		Diameter	¢ <sub>2 (</sub> m) ≖	0 0254	α	Packer	0 12
	Coet rugosidad	rn1 ≈	0 01		Coef rugosi	dad n2 =	0.008	}	Codo	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	Ţ	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME	ļ		<del>r</del>	A850PTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe= Po+Lh - Pla	t	Qt	Qo≖Qt/t	Q1≈Q/60000	Q2=Q*100/6	Ae=Q/L	UL = <u>10* A</u> 8 Pe	$K = \frac{Q}{2\pi} \frac{2}{r} \frac{L}{r} \frac{L}{r} \frac{2L}{D}$
( kg/cm² )	( kg/cm² )	(kg/cm <sup>2</sup> )	(min)	(1)	(Vmin)	(m³/s)	(cm³/s)	(Vmirvm)	υί	(cm/s)
1 00	0 00000	1.57	10	0 00	0 00	0 00E+00	0.00	0 00	00	0 00E+00
5 00	0 06863	5 50	10	152 00	15.20	2 53E-04	253 33	3.04	55	7 16E-05
10 00 5 00	1 90407 0 47970	8 66 5 09	10	801 00 402 00	80.10 40.20	1 34E-03 6 70E-04	1335 00 670.00	16 02 8 04	16.5	2 40E-04 2 05E-04
1 00	0 47970	1 53	10	104 00	10.40	1 73E-04	173 33	2 08	13.6	1 76E-04
		t !								
										L
		 	<u> </u>	ΤΟΤΑΙ						<u> </u>
						DAD $C_2 + PC_3$				L
	10.34 * (n,) <sup>2</sup>	* (Q <sup>2</sup> ) * lt		Pc=	Pc <sub>1</sub> + P	C <sub>2</sub> + PC <sub>3</sub>				٦
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1^{5})^5}$	$(Q_1^2) * lt$		Pc=	Pc <sub>1</sub> + P		<u>n</u>	$P_3 = \sum_{i=1}^{n}$	$\sum \alpha * (Q_i)$	)]
P. =				$Pc = \frac{10}{P_2} = \frac{10}{2}$	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$	-	L#	<del>, .</del>	
P. =	10.34 * $(\mathbf{n}_1)^2$ ( $\phi_1^5$ P1≈ loss load on			Pc=	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$	-	P3= loss load	<del>, .</del>	
				$Pc = \frac{10}{P_2} = \frac{10}{2}$	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$	-	P3= loss load	on reduccione	
P, =			-,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = loss load$	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$	_	P3= loss load	on reduccione y uniones	<b>_</b> \$,
10 <b>-</b>			,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$	VALU	P3= loss load valvulas	סה reduccione y uniones GEON UNI	<b>_</b> \$,
10 9 8 7			,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$	VALU	P3= loss load valvulas JES OF LU	סה reduccione y uniones GEON UNI	⊐ s, T
10 9 8 7		steel pipe	,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	С <sub>2</sub> + РС <sub>3</sub>	VALU	P3= loss load valvulas JES OF LU	סה reduccione y uniones GEON UNI	⊐ s, T
10 9 8 7 5	P1≈ loss load on		,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	С <sub>2</sub> + РС <sub>3</sub>	VALU	P3= loss load valvulas JES OF LU	סה reduccione y uniones GEON UNI	⊐ s, T
10 (kg/cm²) 9 8 7 4 4	P1≈ loss load on	steel pipe	,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	С <sub>2</sub> + РС <sub>3</sub>	VALU	P3= loss load valvulas JES OF LU	on reduccione y uniones GEON UNI	
10 [ 9 [ 8 [ 7 6 3 3	P1≈ loss load on	steel pipe	,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$	VALU	P3= loss load valvulas JES OF LU	on reduccione y uniones GEON UNI	20 0 17 10.5
10 9 8 7 5 3 2	P1≈ loss load on	steel pipe	,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	С <sub>2</sub> + РС <sub>3</sub>	VALU	P3= loss load valvulas JES OF LU	on reduccione y uniones GEON UNI Runit 150	20 0 17 10.5
10 9 8 7 5 3 2	P1≈ loss load on	steel pipe	,	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	С <sub>2</sub> + РС <sub>3</sub>		P3= 1055 load valvulas JES OF LU LUGEON 50 10.0	ол reduccione y uniones GEON UNI кимп 150 136 13.6	200 <b>T</b> 10.5 5.8
10 9 8 7 6 5 3 2 1.55	P1≈ loss load on	steel pipe	50 00	$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = \log $	$\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$	С <sub>2</sub> + РС <sub>3</sub>		P3= loss load valvulas JES OF LU	ол reduccione y uniones GEON UNI кимп 150 136 13.6	20 0 17 10.5

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## swissbering

		EVELOPMENT	Co.	DATE.	3-diciembre			LUGEON T	EST Nº:	8
PROJECTTO	ROLA HYDROEL	ECTRIC COMPI	EX	SITE	DAM SITI	E (left margi	<b>n</b> )	TESTED BY	Geols. L.P	eréz- R. Alvarado
HOLE No	CDB-1			ELEVATI	ON	208.84	m.s.l	CHECKED	ВҮ	Geol.W. Hernánd
Packer type	Neumatic	Length (m) =	0 80	-	Water pump	Bean F	loyal 535	Flood (l/min) =		· · · · · · · · · · · · · · · · · · ·
					Test depth (r	n) from	35 00	to	40 00	
Test length (cm)		L * Cos X ° =	500 00		Depth of hole	(m)	40 00		Dip X (*)=	Û
Swivel H1 (m)		H1 =	1 00		Dameter of h	iole D (cm)	7 57	WL Be	fore of test (m)=	64
Vater level Ha (m)	64	Ha*CosX°⊭	6 40		Hydrostatic id	ad (kg/cm2)	Lh= (H1+Ha)/1	10 ≃	0 740	
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe	Length (m)	1 m =	5 00	Reducciones.	Valv uniones	02
	Diameter $\phi_1$	(m) =	0 0603		Diameter	φ <sub>2 (m) ≖</sub>	0 0254	α	Packer	0,12
	Coef rugosidad	n1 =	0 01		Coef rugosid	adi n2 ⊭	0 008		Codo	0 008
PRESSURE	LOBS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABUTY
READING	PRESSURE	PRESSURE	TIME	VOLUME			<b>.</b>	ABSOPTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe= Po+Lh - Pl	t t	Qt	Qo⊭Qt/t	Q1=Q/60000	Q2≈Q*100/6	Ae=Q/L	UL = <u>10* Ae</u> Pe	$K = \frac{Q 2}{2 \pi P c L} \cdot \ln \frac{2 L}{D}$
( kg/cm² )	(kg/cm²)	(kg/cm²)	(min)	(1)	(Vmin)	(m³/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1 00	0 00306	1 74	10	32 00	3 20	5 33E-05	53 33	0 64	37	4.77E-05
5 00	0 78110	4 96	10	513 00	51 30	8 55E-04	855 00	10 26	207	2 68E-04
10 00 5 00	2 80370 0 79948	7 94	10	972 00 519 00	97 20 51 90	1 62E-03 8 65E-04	1620 00 865 00	19 44 10 38	24 5 21 0	3 17E-04 2 72E-04
1 00	0.15572	1.58	10	229 00	22 90	3 82E-04	381 67	4 58	28.9	3.74E-04
				Pc=	L LOSS LC : Pc <sub>1</sub> + P					
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1^2}$			r	$Pc_1 + Pc_1$ .34* $(n_2)^2$ $(\phi_2$	$c_2 + Pc_3$ $\frac{*(Q_2^2)*b}{5^{33}}$	m	P3= loss load	$\sum_{i=1}^{n} \alpha * (Q_i)$	_
9 <b>T</b>		n steel pipe		$P_2 = \frac{10}{1000}$ P2= loss loa	$\frac{PC_1 + PC_1}{(\phi_2)^2}$	$c_2 + Pc_3$ $\frac{*(Q_2^2)*b}{5^{33}}$		P3= loss load	on reduccione y uniones	us,

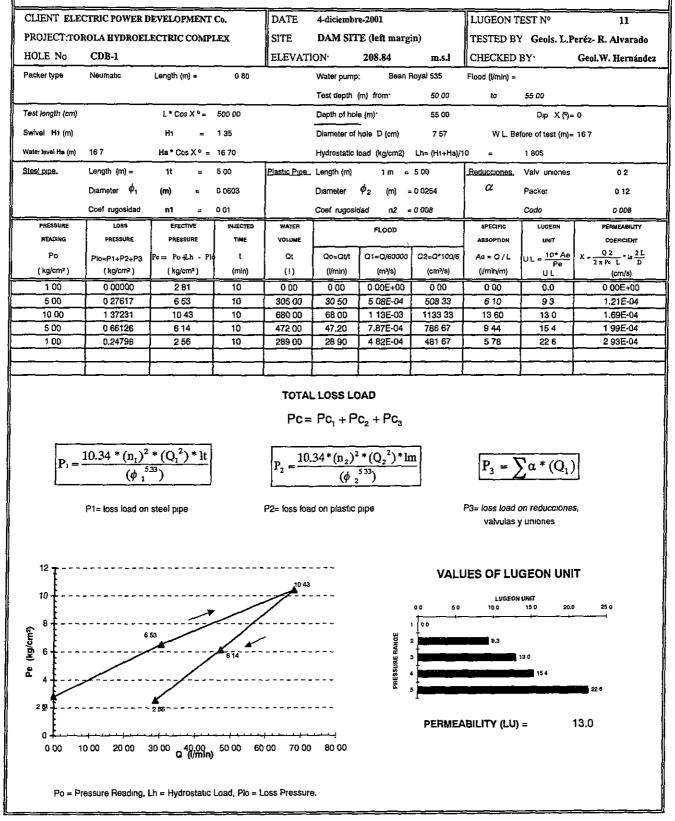
### swissbering



## swissbering

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CLIENT, ELE	CTRIC POWER D	EVELOPMENT	Co.	DATE	4-diciembra	-2001		LUGEON T	EST N⁰	10
PROJECT TO	ROLA HYDROEL	ECTRIC COMPI	.EX	SITE	DAM SIT	E (left margi	n)	TESTED BY	Geols. L.P	eréz- R. Alvarado
HOLE No	CDB-1			ELEVATI	ON	208.84	m.s.l	CHECKED	ВҮ∙	Geol.W. Hernández
Packer type	Neumatic	Length (m) =	0 80		Water pump	Bean R	loyal 535	Flood (I/min) ×		
					Test depth {	m) from	45 00	to	50 00	
Test length (cm)		L * Cos X ° =	500 00		Depth of hole	e (m)	50 00		Dup X(?)=	0
Swivel H1 (m)		H1 =	0 95		Diameter of I	- hole D (cm)	7 57	WL Be	fore of test (m)=	36 15
Water level He (m)	36 15	Ha*CosX° =	36 15		Hydrostatic l	oad (kg/cm2)	Lh= (H1+Ha)/1	≠ 0i	3 710	
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe	Length (m)	1.m =	5 00	Reducciones.	Valv uniones	02
	Diameter $\phi_1$	(m) ≂	0 0603		Diameter	¢ <sub>2</sub> (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	n1 =	0 01		Coef rugose	ad n2 =	0 008		Codo	0 006
PRESSURE	Loss	EFECTIVE	INJECTED	WATER	<u></u>	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME				ABSOPTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe= Po+Lh - Pla	t	Qt	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q/L	$UL = \frac{10*Ae}{Pe}$	$K = \frac{Q 2}{2 \pi P e L} \cdot \ln \frac{2 L}{D}$
(kg/cm²)	(kg/cm²)	( kg/cm <sup>2</sup> )	(min)	(1)	(Vmin)	(m³/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1 00	0 07700	4 63	10	161 00	16 10	2 68E-04	268 33	3 22	70	9 00E-05
5 00	1 20805	7 50	10	638 00	63 80	1 06E-03	1063 33	12 76	17 0	2.20E-04
10 00 5 00	3 61028 1.84745	10 10 6 86	10	1103 00 789.00	110 30 78 90	1 84E-03 1.32E-03	1838 33 1315 00	22 06 15.78	21.8	2 83E-04 2 98E-04
1 00	0 19764	4 51	10	258 00	25 80	4 30E-04	430 00	5 16	11 4	1 48E-04
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$			$P_2 = \frac{10}{2}$ $P_2 = \log $		<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*h <sup>533</sup> ) pipe	m	P3= loss load	$\sum_{\alpha} \alpha * (Q_1)$ on reduccione y uniones	
12 <b>-</b>				/	±0 10		<b>VAL</b>			-
be (kg(cm <sup>3</sup> )	163 - 3 51	7.50	6 86			PRESSURE RANGE	2 3 4 5 PERME			21.8
0.00	20.00 40	0.00 60.00 Q (I/min	80 00	100 00	120 00					
Po = i	Pressure Reading,	Lh = Hydrostatio	c Load, Pio ≂	Loss Pressu	re 					

### swissboring



## swissbering

CTIENT FIE	TRIC POWER D	EVELOPMENT		DATE	5-diciembr			LUGEON T	EST N0.	12
										-
	CDP 1	ECTRIC COMP	LEA	SITE:		E (left margi		f		eréz- R. Alvarado
HOLE No.	CDB-1			ELEVATI		208.84	m.s.l	CHECKED	BY.	Geol.W. Hernández
Packer type.	Neumatic	Length (m) ≈	0 80		Water pump		loyal 535	Flood (l/min) ≂		
	<u> </u>				Test depth	(m) from	55 00	to	60 00	
Test length (cm)		L * Cos X ° =	500 00		Depth of hol	e (m) -	60 00		Dıp X{")≃	0
Swive! H1 (m).		H1 =	2 45		Diameter of	hole D (cm)	7 57	WL Be	fore of test (m)=	14 8
Water level Ha (m)	14 8	Ha*CosX° =	14 80		Hydrostatic	load (kg/cm2)	Lh≃ (H1+Ha)/	10 =	1 725	
Steel pipe.	Longth (m) =	1t =	5 00	Plastic Pipe	Length (m)	1 m =	5 00	Reducciones,	Valv uniones	02
	Diameter $\phi_1$	(m) ≖	0 0603		Diameter	$\phi_2$ (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	ก1 =	10 0	ļ	Coel rugosi	dad n2 =	800 0	1	Codo	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEÓN	PERMEABILITY
READING	PRESSURE	PRESSUAE	TIME	VOLUME	ļ			ABSOPTION	'זזאט	COEFICIENT
Po	Plo=P1+P2+P3	Pe≕ Po+Lh - Pl	ι τ	Qt	Qo≃Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae⊭Q/L	$UL = \frac{10^* Ae}{Pe}$	$K = \frac{Q 2}{2 \pi Pe L} = \frac{2 L}{D}$
( kg/cm² )	(kg/cm²)	(kg/cm²)	(min)	(1)	(l/min)	(m <sup>s</sup> /s)	(cm³/s)	(I/min/m)	UL	(cm/s)
1 00	0 00000	2 73	10	0 00	0.00	0 00E+00	0 00	0 00	0.0	0 00E+00
5 00	0.00001	6 72 11 30	10	2.00	0.20	3.33E-06 6.30E-04	3 33 630 00	0.04	67	7 71E-07 8 67E-05
5 00	0.42414	6 65	10	157.00	15.70	2 62E-04	261 67	3 14	47	6 12E-05
1.00	0 01144	271	10	62.00	6.20	1.03E-04	103 33	1 24	46	5 92E-05
<b>P</b> <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$	$(Q_1^2)^*$ lt (5.33)		Pc=	, 	$Pc_{2} + Pc_{3}$ $\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 33}$	m	$P_3 = \sum_{i=1}^{n}$	$\sum \alpha^* (Q_1)$	2]
	P1= loss load or	n steel pipe		P2= loss loa	d on plastic	рре		P3= loss load valvulas	on reduccione y uniones	s,
<sup>12</sup>					11.30		VAL	ues of Lu	GEON UN	IT
10								LUGEO	N IIMT	
		*	/				00 10	20 30 40		70 80
8 6 72			×				1 00 '	, , ,		. ,
6 (kg/cm <sup>2</sup> ) 6		6.55				PRESSURE RANGE	2 01			_
a l						SURE	3			67
- 4	/					PRES	4 	·		
28	2.74						°			
Ē							PERME	ABILITY (LU	) =	6.7
0 <b>4</b> 0 00	5 00 10.00	15 00 20 00 Q (i/mir		000 350	 0 40.00		r = 1,0		,-	0.7
Po = P	Pressure Reading,	. Lh = Hydrostatu	: Load; Plo =	Loss Pressu	re	<u> </u>	<u></u>		<u></u>	

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COMPLEX (m) = 0.60 (m) = 0.60 (m) = 1.10 (m) = 28.25 (m) = 0.0603 (m) = 0.01 (m) = 0.	Plastic Pipe.	ION Water pump Test depth ( Depth of hole Diameter of f Hydrostatic I:	m) from e (m) nole D (cm)	m.s.l Royal 535 60 00 55 00 7 57	TESTED BY CHECKED 1 Flood (Vmin) = to		Peréz- R. Alvarado Geol.W. Hernánde
$505 X^{\circ} \approx 500 00$ = 1 10 $505 X^{\circ} \approx 28 25$ = 5 00 $\approx 0.0603$ = 0.01	H	Water pump Test depth ( Depth of hole Diameter of f Hydrostatic la	Bean F m) from e (m) nole D (cm)	Royal 535 60 00 65 00	Flood (l/min) =	65 00	
$505 X^{\circ} \approx 500 00$ = 1 10 $505 X^{\circ} \approx 28 25$ = 5 00 $\approx 0.0603$ = 0.01	Plastic Pipe.	Test depth ( Depth of hole Diameter of f Hydrostatic Ia	m) from e (m) nole D (cm)	60 00 65 00			
= 1 10 = 28 25 = 5 00 ≈ 0 0603 = 0 01	Plastic Pipe .	Depth of hole Diameter of f Hydrostatic lo	e (m) nole D (cm)	65 <b>0</b> 0	to		
= 1 10 = 28 25 = 5 00 ≈ 0 0603 = 0 01	Plastic Pipe .	Diameter of f	ole D (cm)			Dup X (9)=	<u></u>
cs X° = 28 25 = \$ 00 ≈ 0 0603 = 0 01	Plastic Pipe .	Hydrostatic li		7 57			) <b>D</b>
= \$00 ≈ 0.0603 = 0.01	Plastic Pipe .				W L Bet	fore of test (m)=	28 25
≈ 0.0603 = 0.01	Plastic Pipe .	Longeth ()	pad (Kg/cm2)	Lh= (H1+Ha)/1	0 =	2 935	
= 001		Cenditr (11)	1m =	5 00	Reducciones.	Valv uniones	02
		Diameter	∲ <sub>2</sub> (m) =	0 0254	α	Packer	0 12
TIVE INJECTED		Cost, rugosid	lad n2 =	0 008		Codo	0 008
	WATER	<del> </del>	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
SURE TIME	VOLUME		·		ABSÓPTION	UNIT	COEFICIENT
+Lh - Pla 1	Ot	Qo≠Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	$UL = \frac{10^* Ae}{Pe}$	$K = \frac{Q 2}{2 \pi P c L} + \ln \frac{2 L}{D}$
cm²) (min)	(1)	(Vmin)	(m³/s)	(cm³/s)	(l/min/m)	<u></u>	(cm/s)
93 10	19 00	1 90	3.17E-05	31.67	0 38	10	1 25E-05
91 10 93 10	96 00 34 00	9 60 3 40	1 60E-04 5 67E-05	160 00 56 67	1.92 0.68	24	3.15E-05 6 81E-06
90 10	116 00	11 60	1 93E-04	193 33	2 32	29	3 81E-05
93 10	27 00	2 70	4 50E-05	45 00	0 54	14	1 78E-05
	{					╞────┤	<u> </u>
<u>) * It</u>	P2= loss loa		*(Q <sub>2</sub> <sup>2</sup> )*In <sup>5 33</sup> )	_	P3≖ loss load o		
				VALL	valvulas y JES OF LU(		ſΤ
					LUGEON	111111	
2.91	<u> </u>		ų	0.0 0.5		2.0 2.5 	3.0 3,5 
X	7,90	· - ~ -	PRESSURE RANGE			24	2.9
				PERMEA	BILITY (LU)	= (	0.5
) 800 10.0	<u></u>						
Ĵ		·····		·····	8 00 10.00 12 00 14 00	PERMEABILITY (LU) 8 00 10.00 12 00 14 00	PERMEABILITY (LU) = (

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		a								
CLIENT: ELEC	CTRIC POWER D	EVELOPMENT	Co.	DATE	6-dictembr	e-2001	i	LUGEON T	EST N <sup>o.</sup>	14
PROJECT.TOP	ROLA HYDROEL	ECTRIC COMPL	ÆΧ	SITE	DAM SIT	E (left margi	<b>n</b> )	TESTED BY	Geols. L.P	eréz- R. Alvarado
HOLE No .:	CDB-1			ELEVATI	ON∙	208.84	m.s.l	CHECKED	вү	Geol.W. Hernández
Packer type	Neumatic	Length (m) =	0.80	<u> </u>	Water pump	Bean F	loyal 535	Flood (Vmin) =		
					Test depth	(m) from	65 00	to	70 00	
Tøst length (cm)		L*Cos X°=	500 00		Depth of hol		70 00		Dip X (*)=	0
Swivel H1 (m)			1 60		Diameter of	-	7 57	W I Da	fore of test (m)=	
	10 57					• •				10 37
Water level Ha (m)	18 57	Ha*CosX * =		T		load (kg/cm2)	Lh= (H1+Ha)/1	<u>,                                    </u>	2 017	
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe .		1m =	5 00	Reducciones.	Valv uniones	0 2
	Diameter $\varphi_1$	(m) =	0 0603	{	Diaméter	¢₂ (m) =	0.0254	α	Packer	0 12
	Coef rugosidad	ກ1 =	0 01	<u> </u>	Coef rugosi	dad n2 ≃	0 0/8		Codo	0 008
PRESSURE	1095	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME		T		ABSOPTION		COEFICIENT
Po	Plo=P1+P2+P3	Pe = Po-iLh - Pic		Qt	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q / L		$K = \frac{Q2}{2\pi Pr L} \cdot \ln \frac{2L}{D}$
( kg/cm <sup>2</sup> )	(kg/cm <sup>2</sup> )	(kg/cm²)	(min)	(1)	(l/min)	(m³/s)	(cm <sup>3</sup> /s)	(l/mln/m)		(cm/s)
1 00	0 00218	3 01 7 01	10 10	27 00	2 70	4 50E-05 9 00E-05	45 00	0.54	1.8	2 32E-05 2 00E-05
10 00	0 35744	11 66	10	347 00	34 70	578E-04	578 33	6.94	60	7.71E-05
5 00	0 08787	6 93	10	172 00	17 20	2 87E-04	286 67	3 44	5.0	6.43E-05
1 00	0 00000	3 02	10	0.00	0.00	0 00E+00	0.00	0.00	00	0 00E+00
<b>P</b> <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$ P1= loss load of			$P_2 = \frac{10.}{2}$ P2= loss loa		<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*lı <sup>533</sup> ) spipe		P3≃ loss load	$\sum \alpha * (Q_1)$ on reduccione y uniones	
14 12	ol	*	/	14.6	36 	ANGE	VAL			<b>17</b> 60 70
2 3921 0 00	5 00 10 00	6 93 15 00 20 00 C (i/min			  	PRESSURE NANCE	3 Dennes 4 Dennes 5 00 PERME	ABILITY (LU	) =	<b>6</b> 0

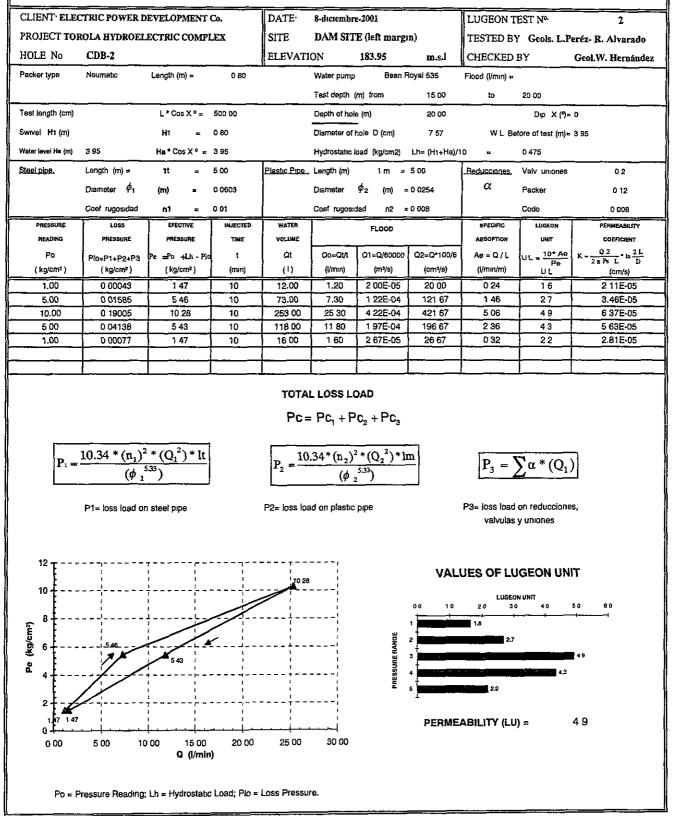
## swissboring

Swissboring Overseas Corporation Ltd.

CUIENT: ELE	TRIC BOWER D	EVEL OBMENT		DATE	9 dialographic	. 2001		LUCEONT	DOT MO.	
	TRIC POWER D			DATE	8-diciembr			LUGEON T		1
	CDB-2	RCTRIC COMP	LEX	SITE:		E (left margi		j)		eréz- R. Alvarado
HOLE No	CDB-2 Neumstic	1		ELEVATI		183.95	m.s.l	CHECKED	BI:	Geol.W. Hernánde:
Packer type,	INBUMBELIC	Length (m) =	080		Water pump		foyal 535 9 75	Flood (l/min) =	14 76	
Test length (cm)		L* Cos Xº=	500 00		Test depth		975 1475	to	1475  Dip X(″)⊭	
Swivel H1 (m)		H1 =	2 60		Diameter of 2	•	7 57	WI Ba	=(-) × µ∪ =fore of test (m)	
Water lavel Ha (m)	35	Ha*CosX°=				oad (kg/cm2)			D 610	95
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe		1 m =		Reducciones.	Valv uniones	02
	Diameter $\phi_1$	(m) =	0 0603			,	0 0254	α	Packer	0 12
	Coel rugosidad	n1 =	0 01	•	Coef rugosh			[	Codo	0 006
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	<u></u>	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRE&SURE	PRESSURE	TIME	VOLUME	<b> </b> -	<u> </u>	I	ABSOPTION	UNIT	COEFICIENT
Po	Pio=P1+P2+P3	Pe =Po +Lh - Plo		Qt	Qo≂Qt/t	Q1=Q/60000	Q2≈Q*100/6		UL = 10* Ae Pe	$K = \frac{Q 2}{2 \pi P c L} + \ln \frac{2 L}{D}$
( kg/cm² )	( kg/cm² )	(kg/cm²)	(min)	(1)	(Vmn)	(m³/s)	(cm³/s)	(Vm)n/m)	UL	(cm/s)
1 00	0.00000	1 61	10	0 00	0 00	0 00E+00	0 00	0 00	00	0 00E+00
3 00	0 00630	3 60	10	46.00	4 60	7 67E-05	76 67	0.92	26	3 31E-05
5 00	0 07795	5 53	10	162 00	16 20	2 70E-04	270 00	3 24	59	7.59E-05
3 00	0 02571	3 58	10	93.00	930	1 55E-04	155 00	1 86	52	6 72E-05
1 00	0 00037	1 61	10	11 00	1,10	1 83E-05	18 33	0 22	14	1 77E-05
$P_i = \cdot$	$\frac{10.34 * (n_1)^2}{(\phi_1^5)^5}$ P1= loss load on			$P_2 = \frac{10}{1000}$ P2= loss loa		* (Q <sub>2</sub> <sup>2</sup> ) * Ir <sup>5 33</sup> ) pipe		P3= loss load valvulas		
6 5 6			/	563	~		VALU	JES OF LU		<b>T</b> 60 70
(wu) 6 (wu) 7 (wu)	5 00	3,58 10.00 Q (l/min)			20.00	PRESSURE RANGE	PERMEA	ABILITY (LU)	5.2	5.9

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### swissbering



## SWISSDORING Swissboring Overseas Corporation Ltd,

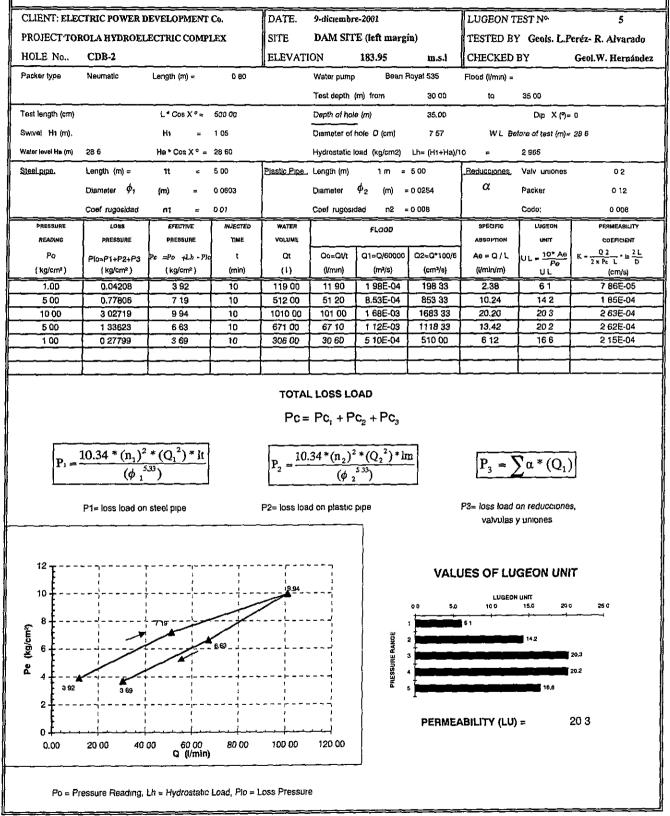
CLIENT ELF	ECTRIC POWER I	DEVELOPMENT	Co.	DATE.	8-diciembr	e-2001		LUGEON T	EST №	3	
PROJECT.TOROLA HYDROELECTRIC COMPLEX					DAM SIT	E (left marg	in)	TESTED BY Geols. L.Peréz- R. Alvarado			
HOLE No	No CDB-2				ELEVATION. 183.95 m.s.i				CHECKED BY Geol.W. Herns		
Packer type	Neumatic	Length (m) $=$	0 80		Water pump	Bean I	Royal 535	Flood (Vmin) =			
					Test depth	(m) from	20 00	to	25 00		
Test length (cm)		L * Cos X ª =	500 00		Depth of hol	ie (m)	25 00		D1p X (9)=	D	
Swivel H1 (m)		Hı =	0 <b>8</b> 0		Diameter of	hole D (cm),	7 57	WL Be	tore of test (m)≂	3.5	
Valer level Ha (m)	35	Ha≭CosX° =	3 50		Hydrostatic I	load (kg/cm2)	Lh= (H1+Ha)/	10 =	0 430		
Steet pipe,	Length (m) ≈	 1t ≃	5 00	Plastic Pipe	Length (m)	1m ≈	5 00	Reducciones.	Valv uniones	0 2	
	Diameter $\phi_1$	(m) =	0 0603	}	Diameter	$\phi_2$ (m) =	= 0 0254	α	Packer	0 12	
	Coet rugosidad	n1 =	0.01		Cost rugosi	dad n2 =	- 0 008		Codo	0 008	
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	{	FLOOD		SPECIFIC	LUGEON	PERMEABUTY	
READING	PAESSURE	PRESSURE	TIME	VOLUME			<del></del>	ABSOPTION	UNIT	COEFICIENT	
Po (katom2)	Plo≖P1+P2+P3	Pe ≕Po +Lh - Plo			Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q / L		$K = \frac{Q 2}{2 \pi F c L} = \frac{2 L}{D}$	
(kg/cm²)	(kg/cm²)	(kg/cm²)	(min) 10	(1)	(Vmin)	(m <sup>3</sup> /s)	(cm³/s)	(l/min/m)		(cm/s)	
<u> </u>	0.00000	1 43 5 29	10	0.00	0 00 21 70	0 00E+00 3 62E-04	0 00	0.00	00 82	0.00E+00 1.06E-04	
10 00	1 06134	9 37	10	598.00	59 80	9 97E-04	996.67	t1 96	12.8	1 65E-04	
5.00	0 18409	5 25	10	249.00	24 90	4 15E-04	415 00	4 98	95	1 23E-04	
1 00	0 01999	1 41	10	82 00	8 20	1 37E-04	136 67	1 64	116	<u>1 51E-04</u>	
					Pc <sub>1</sub> + P		_				
<b>P</b> <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1^5)^2}$	J		Pc=	$Pc_1 + P$ $\frac{34^*(n_2)^2}{(\phi_2)^2}$	$c_2 + Pc_3$ $\frac{2}{2} * (Q_2^2) * ln \frac{1}{2}$	n	P3= loss load	$\sum \alpha * (Q_1)$		
10 9 8	P1= loss load on	J		$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = loss load$	$Pc_1 + P$ $\frac{34^*(n_2)^2}{(\phi_2)^2}$	$c_2 + Pc_3$ $\frac{2}{2} * (Q_2^2) * ln \frac{1}{2}$		P3= loss load	on reduccione y uniones GEON UNI	⊐ s,	
10 <u>-</u> 9 <u>+</u>	P1= loss load on	steef pipe		$Pc = \frac{10}{P_2} = \frac{10}{10}$ $P2 = loss load$	$Pc_1 + P$ $\frac{34^*(n_2)^2}{(\phi_2)^2}$	$c_2 + Pc_3$ $\frac{2}{2} * (Q_2^2) * ln \frac{1}{2}$	VALU	P3= loss load valvulas JES OF LU	on reduccione y uniones GEON UNI		

}

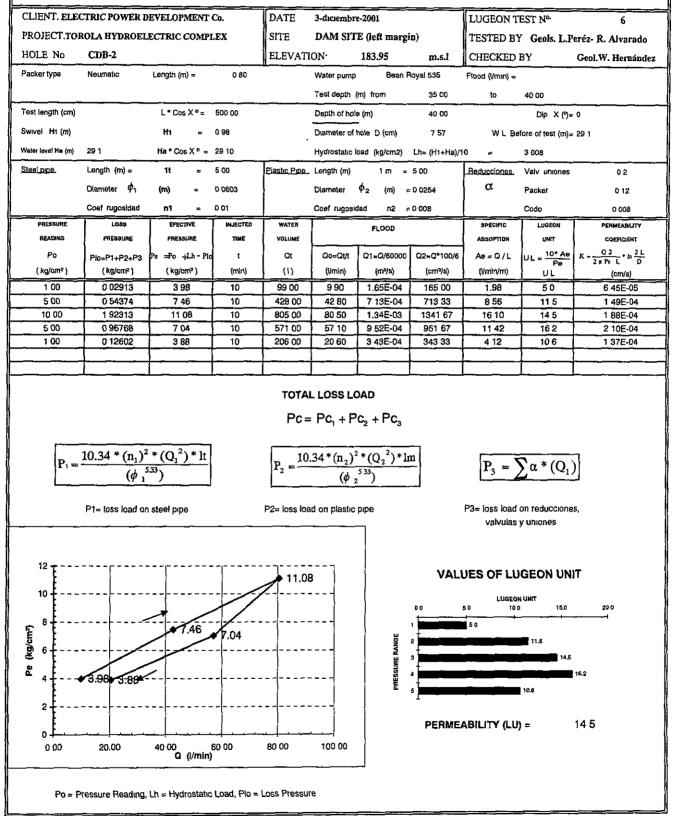
## swissboring

CLIENT ELECTRIC POWER DEVELOPMENT Co.					DATE. 9-diciembre-2001				LUGEON TEST Nº: 4			
PROJECT TOROLA HYDROELECTRIC COMPLEX					SITE, DAM SITE (left margin)			TESTED BY Geols. L.Peréz- R. Alvarado				
HOLE No.	CDB-2			ELEVAT	ON	183.95	m.s.l	CHECKED	вү	Geol.W. Hernánde		
Packer type	Neumatic	Length (m) =	0 80		Water pump	Bean F	Royal 535	Flood (l/min) =				
					Test depth	m) from	25 00	to	30 00			
Test length (cr	n)	L * Cos X ° =	500 00		Depth of hole	∍ (m)	30 00		Dip X (°)=	0		
Swivel Ht (m)	)	H1 ≂	1 85		Diameter of	- hole D (cm)	7 57	WL 8e	forø of test (m)≂	26 4		
Water level He (n	n) 264	Ha*CosX° =	26 40		Hydrostatic I	oad (kg/cm2)	Lh≃ (H1+Ha)/	IÔ =	2 825			
Steel pipe.	Length (m) =		5 00	Plastic Pipe	Length (m)	1 m =	5 00	Reducciones.	Valv uniones	0 2		
	Diameter $\phi_1$	(m) =	0 0603		Diameter	¢₂ (m) ⊧	- D 0254	α	Packer	0 12		
	Cost rugosidad	n1 =	0 01		Cost rugosle	dad n2 ⊭	= 0 008		Codo	0 008		
PRESSURE	Loss	EFECTIVE	INJECTED	WATER	<u> </u>	FLOOP		SPECIFIC	LUGEON	PERMEABILITY		
READING	PRESSURE	PRESSURE	TINE	VOLUME			·	ABSOPTION	UNIT	COEFICIENT		
Po	Plo=P1+P2+P3	Pc ==Po +Lh - Plo	a t	Qt	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	UL = $\frac{10*Ae}{Pe}$	$K = \frac{Q 2}{2 \pi P e L} * \ln \frac{2 L}{D}$		
(kg/cm²)	( kg/cm² )	(kg/cm²)	(min)	(1)	(l/min)	(m³/s)	(cm³/s)	(l/min/m)	UL	(cm/s)		
1 00	0 10721	372	10	190.00	19.00	3 17E-04	316 67 1391 67	3 B0 16 70	10.2 29.0	1 32E-04 3 76E-04		
5 00	2 06912	<u> </u>	10	835 00	83 50 115 00	1.39E-03 1 92E-03	1916 67	23 00	25 8	3 76E-04 3 35E-04		
5 00	2 89090	4 93	10	987 00	98 70	1 65E-03	1645 00	19 74	40 0	5 18E-04		
1 00	0 81185	3 01	10	523 00	52 30	8 72E-04	871 67	10.46	34 7	4 50E-04		
P.	$=\frac{10.34 * (n_1)^2}{(\phi_1)^2}$ P1= loss load or			$P_2 = \frac{10}{2}$	$= \mathbf{P}\mathbf{C}_1 + \mathbf{P}$ $\frac{0.34*(\mathbf{n}_2)}{(\phi)}$	$\frac{2^{2} * (Q_{2}^{2}) * l_{2}}{2^{5} \frac{33}{2}}$	m	P3= loss load	$\sum_{n=1}^{\infty} \alpha * (Q_n)$			
Pe (kg/cm <sup>2</sup> ) Pe (kg/cm <sup>2</sup> ) Antherite (kg/cm <sup>2</sup> ) Per (kg/cm	3.72	5	76	433		PRESSUAE RANGE		LUGEO	300 40 ;; 29.0 25.6			
	20 00 40 00	60 Q0 8 Q (I/mir			   140.00	-	PERME	ABILITY (LU	<b>) =</b>	25 8		

### swissboring



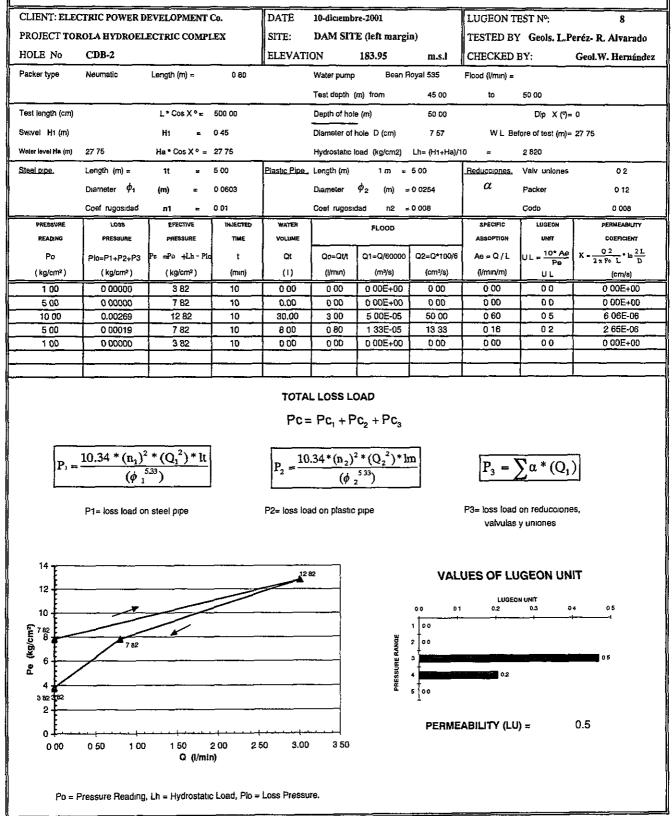
### swissbering



### swissbering

CLIENT ELE	CTRIC POWER I	DEVELOPMENT	Co.	DATE	10-diciemb	ore-2001	,	LUGEON T	EST Nº.	7	
PROJECT TOROLA HYDROELECTRIC COMPLEX					SITE- DAM SITE (left margin)				TESTED BY Geols. L.Peréz- R. Alvarado		
HOLE No.	CDB-2	<del></del>		ELEVATI	ON	183.95	m.s.l	CHECKED	BY	Geol.W. Hernánde	
Packer type	Neumatic	Length (m) =	0 60		Water pump	Bean I	Royat 535	Flood (Vmin) =			
					Test depth	(m) from	40 00	to	45 00		
Test length (cm)		L * Cos X ° ≈	500 00		Depth of hol	e (m)	45 00		Dip X(°)=	0	
Swivel Ht (m)		H1 ±	2 20		Diameter of	hole D (cm)	7 57	W L Be	fore of test (m)=	38 2	
Water jevel H# (m)	38 2	Ha*CosX° =	38 20		Hydrostatic	load (kg/cm2)	Lh≃ (H1+Ha)/1	10 =	4 040		
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe_	Length (m)	1 m =	5 00	Reducciones.	Valv uniones	02	
	Diameter $\phi_1$	(m) =	0 0603	1	Diameter	φ <sub>2</sub> (m)	= 0 0254	α	Packer	0 12	
	Coef rugosidad	nt =	0 01	1	Coef rugosi	dad n2 ·	= 0 008	ł	Codo	O QOB	
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY	
READING	PRESSURE	PRESSURE	TIME	VOLUME		+	<del></del>	ABBOPTION	UNIT	COEFICIENT	
Po	Plo=P1+P2+P3	Pe =Po +Lh•Plo	t	Qt	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Aa = Q/L	UL = 10* Ae Pe	$K = \frac{Q2}{2\pi Pc} L \cdot \ln \frac{2L}{D}$	
(kg/cm²)	( kg/cm² )	(kg/cm²)	(mìn)	(1)	(l/min)	(m³/s)	(cm <sup>3</sup> /s)	(i/miri/m)	UL	(cm/s)	
1 00	0 11177	4 93	10	194 00	19 40	3 23E-04	323 33	3 88	7.9	1 02E-04	
5 00	0 29645	874	10 10	316 00 743 00	31 60 74 30	5 27E-04 1 24E-03	526 67 1238 33	<u>6 32</u> 14 86	72	9 36E-05 1.55E-04	
10 00 5 00	0 69243	12 40 8 35	10	483 00	48 30	8 05E-04	805 00	9 66	116	1.55E-04	
1 00	0 21325	4 83	10	268 00	26 80	4 47E-04	446 67	5 36	11.1	1 44E-04	
			<del>_</del>	<u>1</u>		<b>l</b>	I	<u> </u>	<u> </u>		
				TOTAI	LOSSLO	DAD					
				Pc=	PC <sub>1</sub> + P	$C_2 + PC_3$					
<b></b>	$10.24 * (r)^{2}$	2 * (O <sup>2</sup> ) * It		<b>—</b> 10	24*1- 1	2 * (O <sup>2</sup> ) *1				-	
$\mathbf{P}_1 =$	$\frac{10.34}{(h^{-3})}$	$\frac{2 * (Q_1^2) * lt}{533}$		$P_2 = \frac{10}{2}$	. <u>34 (ll<sub>2</sub>)</u>	$\frac{1}{5^{5}33}$	<u>"</u> ]	$P_3 = \sum_{i=1}^{n}$	$\sum \alpha * (Q_1)$	)	
L				L	(\V :			L	<b>-</b>		
	P1= loss load or	n steel pipe		P2= loss loa	d on plastic	ріре		P3= loss load	on reduccione	s,	
								valvulas	y uniones		
					12.40		VAL	UES OF LU	GEON UN	т	
12			/ /					LUGEON		120 140	
				/			00 20	40 60	8.0 100	120 140	
10		874							<b>.</b>		
		874	8.35		{	g	2		7.2		
	/	874	8.35			ERANGE	2	ادر کمبر می اندر کمبر می	7.2	12.0	
<u>s</u>	_/	874	0.35			ISSURE RANGE			7.2	12.0	
	450	874	8.35			PRESSURE RANGE					
Pe (kg/cm²)	490	874	8.35			PRESSURE RANGE		ام کمبود اندر کی در اندر کی در اندر کاروان		11.6	
Pe (kg/cm <sup>3</sup> )	4.92	874	8.35			Pressure range		ABILITY (LU)	ان والمحديد بي الأوكار معالم البوكار معالم	11.6	
be (kg/cm <sup>2</sup> ) be (kg/cm <sup>2</sup> ) be 4 be (kg/cm <sup>2</sup> )	4 93	874 4.83 30 00 40.00 Q (//min		50.00 70 Q	0 80 00	PRESSURE RANGE			ان والمحديد بي الأوكار معالم البوكار معالم	111.6 13 1	
be (kg/cm <sup>2</sup> ) be (kg/cm <sup>2</sup> ) be 4 be (kg/cm <sup>2</sup> )	10.00 20.00	30 00 40.00		50.00 70 D	0 80 00	adnasang			ان والمحديد بي الأوكار معالم البوكار معالم	111.6 13 1	

## swissbering



CLIENT ELECTRIC POWER DEVELOPMENT Co.					10-01010100	re-2001		LUGEON TEST Nº- 9			
PROJECT TOROLA HYDROELECTRIC COMPLEX					SITE · DAM SITE (left margin)				TESTED BY Geols. L.Peréz- R. Alva		
HOLE No	CDB-2	ELEVATI	ON·	183.95	83.95 m.s.)		ВҮ∙	Geol.W. Hernánde			
Packer type	Neumatic	Length (m) =	0 80		Water pump	Bean F	Royal 535	Flood (I/min) =			
					Test depth	(m) from	50 00	to	55 00		
fest length (cm)		L*Cos X °=	500 00		Depth of hol	е (т.).	\$5 00		Dıp X(°)⊨	• 0	
Swivel H1 (m)		Ht ≂	1 25		Diameter of	- hole D (cm)	7 57	WL Ba	ntore of test (m)≈	26 75	
Vater level Ma (m)	26 75	Ha*CosX° =	26 75		Hydrostatic I	oad (kg/cm2)·	Lh= (H1+Ha)/1	i0 ≃	2 800		
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe	Length (m)	3 m =	\$ 00	Reducciones.	Valv uniones	02	
	Diameter $\phi_1$	(m) =	0 0503		Diameter	\$\phi_2 (m) =	0 0254	α	Packer	0 12	
	Coef rugosidad	n1 *	0.01	}	Coef rugosu	dad n2 =	0.008	]	Codo	0 008	
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY	
READING	PRESSURE	PRESSURE	TIME	AOTAME				ABSOPTION	тин	COEFICIENT	
Po	Plo=P1+P2+P3	Pe =Po +Lh · Plo	t t	Qt	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	As = Q/L	$UL = \frac{10^* \text{Ae}}{\text{Pe}}$	$K = \frac{Q 2}{2 \pi P \epsilon} L^* \ln \frac{2 L}{D}$	
(kg/cm²)	(kg/cm²)	(kg/cm²)	(min)	(1)	(Vmin)	(m³/s)	(cm³/s)	(i/min/m)	ບເ.	(cm/s)	
1 00	0 01458	3 79	10	70 00	7 00	1 17E-04	116 67	1 40	37	4 79E-05	
5 00	0 06419	774	10	147 00	14 70	2 45E-04	245 00	2 94	38	4 92E-05	
10 00	0 38046	12 42	10	358 00	35 80	5 97E-04	596 67	7.16	58 47	7 47E-05 6 05E-05	
<u> </u>	0 09623	7 70 3 78	10	180 60 91 00	18 00 9 10	3 00E-04 1 52E-04	309 00 151 67	3.60	47	6 24E-05	
	1								1 1		
				L		<u> </u>	L		┦──╌──┤	L	
	<u> </u>			TOTAL	LOSS LO	DAD	L	L	4,,	L	
	]				LOSS LC Pc <sub>1</sub> + P		L	L_,	4	<b></b> ,,_,	
	$\overline{10.34*(n,)^2}$	$*(Q_{1}^{2})*$ lt		Pc=	Pc <sub>1</sub> + P	c <sub>2</sub> + Pc <sub>3</sub>	 n		······	٦	
P1 =-	$\frac{10.34 * (n_1)^2}{(\phi_1)^5}$	$\frac{*(Q_1^2)*1t}{^{33}}$		Pc=	Pc <sub>1</sub> + P	c <sub>2</sub> + Pc <sub>3</sub>	<u>n</u>	$P_3 = $	$\sum \alpha * (Q_1)$	)	
$P_1 \approx$	$\frac{10.34 * (n_1)^2}{(\phi_1^5)^2}$	$(Q_1^2)^*$ lt 333)		Pc=	Pc <sub>1</sub> + P		n	P <sub>3</sub> = 2	$\sum \alpha^* (Q_1)$	)]	
P. =-	$\frac{10.34 * (n_{1})^{2}}{(\phi_{1}^{5})^{5}}$ P1= loss load on	·····		Pc=	$Pc_1 + P$ $34*(n_2)^2$ $(\phi_2$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$	n	P3= loss load		_	
P <sub>1</sub> =		·····		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$Pc_1 + P$ $34*(n_2)^2$ $(\phi_2$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$	n	P3= loss load		_	
P <sub>1</sub> = -		·····		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$Pc_1 + P$ $34*(n_2)^2$ $(\phi_2$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$	_	P3= loss load valvulas	on reduccione y uniones	<b>s</b> ,	
14		·····		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_1 + P$ $34*(n_2)^2$ $(\phi_2$	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$	_	P3= loss load	on reduccione y uniones	<b>s</b> ,	
14		·····		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$	VALI	PS= loss load valvulas JES OF LU	on reduccione y uniones	<b>s</b> ,	
14 <b></b> 12 <b></b> 10 <b></b>	P1= loss load on	steel pipe		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	$c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$	VALI	P3= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI	s. IT	
14 <b></b> 12 <b></b> 10 <b></b>		steel pipe		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	С <sub>2</sub> + РС <sub>3</sub>	VALI	PS= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI 10 50	s. IT	
14 <b></b> 12 <b></b> 10 <b></b>	P1= loss load on	steel pipe		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	С <sub>2</sub> + РС <sub>3</sub>	VALI	PS= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI N UNIT 40 50 137	s. IT	
14 12 10	P1= loss load on	steel pipe		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	С <sub>2</sub> + РС <sub>3</sub>	<b>VAL</b>	PS= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI N UNIT 40 50 137	□ S, IT 60 70 →1	
14 <b></b> 12 <b></b> 10 <b></b>	P1= loss load on	steel pipe		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	С <sub>2</sub> + РС <sub>3</sub> <sup>3</sup> * (Q <sub>2</sub> <sup>2</sup> ) * Ш <sup>5 33</sup> ) ріре	<b>VAL</b>	PS= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI N UNIT 40 50 137	□ S, IT €0 70 →	
Le (kg/cm <sup>3</sup> )	P1= loss load on	steel pipe		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	С <sub>2</sub> + РС <sub>3</sub>	<b>VAL</b>	PS= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI N UNIT 40 50 137	□ S, IT €0 70 →	
14 12 10 8 4 2	P1= loss load on	steel pipe		$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})$ d on plastic	С <sub>2</sub> + РС <sub>3</sub>		PS= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI 10 50 137 3A 3A 40 50 147 40	□ S, IT €0 70 →	
14 12 10 8 8 6 2 0	P1= loss load on	steel pipe	25.00 30	$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$	$Pc_{1} + P$ $34^{*}(n_{2})^{2}$ $(\phi_{2})^{2}$ $d \text{ on plastic}$ $242$	С <sub>2</sub> + РС <sub>3</sub>		P3= loss load valvulas JES OF LU	on reduccione y uniones IGEON UNI 10 50 137 3A 3A 40 50 147 40		

# SWISSDORING Swissboring Overseas Corporation Ltd,

		<u> </u>								
CLIENT ELE	CTRIC POWER D	EVELOPMENT	Co.	DATE	10-diciemb	re-2001		LUGEON T	EST Nº	10
PROJECT TO	SITE	DAM SIT	E (left margi	n)	TESTED BY	TESTED BY Geols. L.Peréz- R. Alvarado				
HOLE No	CDB-2		ELEVATION. 183.95 m.s.				CHECKED	BY	Geol.W. Hernández	
Packer type	Neumatic	Length (m) =	# <u></u>	Water pump	Веал Р	loyai 535	Flood (l/min) =			
					Test depth	(m) from	55 00	to	60 00	
Test length (cm)	·	L*Cos Xº=	500.00		Depth of hol		80 QC		 Dip X(?)=	0
Swivel H1 (m)	• • •					hale D (cm)	7 57	WL Ba	fore of test (m)=	31 4
Water level Ha (m)						load (kg/cm2)			3 236	
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe	~	1 m =		Reducciones.	Valv uniones,	D 2
- TELL POPUL	Diameter $\phi_1$		0 0603		Diameter	<u>ـ</u>	0 0254	α		
		<b>*</b> **		{		- • •			Packer	0 12
	Coef rugosidad	n1 =	0 01	<u> </u>	Coef rugosi	dad n2 =	800.0		Codo	0 008
PRESSURE	LOSS	PRESSURE	INJECTED TIME	WATER VOLUME		FLOOD		ABSOPTION	LUGEON	COEFICIENT
Po	1	Pe =Po +Lh - Plo		Qt	Qo=Q1/1	Q1=Q/60000	Q2=Q*100/6	Ae = Q/L	UL = 10* Ae	1
ru (kg/cm²)	Plo=P1+P2+P3 (kg/cm <sup>2</sup> )	re ⊒ro +∪n - Pio (kg/cm²)	(min)	(1)	(Vmin)	(m <sup>3</sup> /s)	(cm <sup>2</sup> /s)	(l/min/m)	UL = Pe	$K = \frac{Q 2}{2 \pi P \epsilon L} \cdot \ln \frac{2 L}{D}$ (cm/s)
1.00	0 00008	4 24	10	5 00	0 50	8 33E-06	8.33	0 10	02	3 06E-06
5 00	0 12238	8 12	10	203 00	20 30	3 38E-04	338 33	4 06	50	6 48E-05
10 00	1 12984	12 11	10	617 00	61 70	1 03E-03	1028 33	12 34	10.2	1 32E-04
5 00	0 35951	7 88	10	348 00	34.80	5 80E-04	580 00	6 96	88	1 14E-04
1.00	0 04208	4.20	10	119 00	11 90	1 98E-04	198 33	2 38	57	7.35E-05
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$			<u>.                                    </u>		$\frac{2 * (Q_2^2) * h}{2}$		L4	$\sum_{i=1}^{n} \alpha * (Q_i)$	<b>ل</b> ــ
	P1= loss load or	n steel pipe		P2= loss loa	io on plastic	pipe			y uniones	ns,
14 12		. <u></u> ,	 	12	11				N UNIT	IT 100 120
10	8 12		$\sim$			GE	00 2.0 ? 02	40 60 	) 80 	-+
Pe (kg/cm <sup>2</sup> )	/	7 8	3			PRESSURE RANGE	3		8.8	10.2
4 424 2	4 20					PAG	5	<b></b>	7	
0 4	· ·	30 00 (l/min	000 50 (		70.00		PERME	ABILITY (LU	l) =	102
Po = 1	Pressure Reading,	Lh = Hydrostatic	: Load, Pio =	Loss Pressu	re 					

# SWISSDORING Swissboring Overseas Corporation Ltd.

					· · · · · · · · · · · · · · · · · · ·				oring Ove		
CLII	ENT: ELEO	CTRIC POWER D	EVELOPMENT	Co.	DATE:	10-diciemb	are-2002		LUGEON T	EST №:	1
PROJECT TOROLA HYDROELECTRIC COMPLEX					SITE:	DAM SIT	E (right mar	gin)	TESTED B	Y ERNESTO	HERRERA
HOLE No.: CDB-3					ELEVATI	ON:	131.6	m.s.l	CHECKED	BY:	Geol.W. Hernánde:
Packe	er type	Neumatic	Length (m) ≈	0,80	<u> </u>	Water pump	Bean F	Royal 535	Flood (I/min) =		
						Test depth	(m) from	10 00	to	15 00	
Test l	angth (cm).		L * Cos X ° =	500 00		Depth of hol	le (m)	15 00		Dip X (?)=	0
Swive	H1 (m)		H1 =	2 50		Diameter of	hole D (cm)	7 5 <b>7</b>	W,L Bet	ore of test (m)=	47
Water I	ievel Ha (m)	47	Ha*CosX° =	4 70		Hydrostatic	load (kg/cm2).	Lh= (Hi+Ha)/	10 =	0 720	
Steel	pipe:	Length (m) =	lt =	11 30	Plastic Pipe :	Length (m)	lm =	5 00	Reducers.	Valv cuopling	0.2
		Diameter $\phi_1$	(m) =	0.0603		Diameter	$\phi_2$ (m) =	0.0254	α	Packer	0 12
		Roughness index	กาี =	0.01		Roughness	index n2	0 008	<u> </u>	Union elbow:	0.008
	RESOURE	LOSS	EFECTIVE	INJECTED	WATER	1	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
	Po	PRESSURE	PRESSURE	TIME t		Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q/L		
c	kg/cm²)	Plo=P1+P2+P3 (kg/cm <sup>2</sup> )	(kg/cm <sup>2</sup> )	(ກາກ)	(I)	(l/min)	(m <sup>3</sup> /s)	(cm <sup>3</sup> /s)	(i/min/m)		$K = \frac{Q 2}{2 \pi Pe L} \cdot \ln \frac{2L}{D}$
		ļ								UL	(cm/s)
	1 00	0.03214	1.69	10	103.00	10.30	1.72E-04	171.67	2.06	12.2	1.58E-04
<u> </u>	5 00	1.05667	4 66	10	591.00	59.10 82.50	9 85E-04	985.00 1375.00	11 82 16.50	25 3 19 1	3.28E-04 2 47E-04
	10.00 5 00	2 05889	8 66	10	825.00 598.00	59.80	1.38E-03 9 97E-04	996.67	11 96	25.8	3 34E-04
	1.00	0.11629	1.60	10	196 00	19.60	3.27E-04	326 67	3.92	24.4	3 17E-04
/cm²)	$P_{2} = \frac{1}{2}$	$\frac{10.34 * (n_1)^2}{(\phi_1^{5})^3}$ P1= loss load on				$\frac{34*(n_2)^2}{(\phi_2)^2}$	Pressure Range		P3= loss load	nd packer GEON UNI	
	2	20 00 ressure Reading,	Q (i/mın)		80 00			PERME	ABILITY (LU	) =	19.1

HOLE No.:       CDB-3       ELEVATION:       131.6       m.s.l       CHECK         Packet type*       Neumatic       Length (m)=       0.80       Water pump       Bean Reyal 535       Flood (linter the text of tex	= 23 00 Dip X (%)= 3efore of test (m): 0 480 Valv cuoplin Packer: Union elbow Luceon Luceon UNIT LUL = <u>10* A</u> Pe	Geol.W. Hernánde: = 0 = 2 3 n( 0.2 0 12
Packer type:       Neumatic       Length (m) =       0.80       Water pump       Bean Royal 535       Flood (//r         Test length (cm).       L* Cos X* =       500.00       Depth of hole (m)*       23.00         Sweel Hir (m):       Hin       =       250       Diameter of hole D (cm)       7.67       With the (m)         Sweel Hir (m):       Hin       =       1970       Plastic Pipe.       Length (m)       Im       5.00       Depth of hole D (cm)       7.67       With the (m)         Steel Dipa:       Length (m) =       It       =       1970       Plastic Pipe.       Length (m) =       5.00       Depth of hole D (cm)       7.67       With the (m)         Diameter Ø, (m)       0.0053       Roughness index       n1       =       0.01       Roughness index       n2       0.008         Pressure       Loss       seterine       messure       rate       vouxet       FLOOD       seterine       seterine         No.00       0.00659       1.47       10       46.00       7.675-05       76.67       0.97         1.00       0.00559       1.47       10       46.00       7.675-04       296.67       3.56         1.000       0.005247       5.43       10 <td>= 23 00 Dip X (%)= 3efore of test (m): 0 480 Valv cuoplin Packer: Union elbow Luceon Luceon UNIT LUL = <u>10* A</u> Pe</td> <td>= 0 = 2 3 nş 0,2 0 12</td>	= 23 00 Dip X (%)= 3efore of test (m): 0 480 Valv cuoplin Packer: Union elbow Luceon Luceon UNIT LUL = <u>10* A</u> Pe	= 0 = 2 3 nş 0,2 0 12
Test depth (m) from         18.00         to the depth (m) from         18.00         Depth of hole (m):         23.00           Sevel H1 (m):         H1 = 2.50         Diameter of hole D (cm)         7.57         VI           Water level H1 (m)         23.00         Diameter of hole D (cm)         7.57         VI           Water level H1 (m)         23.00         Diameter of hole D (cm)         7.57         VI           Steel Dige:         Length (m) = 1         19.00         Diameter of hole D (cm)         7.57         VI           Diameter of hole D (cm)         7.57         VI           Diameter of hole D (cm)         7.57         VI           Diameter of hole D (cm)         1.500         Call depth (m)         Im m = 5.00         Call depth (m)         <	23 00 Dip X (?): 3efore of test (m): 0 480 Valv cuoplin Packer: Union elbow Luozon Luozon Luozon Luozon Luozon Luozon	= 2 3 nç 0.2 0 12
Test length (cm). L * Cos X * = 500.00 Depth of hole (m): 23 00 Sinvel H1 (m): H1 = 250 Diameter of hole D (cm) 7 57 V/1 Water level H2 (m) 23 He * Cos X * = 230 Hydrostatic load (kg/cm2) Lh= (h+Ha)/10 = Steel_DDD: Length (m) = It = 1970 Diameter $\phi_2$ (m) = 0.0254 $\alpha$ Roughness index n1 = 0.06003 Roughness index n2* 0.008 Precision Pressure Pressure Pressure Pressure Numeric Vocume Vocume Proop (kg/cm2) List (kg/cm2) (kg/cm2	Dip X (?): Before of test (m): 0 480 Valv cuoplin Packer: Union elbow Lugeon Lugeon Lugeon Lugeon Lugeon Lugeon	= 2 3 nç 0.2 0 12
Sinval H1 (m): H1 = 250 Diameter of hole D (cm) 757 With the (m) 23 Ha*Cos X° = 230 Hydrostatic load (kg/cm2) Lh= (H+Ha)/10 = Sisej Dipp: Length (m) = it = 1970 Diameter $\phi_1$ (m) = 0.0603 Roughness index n1 = 0.01 Pacesure Pacesure Integration (Mathematic Length (m) Im = 5.00 Roughness index n1 = 0.01 Pacesure Pacesure Integration (Mathematic Length (m) Im = 5.00 Roughness index n1 = 0.01 Pacesure Pacesure Integration (Mathematic Length (m) Im = 5.00 Pacesure Pacesure Integration (Mathematic Length (Length (Leng	Calv cuoplin Packer: Union elbow	= 2 3 nç 0.2 0 12
Weiter level Hz (m)       2.3       Ha*Cos X° = 2.30       Hydrostatic load (kg/cm2)       Lh= (H+Ha)/10       =         Steal pape:       Length (m) =       It       =       1970       Plastic_Eppa.       Length (m)       Im       =       5.00       Reduces         Dameter $\phi_1$ (m)       =       0.0603       Diameter $\phi_2$ (m)       =       0.08         Processing       Procesing       Procesing	0 480 Vaiv cuopin Packer Union elbow	nç 0,2 0 12
Sites       Length (m) =       It       =       19 70       Plastic Pipa. Length (m)       Im       =       500       Peducation         Roughness Index       n1       =       0.0603       Roughness index       n2       0.008       0.008         PRESSURE       Loss       SPECTIVE       INJECTED       WATER       FLOOD       Assort         Roughness Index       n1       =       0.01       Roughness index       n2       0.008         PRESSURE       Loss       SPECTIVE       INJECTED       WATER       FLOOD       Assort         Roughness index       n1       =       0.01       C1=Q/60000       Q2=Q*100/6       Assort         PO       PIo=P1+P2+P3       P2 about (kg/cm2)       (fmm)       (1)       (fmm)       (ms/s)       (fmm/s)         1.00       0.00655       1.47       10       46.00       4.60       7.67E-05       76.67       0.97         5.00       0.026526       10.11       10       245.00       34.50       23.67       2.68         10.00       0.000000       1.48       10       10.00       2.17E-04       216.67       2.68         10.00       0.00000       1.48       10       0	Valv cuoplir Packer Union elbow Luceon UNIT UL = <u>10* A</u> Pe	0 12
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Packer Union elbow Lugeon UL <u>UNIT</u> UL <u>10* A</u> Pe	0 12
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Union elbow Lugeon UNIT UL = <u>10* A</u> Pe	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	LUGEON UNIT UL = <u>10* A</u> Pe	0.008
READING         PRESSURE         PRESSURE         TIME         VOLUME         PLOOD         ABSOPT           Po         Plo=P1+P2+P3         fe =20 +1.b. Plo         t         Qt         Q1=Q401         Q1=Q60000         Q2=Q*100/6         ABSOPT           (kg/cm2)         (kg/cm2)         (kg/cm2)         (kg/cm2)         (mun)         (1)         (//min)         (m=9/s)         (//min)           1.00         0.00659         1.47         10         46.00         4.60         7.67E-05         76.67         0.93           5.00         0.036926         10.11         10         345.00         34.50         5.75.00         6.93           5.00         0.05247         5.43         10         130.00         13.00         2.17E-04         216.67         2.60           1.00         0.00000         1.48         10         0.00         0.00         0.00         0.00         0.00           1.00         0.00000         1.48         10         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00	UNIT	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	UL = <u>10* A</u> Pe	PERMEABILITY
$\frac{(kg/cm^2)}{(kg/cm^2)} \frac{(kg/cm^2)}{(kg/cm^2)} \frac{(kg/cm^2)}{(kg/cm^2)} \frac{(mn)}{(kg/cm^2)} \frac{(mn)}{(mn)} \frac{(1)}{(1)} \frac{(mn)}{(mn)} \frac{(m^2/s)}{(m^2/s)} \frac{(mn^2/s)}{(mn)} \frac{(m^2/s)}{(mn)} (mn$		COEFICIENT
$\frac{100}{100} = 100000000000000000000000000000000$	F 134	$\frac{Q}{2\pi Pc} = \frac{Q^2}{2\pi Pc} + \ln \frac{2L}{D}$
$\frac{5 00}{10.00} = \frac{0.9834}{0.36926} = \frac{5.38}{10.11} = \frac{10}{10} = \frac{10.34 * (n_1)^2 * (Q_1^{-2}) * lt}{(\phi_1^{-533})} = \frac{10}{10} = \frac{10.34 * (n_1)^2 * (Q_1^{-2}) * lt}{(\phi_2^{-533})} = \frac{10}{10} = \frac{10.34 * (n_2)^2 * (Q_2^{-2}) * lm}{(\phi_2^{-533})} = \frac{10}{10} = \frac{10}{$		(cm/s)
$\frac{10,00}{5,00} = 0.36926 = 10.11 = 10 = 345.06 = 34.50 = 575E.04 = 575.00 = 6.94 = 575.00 = 6.94 = 575.00 = 6.94 = 575.00 = 6.94 = 575.00 = 6.94 = 575.00 = 6.94 = 575.00 = 6.94 = 575.00 = 0.00 = 10.00 = 10.00 = 10.00 = 10.00 = 0.00$	62	8.09E-05 8 57E-05
$\frac{100}{0.0000} \frac{148}{148} \frac{10}{10} \frac{000}{000} \frac{000}{000} \frac{00000}{0000} \frac{000}{000}$	68	8.84E-05
$TOTAL LOSS LOAD$ $Pc = Pc_{1} + Pc_{2} + Pc_{3}$ $P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{2}) * 1t}{(\phi_{1}^{5.33})}$ $P_{2} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * 1m}{(\phi_{2}^{-5.33})}$ $P_{1} = loss load on steel pipe$ $P_{2} = loss load on plastic pipe$ $P_{3} = loss val$ $VALUES OF$ $Q_{1} = \frac{10}{10} + \frac{10}{10$	48	6.21E-05
$Pc = Pc_{1} + Pc_{2} + Pc_{3}$ $P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{2}) * 1t}{(\phi_{1}^{5.33})}$ $P_{2} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * 1m}{(\phi_{2}^{5.33})}$ $P_{2} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * 1m}{(\phi_{2}^{5.33})}$ $P_{3} = loss$ $P_{4} = loss load on steel pipe$ $P_{2} = loss load on plastic pipe$ $P_{3} = loss$ $VALUES OF$ $Q_{1} = \frac{10 + 10}{10}$ $Q_{2} = \frac{10 + 10}{10}$ $Q_{3} = \frac{10 + 20}{10}$	0.0	0 00E+00
10 11 10 11 0.0 10 2.0 3.0	$= \sum \alpha * (Q)$ ad on couplings s and packer	ł
	++	62
		6.6
		68
2 5 38 6 4 4 5 43 5 4 5 4 5 4 5 4 5 4 5 4 5 4 5 4	48	
2		
		6.8
0 00 5.00 10 00 15 00 20 00 25 00 30 00 35 00 40 00 Q ()/min)	LU) =	

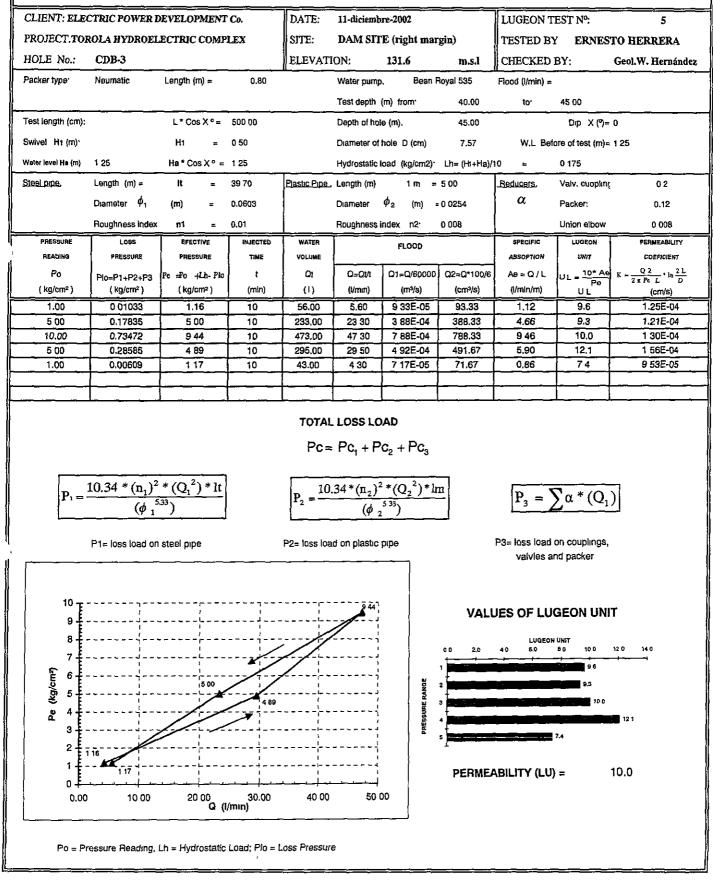
## swissbering

CLIENT E	LECTRIC POWER I	DEVELOPMENT	'Co.	DATE.	11-diciemt	ore-2002		LUGEON T	EST №:	3
PROJECT:	FOROLA HYDROEL	ECTRIC COMP	LEX	SITE:	DAM SIT	E (right mai	rgin)	TESTED BY	Y ERNE	STO HERRERA
HOLE No.	CDB-3			ELEVATI	ION:	131.6	m.s.l	CHECKED	BY.	Geol.W. Hernánd
Packer type:	Neumatic	Length (m) =	0 80		Water pum	o Bean	Royal 535	Flood (I/min) =		
					Test depth	(m) from,	26 00	to	31 00	
Test length (c	:m).	L*CosX°≓	500 00		Depth of ho	le (m).	31 00		Dip X (%)=	0
Swivel H1 (m	1)	H1 =	2 00		Diameter of	hole D (cm).	7 57	WL Bef	ore of test (m)=	1 15
Water level Ha (	m) 115	Ha*CosX° =	1 15		Hydrostatic	load (kg/cm2)	Lh= (Hi+Ha)/	10 =	0 315	
Steel pipe.	Length (m) =	lt =	27 20	Plastic Pipe .	Length (m)	im =	5.00	Reducers.	Valvie, cuoplings	0.2
	Diameter $\phi_1$	(m) =	0.0603	1	Diameter	$\phi_2$ (m)	≈ 0 0254	α	Packer:	0 12
	Roughness index	n1 =	0 01		Roughness	index n2;	0.008		Union elbow:	Q.008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	1	FLOOD	<u> </u>	SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME		,	<del>,</del>	ABSOPTION	UNIT	COEFICIENT
Po	, Plo=P1+P2+P3	Pe =Po +Lh-Plo	t	Cit	Q=Ct/t	Q1=Q/60000		Ae=Q/L	UL = <u>10* Ae</u> Pe	$K = \frac{Q 2}{2 \pi P c L} * \ln \frac{2L}{D}$
( kg/cm <sup>2</sup> )		( kg/cm² )	(min)	(1)	(l/min)	(m³/s)	(cm <sup>3</sup> /s)	(l/min/m)	UL	(cm/s)
1.00	0.00535	1.31 5.29	10	41.00 95.00	4 10 9 50	6 83E-05	68.33 158 33	0.82	6.3 3.6	8.11E-05 4.66E-05
10 00	0 15631	10.16	10	222.00	22 20	3.70E-04	370 00	4 44	4.4	5.66E-05
5.00	0.02572	5.29	10	90.00	9 00	1.50E-04	150.00	1.80	34	4 41E-05
1.00	0.00000	1 32	10	0.00	0.00	0.00E+00	0 00	0.00	0.0	0.00E+00
	$= \frac{10.34 * (n_1)^2}{(\phi_1^{-5})^2}$			$P_2 =$ P2= loss loa		<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*1 <sup>5.33</sup> ) pipe		P3= loss load	$\sum \alpha * (Q_1)$ on couplings, nd packer	<u>/</u>
12 <del>-</del> 10 <del>-</del> -					016		VAL	ues of Lu	GEON UNI	T
8								LUGEO	10000 4050	60 70
Pe (kg/cm <sup>3</sup> )		5,29				PRESSURE RANGE	2 000 3 000 4 000 5 00		 44 4	
2	1 32 <b>4</b>			4	 		PERME	ABILITY (LU)	) =	4.4
0.00	5.00	10.00 <b>Q (I/m</b> m	15 00 )	20.00	25.00					

## swissbering

PRESSURE         PRI           READING         PRI           P <sup>3</sup> D         Plo=P <sup>3</sup> (kg/cm <sup>2</sup> )         (kg           1.00         0 (           5.00         0 (           10.00         0 (           5.00         0 (	3 tic Length (m L*Cos H1 Ha*Cos (m) = it	) = 0 80 X ° = 500.00 = 0 00 X ° = 1.20 = 35 20 = 0 0603 = 0 01 TVE INJECTE URE TIME Lb- Plo 1 m <sup>2</sup> ) (min) 2 10	Plastic Pipe D WATER VOLUME Q1	ON: Water pump Test depth Depth of hol Diameter of Hydrostatic Length (m)	(m) from e (m): hole D (cm): load (kg/cm2): im = $\phi_2$ (m) =	m.s.l toyal 535 31.00 36.00 7 57 Lh= (H1+Ha)/ 5 00	CHECKED I Flood (//min) = to. W L Befo		1 2 D 2 0 12 0 008
Packer type. Neuman Test length (cm)· Swivel H1 (m)· Water level Ha (m) 12 Steel pipe: Length Diamete Readina Pai Pac Plo=Pr (kg/cm²) (kg 1.00 0 0 0 5.00 0 0	tic Length (m) L * Cos H1 Ha * Cos (m) = it er $\phi_1$ (m) ress index n1 Loss Erect ersure Pressi 1+P2+P3 Pe $\Rightarrow 0$ $\Rightarrow 1$ g/cm <sup>2</sup> ) (kg/cr 20084 1.12 20630 5.1 22347 10 1 20000 5 12	X ° = 500.00 = 0 00 = 35 20 = 0 0603 = 0 01 TVE INJECTE URE TIME Lb- Plo 1 m <sup>2</sup> ) (min) 2 10	D WATER VOLUME Ct	Water pump Test depth Depth of hol Diameter of Hydrostatic Length (m) Diameter Roughness	Bean R           (m) from           e (m)*           hole D (cm)*           ioad (kg/cm2)*           Im =           \$\$\phi_2\$ (m) =           index n2.	Royal 535 31.00 36.00 7 57 Lh= (H+Ha)/: 5 00 0 0254	Flood (I/min) = to. W L Befo 0 = <u>Reducers:</u> <i>C</i>	36 00 Dip X (9)≠ ore of test (m)= 0 120 Vatv. cuopling Packer. Union elbow	0 12 02 012 0008
Test length (cm) Swivel H1 (m) Water level Ha (m) 12 Steel pipe: Length Diametr Roughr PRESSURE READING PRI PO Pto=Pr (kg/cm²) (kg 1.00 0 ( 5.00 0 ( 5.00 0 (	L * Cos H1 Ha * Cos (m) = 11 er $\phi_1$ (m) tess index n1 Loss EFECT ESSURE PRESSI 1+P2+P3 Pe $\pm 0$ $\pm 1$ g/cm <sup>2</sup> ) (kg/cr 20084 1.11 200630 5.1 22347 10 1 20000 5 11	X ° = 500.00 = 0 00 = 35 20 = 0 0603 = 0 01 TVE INJECTE URE TIME Lb- Plo 1 m <sup>2</sup> ) (min) 2 10	Plastic Pipe D WATER VOLUME Q1	Test depth Depth of hol Diameter of Hydrostatic Length (m) Diameter Roughness	(m) from le (m) <sup>,</sup> hole D (cm) <sup>,</sup> load (kg/cm2) <sup>,</sup> im = $\phi_2$ (m) = index n2,	31.00 36.00 7 57 Lh= (H+Ha)/ 5 00 0 0254	to. W L Befo 10 = <u>Reducers:</u> $\alpha$	Dip X (9≄ ore of test (m)≈ 0 120 Valv. cuopling Packer. Union elbow	1 2 D 2 0 12 0 008
Swivel H1 (m)           Water level Ha (m)         1 2           Stepl pip8:         Length           Diametric         Diametric           Reading         Price           PRESSURE         Price           READING         Price           Po         Pto=Price           (kg/cm²)         (kg           1.00         0 (c)           5.00         0 (c)	H1 Ha * Cos (m) = it er $\phi_1$ (m) tess index n1 tess index n1 tess index n1 tess index n1 tess index n1 tess index n1 (kg/cr 20084 1.11 200630 5.1 22347 10 1 200000 5 11	= 0 00 X <sup>o</sup> = 1.20 = 35 20 = 0 0603 = 0 01 TVE INJECTE URE TIME Lb- Plo 1 m <sup>2</sup> ) (min) 2 10	D WATER VOLUME Qt	Depth of hol Diameter of Hydrostatic Length (m) Diameter Roughness	ie (m) <sup>,</sup> hole D (cm) <sup>,</sup> ioad (kg/cm2) <sup>,</sup> im = $\phi_2$ (m) = index n2,	36.00 7 57 Lh= (H+Ha)/ 5 00 0 0254	₩LBefc 0 = _ <u>Reducers:</u> α	Dip X (9≄ ore of test (m)≈ 0 120 Valv. cuopling Packer. Union elbow	1 2 D 2 0 12 0 008
Swivel H1 (m)           Water level Ha (m)         1 2           Stepl pipB:         Length           Diametric         Diametric           READING         PRESSURE           READING         PROUGHT           Po         Pto=Pt           (kg/cm²)         (kg           1.00         0 (           5.00         0 (           5.00         0 (	H1 Ha * Cos (m) = it er $\phi_1$ (m) tess index n1 tess index n1 tess index n1 tess index n1 tess index n1 tess index n1 (kg/cr 20084 1.11 200630 5.1 22347 10 1 200000 5 11	= 0 00 X <sup>o</sup> = 1.20 = 35 20 = 0 0603 = 0 01 TVE INJECTE URE TIME Lb- Plo 1 m <sup>2</sup> ) (min) 2 10	D WATER VOLUME Qt	Diameter of Hydrostatic Length (m) Diameter Roughness	hole D (cm) load (kg/cm2) )m = \$\$2 (m) = index n2.	7 57 Lh= (Hi+Ha)/ 5 00 0 0254	0 = <u>Reducers:</u> α	ore of test (m)≠ 0 120 Valv. cuopling Packer. Union elbow	1 2 D 2 0 12 0 008
Water level Ha (m)         1.2           Steel pipe:         Length           Diameter         Diameter           Roughr         PRESSURE           READING         PRE           P0         Pto=P'           ( kg/cm² )         ( kg           1.00         0 (           5.00         0 (           5.00         0 (	Ha * Cos           (m) =         it           er $\phi_1$ (m)           bess index         n1           Loss         EFECT           cssure         Pressing           1+P2+P3         Pe = Po +1           g/cm <sup>2</sup> )         (kg/cr           D0084         1.12           D0630         5.1           D2347         10 f	X <sup>o</sup> = 1.20 = 35 20 = 0.0603 = 0.01 INJECTE TIME ILb-Plo t m <sup>2</sup> ) 2 10	D WATER VOLUME Qt	Hydrostatic Length (m) Diameter Roughness	load (kg/cm2) Im = $\phi_2$ (m) = index n2.	Lh= (Hi+Ha)/: 5 00 :0 0254	0 = <u>Reducers:</u> α	0 120 Valv. cuopling Packer, Union elbow	D 2 0 12 0 008
Steel pipe:         Length           Diametric         Diametric           Reading         Price           Po         Pto=Price           (kg/cm²)         (kg/cm²)           1.00         0 (construction)           1000         0 (construction)           5,00         0 (construction)	(m) =     ii       er $\phi_1$ (m)       ness index     n1       Loss     EFECT       essure     PRESSI       1+P2+P3     Pe = 0 +1       g/cm²)     (kg/cr       200630     5.1       202347     10 1       20000     5.1	= 35 20 = 0 0603 = 0 01 IVE INJECTE URE TIME Lb- Plo 1 m <sup>2</sup> ) (min) 2 10	D WATER VOLUME Qt	Length (m) Diameter Roughness	ìm = ∲2 (m) = index n2,	5 00 0 0254	<u>Reducers:</u> α	Valv. cuopiing Packer. Union elbow	0 12 0 008
Diamete Roughr PRESSURE READING PD Pto=P ( kg/cm <sup>2</sup> ) ( kg 1.00 0 ( 5.00 0 ( 10 00 0 ( 5.00 0 (	er ∲1 (m) Ness index n1 Loss EFECT Essure Pressi 1+P2+P3 Pe ⊉o H g/cm²) (kg/cr 20084 1.12 20630 5.1 22347 10 1 20000 5 12	= 0.0603 = 0.01 TVE INJECTE TIME TIME t.b-Plo t tm²) (min) 2 10	D WATER VOLUME Qt	Diameter Roughness	∲2 (m) = index n2.	0 0254	α	Packer. Union elbow	0 12 0 008
PRESSURE         PRESSURE           READING         PRI           Po         Pto=P*           (kg/cm²)         (kg           1.00         0 0           5.00         0 0           5.00         0 0	Ness index         n1           Loss         EFECT           Essure         PRESSI           1+P2+P3         Pe ⊉o +1           g/cm²)         (kg/cr           00084         1.12           00630         5.1           02347         10 1           00000         5 12	= 0.01 IVE INJECTE URE TIME Lb-Plo t m <sup>2</sup> ) (min) 2 10	VOLUME Q1	Roughness	index n2.			Union elbow	0 008
PRESSURE         PRI           READING         PRI           P0         Pto=P'           (kg/cm²)         (kg           1.00         0 (           5.00         0 (           10.00         0 (           5.00         0 (           5.00         0 (	Loss EFECT ESSURE PRESSI 1+P2+P3 Pe ⊉o +3 g/cm²) (kg/cr 20084 1.12 20084 5.1 22347 10 1 20000 5 12	rve injecte use time (Lh-Pio t m²) (min) 2 10	VOLUME Q1			0 008	SPECIFIC		
READING         PRI           Po         Pto=P'           (kg/cm²)         (kg           1.00         0 (           5.00         0 (           10.00         0 (           5.00         0 (           5.00         0 (	ESSURE         PRESSI           1+P2+P3         Pe ⊉o H           g/cm²)         (kg/cr           00084         1.11           00630         5.1           02347         10 1           00000         5.1	ияе пме Lb-Plo t m²) (min) 2 10	VOLUME Q1		FLOOD		SPECIFIC	LUGEON	
Po         Pto=Pto           (kg/cm²)         (kg           1.00         0 (           5.00         0 (           10.00         0 (           5.00         0 (	1+P2+P3         Pe ≠o +i           g/cm²)         (kg/cr           00084         1.11           00630         5.1           02347         10.1           00000         5.1	Lh-Plo t m²) (min) 2 10	Cr	Q=Q1/t			ABSOPTION	UNIT	COEFICIENT
(kg/cm²) (kg 1.00 0 ( 5.00 0 ( 10.00 0 ( 5.00 0 ( 5.00 0 (	g/cm <sup>2</sup> ) (kg/cr 20084 1.12 200630 5.1 22347 10 1 20000 5 12	m²) (min) 2 10			Q1=Q/60000	Q2=Q*100/6		1	
1.00         0 (           5.00         0 (           10.00         0 (           5.00         0 (           5.00         0 (	00084         1.12           00630         5.1           02347         10 1           00000         5 12	2 10		(i/min)	(m³/s)	(cm³/s)	(l/min/m)	UL=Pe UL	$K = \frac{Q 2}{2 \pi P e L} * \ln \frac{2 L}{D}$ (CITI/S)
10 00 0 0 5.00 0 0	02347 10 1 00000 5 12	1 10	16 00	1 60	2.67E-05	26 67	0 32	29	3.70E-05
5.00 0 0	00000 5 1		44 00	4 40	7 33E-05	73,33	0.88	17	2.23E-05
			85 00	8 50	1.42E-04 0.00E+00	141 <u>67</u> 0 <i>0</i> 0	1 70 0.00	<u> </u>	2,18E-05 0 00E+00
			0.00	0.00	0.00E+00	00.00	0.00	00	0 00E+00
• <u>,</u>	$\frac{*(n_{1})^{2}*(Q_{1}^{2})}{(\phi_{1}^{5.33})}$ ss load on steel pipe		<u></u>	$(\phi)$ ad on plastic	<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*li <sup>533</sup> ) pipe		P3= loss load		
12			10 10			<b>VAL</b>			<b>17</b> 30 36
8 6 5 12					RANGE				₹₽
4					PRESSURE RANGE	4 00 5 00	/		
0				ا است.		PERME	ABILITY (LU	) =	1.7
0 00 2 0 Po = Pressure	00 4.00 0 Reading; Lh = Hyd	(I/min) <sup>6.00</sup>	8 00 lo = Loss Pressu	10 00 ire.		-			

## swissbering



## swissbering

CLUDY L. BLU	CTRIC POWER D	EVELOPMENT	Co.	DATE:	12-diciemb	TE-2002		LUGEON T	EST Nº	6
	ROLA HYDROEL			SITE:		E (right mar)	gin)	TESTED BY		TO ALVARADO
HOLE No.:	CDB-3			ELEVATI		131.6	m.s.l	CHECKED		Geol.W. Hernández
Packør type	Neumatic	Length (m) =	0.80	II	Water pump		loyal 535	Flood (i/min) =		
		• • •			Test depth	(m) from·	45 00	to	50 00	
Test length (cm):		L * Cos X *=	500 00	<u></u>	Depth of hol		50.00		Dip X (°)=	0
Swivel Ht (m)		H1 =	0 50		Diameter of	hole D (cm)	7 57	WL Bef	ore of test (m)=	
Water level Ha (m)	1	Ha * Cos X ° =	1.00		Hydrostatic	load (kg/cm2)	Lh= (H1+Ha)/		0 150	
Steel pipe,	Length (m) =	 It =	44.70	Plastic Pipe		im =		Reducers,	Valv cuopling	02
· · · ·	Diameter $\phi_1$	(m) =	0 0603			¢₂ (m) ≠	0 0254	α	Packer	0 12
	Roughness index	n1 =	0 01		Roughness	index n2:	0 008		Union elbow	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	RSTAW		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME			·	ABSOPTION	UNIT	COEFICIENT
Po	Pio=Pt+P2+P3	Pe =Po +Lh-Plo		Ct	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	AØ=Q/L	$UL = \frac{10^* \text{Ae}}{\text{Pe}}$	$K = \frac{Q 2}{2 \pi P \epsilon L} = \ln \frac{2 L}{D}$
(kg/cm²)	(kg/cm <sup>2</sup> )	( kg/cm <sup>2</sup> )	(min)	(1)	(i/min)	(m <sup>9</sup> /s)	(cm³/s)	(i/min/m)		(cm/s)
<u>1 00</u>	0.00177	1 15 5.12	10	23.00	2.30 8.80	3.83E-05	38 33 146.67	0 46	4.0	5.19E-05 4 45E-05
10.00	0.19184	9 96	10	240.00	24.00	4.00E-04	400 00	4 80	48	6 24E-05
5.00	0 01635	5.13	10	70.00	7.00	1 17E-04	116.67	1.40	27	3 53E-05
1.00	0 00097	1.15	10	17.00	1.70	2.83E-05	28.33	0.34	30	3.83E-05
	10.34 * (n.) <sup>2</sup>	$*(0^2)*$ lt	]	Pc=		<sup>2</sup> c <sub>2</sub> + Pc <sub>3</sub>		·		-
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1^{-5})^2}$		]	$Pc = \frac{10}{P_2} = \frac{10}{2}$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5}}$	a I	L 4	$\sum \alpha * (Q_1$	
	$\frac{10.34 * (n_1)^2}{(\phi_1^5)^5}$ P1= loss load on		]	Pc=	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5}}$	m	P3= loss load		
12 T			]	$Pc = \frac{10}{P_2} = \frac{10}{2}$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5}}$		P3= loss load	on couplings, ind packer	
			]	$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5}}$	VAL	P3= loss load valvies a UES OF LU	on couplings, ind packer GEON UN	ш
12				$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5}}$		P3≃ loss load valvies a	on couplings, ind packer GEON UN	
12				$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * b}{2^{5}}$ pipe	VAL	P3= loss load valvies a UES OF LU	on couplings, ind packer GEON UN N UNIT 40	ш
12				$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * b}{2^{5}}$ pipe	VAL	P3= loss load valvies a UES OF LU	on couplings, ind packer GEON UN N UNIT 40	ш
12 10 8 6	P1= loss load on			$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * b}{2^{5}}$ pipe	VAL	P3≃ loss load valvies a UES OF LU	on couplings, ind packer GEON UN 40 40	 IT ₅0 €0 →
12 10 8 6 8 8 8 8	P1= loss load on			$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5}}$	VAL	P3≃ loss load valvies a UES OF LU	on couplings, ind packer GEON UN N UNIT 40	 IT ₅0 €0 →
12 10 8 6 6 6 2 2	P1= loss load on			$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * b}{2^{5}}$ pipe	VAL	P3≃ loss load valvies a UES OF LU	on couplings, ind packer GEON UN 40 40 34	 IT ₅0 €0 →
12 10 10 Be 6 6 6 1	P1= loss load on		20 00	$Pc = \frac{10}{P_2 = 10}$ $P2 = loss loa$	$\frac{Pc_1 + P}{.34^*(n_2)}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * b}{2^{5}}$ pipe	VAL	P3= loss load valvies a UES OF LU LUGEO 20 30	on couplings, ind packer GEON UN 40 40 34	LT 50 60 
12 10 8 6 6 2 2 2 2	P1= loss load on	1 steel pipe	20 00	$Pc =$ $P_2 = \frac{10}{9.96}$ $9.96$	Pc <sub>1</sub> + F	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * b}{2^{5}}$ pipe	VAL	P3= loss load valvies a UES OF LU LUGEO 20 30	on couplings, ind packer GEON UN 40 40 34	LT 50 60 

# SWISSDORING Swissboring Overseas Corporation Ltd.

AT 112 NOT - THE T	CTRNC RANGE									
	CTRIC POWER D			DATE:	22-noviem		• 、	LUGEON T		1
	ROLA HYDROEL	ECTRIC COMP.	LEX	SITE:		E (right mar	gin)	TESTED B		A, Cortéz
HOLE No.:	CDB-4			ELEVATI		211.99	m.s.l	CHECKED	BY:	Geol.W. Hernánde
Packer type	Neumatic	Length (m) =	0.80		Water pump		loyal 535	Flood (l/min) =		
			<u> </u>		Test depth		15.00	to;	22 00	
Test length (cm).		L*CosX°=			Depth of hol		22.00		Dip X (°)=	
Swivel Ht (m)		Ht =	1 10		Hole Diame	. ,	7 57		fore of test (m)=	18 5
Water level Ha (m)	18.5	Ha*CosX° =		<u>_</u>		load (kg/cm2)	<u> </u>		1.960	
<u>Steel pipe</u> ,	Length (m) =	lt =	14.70	Plastic Pipe :		lm =		Beducers.	Valv cuopling	
	Diameter $\phi_1$	(m) =	0.0603	1		φ <sub>2</sub> (m) =		α	Packer	0 12
PRESSURE	Roughness index	n1 = EFECTIVE	0 01	WATER	Roughness I	ndex n2	0 008	SPECIFIC	Union elbow.	0 008 PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME	1 	FLOOD		ABSOPTION	LUGEON UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe Ro ALh-Plo	t	Qt	Q=Qt/t	Q1=Q/60000	Q2≈Q*100/6	Ae=Q/L	$UL = \frac{10*Ae}{2}$	$K = \frac{O 2}{2 \pi P c L} = \ln \frac{2L}{D}$
( kg/cm <sup>2</sup> )	(kg/cm²)	(kg/cm²)	(min)	(1)	(Vmm)	(m³/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1.00	0 44839	2.51	10	383.00	38.30	6.38E-04	638.33	5.47	218	3.02E-04
5.00	1 12976	5 83	10	608.00	60.80	1 01E-03	1013 33	8.69	14.9	2 06E-04
10 00	2.40429	9 56	10	887 00	88.70	1.48E-03	1478 33	12.67	13 3	1 84E-04
5 00	1 01399	5 95	10	576 00	57.60	9.60E-04	960 00	8.23	13.8	1.92E-04
1 00	0 34306	2.62	10	335.00	33 50	5 58E-04	558 33	4 79	183	2 53E-04
$P_1 =$	$\frac{10.34 * (n_1)^2}{(\phi_1^{-5})^5}$ P1= loss load on			$P_2 = \frac{10}{1000000000000000000000000000000000$		<sup>2</sup> * (Q <sub>2</sub> <sup>2</sup> ) * lr <sup>5 33</sup> ) pipe	—	P3= loss load	$\sum \alpha * (Q_1)$ on couplings, and packer	
12 10 8										
be (kg/cm <sup>2</sup> )		2 51-	5 83 5 93 5 95			PRESSURE RANGE	2 3 4 5 PERMEA	ABILITY (LU)	14.9 13.3 13.8 (13.8 (13.8) 18.3	13.3
0 00	20 00	40 00 Q (I/mi)	60 00	80.00	100 00					

# SWISSDORING Swissboring Overseas Corporation Ltd.

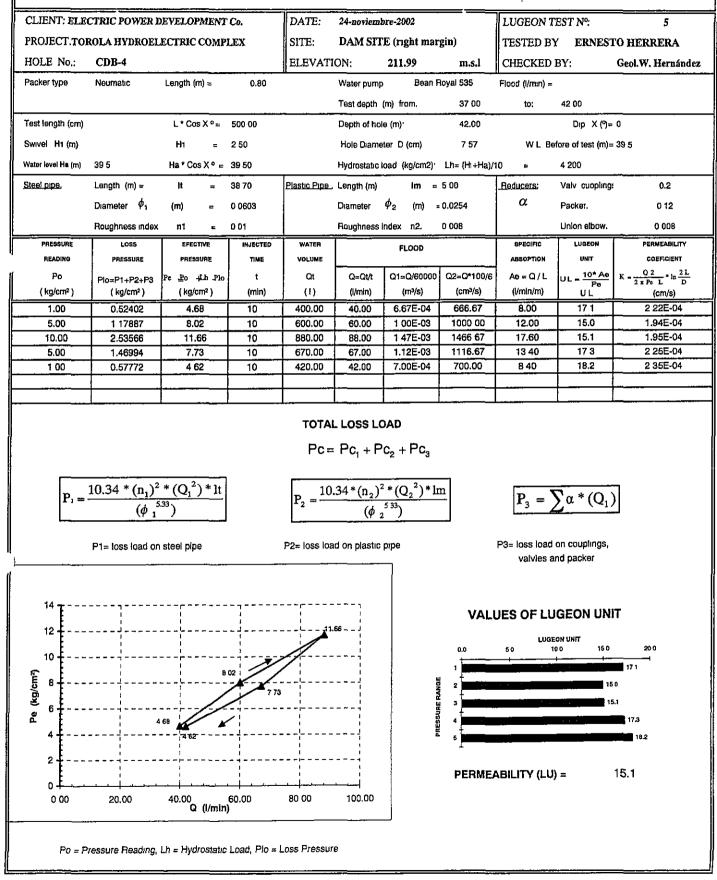
CLIE	NT ELE	CTRIC POWER D	EVELOPMENT	Co	DATE:	23-noviem	bre-2002		LUGEON T	EST Nº:	2
PROJ	ECT:TO	ROLA HYDROEL	ECTRIC COMP	LEX	SITE:	DAM SIT	E (right mar)	gin)	TESTED BY	č:	Julio Rivera
HOL	E No.:	CDB-4			ELEVATI	ON	211.99	m.s.l	CHECKED	BY:	Geol.W. Hernánde
Packe	r type <sup>.</sup>	Neumatic	Length (m) =	0 80		Water pump	: Bean F	loyal 535	Flood (l/min) =		
						Test depth	(m) from	22.00	to:	27 00	
Test le	angth (cm).		L*CosX°=	500 00		Depth of ho	le (m) <sup>.</sup>	27,00		 Dnp X(ໆ⊧	0
Swivel	H1 (m):		Ht =	1 10		Hole Diame	eter D (cm).	7 57	W.L Be	fore of test (m)=	= 22 5
Water le	evel Ha (m)	22,5	Ha * Cos X ° =	22 50		Hydrostatic	load (kg/cm2).	Lh= (Hi+Ha)/	10 =	2 360	
Steel ;	<u>жрө;</u>	Length (m) =	= #	22 30	Plastic Pipe .	Length (m)	<u>ا</u> س =	5 00	Beducers.	Valv cuopling	\$ D2
		Diameter $\phi_1$	(m) =	0 0603		Diameter	φ <sub>2</sub> (m) ≖	0 0254	α	Packer <sup>.</sup>	0 12
	_	Roughness index	n1 =	D 01		Roughness	index n2	0.008		Union elbow	0 008
PI	RESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
F	EADING	PRESSURE	PRESSURE	TIME	VOLUME		<u> </u>		ABSOPTION	UNIT	
	Po	Plo=P1+P2+P3	Pe Po Ah Plo	( t		Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q / L (I/min/m)		$X = \frac{Q 2}{2 \pi P c L} \ln \frac{2 L}{D}$
	(g/cm²)	( kg/cm <sup>2</sup> ) 0.69045	(kg/cm²) 2 67	(min) 10	(1)	(l/m/n) 47.00	(m³/s) 7 83E-04	(cm³/s) 783 33	(/m///m) 9 40	UL 35.2	(cm/s) 4 56E-04
	5.00	1.12513	6 23	10	600.00	60.00	1 00E-03	1000 00	12 00	19.2	2 49E-04
	10 00	2.02517	10.33	10	805.00	80.50	1 34E-03	1341 67	16 10	15.6	2 02E-04
	5 00	1.02259	6 34	10	572.00	57.20	9.53E-04	953.33	11.44	181	2 34E-04
	1.00	0.47544	2.68	10	390.00	39.00	6.50E-04	650 00	7.80	27 0	3.50E-04
	P <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1)^5}$			$P_2 = \frac{10}{1000000000000000000000000000000000$		<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*li <sup>5 33</sup> ) pipe		P3= loss load	• •	)
	12		•••					VAL	valvies a	and packer JGEON UN	ІІТ
	10	·			/					EON UNIT	
_	8	   	   	/		,   		0.0 50	100 150	26,0   25 0   30 0 +	350 400
Pe (kg/cm²)	Į	1	6 23	Y	1 1 1	   1	:			19,2	352
(kg/	6	d		<u>634</u>					15 6		
å	Į	   		/ : ;		J				18 1	
	1	2.0	2 67	1	1	1	1	5		27.0	
	2	· <b></b>						r			
	ŧ	1	1 1 1	) }	1	1 1		PERME	ABIL!TY (LU	J) =	15.6
	0 00 0 00	20 00	40 00 Q (l/mir	60 00 1)	80 00	100.00				-	
	0 <del></del> 0 0 00	20 00 Pressure Reading,	40 00 Q (l/mir	60 00				PERME	ABILİTY (LL	ו) ≠	15.6

## swissbering

	Doridoron Dir	DEVELOPMENT	Co.	DATE:	23-noviem	bre-2002		LUGEON T	EST №.	3
PROJECT:T	OROLA HYDROEL	ECTRIC COMP	LEX	SITE:	DAM SIT	E (right mai	gia)	TESTED BY	Y JULIO I	RIVERA
HOLE No .:	CDB-4			ELEVATI	ON:	211.99	m.s.l	CHECKED	BY:	Geol.W. Hernánd
Packer type	Neumatic	Length (m) =	0 80		Water pump	). Bean l	Royal 535	Flood (I/min) =		·
					Test depth	(m) from	27 00	to <sup>.</sup>	32 00	
Test length (crr	n).	L * Cos X º =	500 00		Depth of ho	le (m).	32 00		D⊮p X(″)=	0
Swivel H1 (m)		H1 =	2 50		Hole Diame	ater D (cm)	7 57	WL Be	fore of test (m)=	29 5
Water level Ha (m	) 29.5	Ha*CosX°=	29.50		Hydrostatic	load (kg/cm2):	Lh≖ (Hi+Ha)/	10 =	3.200	
Steel pipe;	Length (m) =	it =	28.70	Plastic Pipe .	Length (m)	lm =	5 00	Reducers.	Valv cuopling	: 0.2
	Diameter $\phi_1$	(m) =	0 0603	}	Drameter	$\phi_2$ (m)	0 0254	α	Packer.	0 12
	Roughness index	nt =	0.01	}	Roughness	ındex n2.	0.008		Union elbow	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME	<u> </u>		r	ABSOPTION	UNIT	
Po (ko/cm²)	Plo=P1+P2+P3 (ka/cm3)	Pe <u>Po</u> 4Lh Plo			Q=Qt/t (l/min)	Q1=Q/60000		Ae = Q / L (l/min/m)	UL = 10* As Pe	LAREL U
(kg/cm <sup>2</sup> )	(kg/cm <sup>2</sup> ) 0.89431	(kg/cm <sup>2</sup> ) 3.31	(min) 10	(1)	(/min) 53 00	(m³/s) 8.83E-04	(cm³/s) 883.33	10.60	UL 32.1	(cm/s) 4.15E-04
5.00	1 65031	6 55	10	720.00	72.00	1 20E-03	1200.00	14.40	22.0	2 85E-04
10.00	3.18326	10 02	10	1000.00	100 00	1.67E-03	1666.67	20.00	20 0	2 59E-04
5.00	0 50945	7.05	10	600.00	60.00 40.00	1 00E-03 6.67E-04	1000.00	12.00 8 00	17.0	2.20E-04 2 81E-04
1.00						0.072-04			<u> </u>	<u> </u>
	$\frac{10.34 * (n_1)^2}{(\phi_1^5)^2}$			$P_2 =$		<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*b <sup>5 33</sup> ) pipe		P3= loss load		<u> </u>
								valvies a	nd packer	
12 <del>-</del>		<b>r</b> 1     1					VALU	jes of Lu	geon uni	IT
10				10.02			VALU			30,0 350
10		7 05	A6 551 T	10 02			00 50 1	LUGE	ON UNIT 20.0 25.0	30,0 350
10		7 05	<b>K</b> 6 551 <b>A</b>	10.02		Settor Bandar	00 50 1	LUGE	ON UNIT 20.0 25.0	30,0 350
10	369		A6 551 T	10.02		ODFSALIDE DANNE	00 50 1	LUGE	20.0 25.0 20.0 25.0 20.0 25.0 20.0 20.0	30,0 350
10	3 69	7 05	¥6 55 J	10 02		OPESSALIDE & AMAGE	00 50 1	LUGE	20.0 25.0 20.0 25.0 20.0 25.0 20.	30,0 350
	3 69		<b>1</b> € 551	10.02		BDFSGLIDE DANGE		LUGE	20.0 25.0 20.0 25.0 20.0 20.0 20.0 17 D 21 7	30,0 350
Pe (kg/cm <sup>2</sup> )			80.00	100.00		ODESCIDE DAMAG		LUGE 100 15.0	20.0 25.0 20.0 25.0 20.0 20.0 20.0 17 D 21 7	30,0 350 
He (kg/cm <sup>2</sup> )		331 00 60 00 Q (l/min	80 00	100.00		DRFSGLIDE DANGE		LUGE 100 15.0	20.0 25.0 20.0 25.0 20.0 20.0 20.0 17 D 21 7	30,0 350 

	CTRIC POWER D	EVELOPMENT	Co.	DATE:	24-noviemb	re-2002		LUGEON TI	EST №:	4
PROJECT:TO	ROLA HYDROEL	ECTRIC COMPI	LEX	SITE:	DAM SIT	E (right marg	gin)	TESTED BY	JULIO F	livera
HOLE No.:	CDB-4			ELEVATIO	ON.	211.99	m.s.l	CHECKED I	BY:	Geol.W. Hernández
Packer type.	Neumatic	Length (m) =	0.80		Water pump	Bean R	ioyal 535	Flood (I/min) =		·····
					Test depth (	m) from	32 00	to <sup>.</sup>	37 00	
Test length (cm)		L * Cos X ° =	500 00		Depth of hole	e (m).	37.00		Dip X (⁰)≓	0
Swivel H1 (m).		H1 =	2 50		Hole Diame	ter D (cm).	7 57	W L, Bet	lore of test (m)≠	34 5
Water level Ha (m)-	34 5	Ha*CosX°=	34 50		Hydrostatic I	oad (kg/cm2).	Lh= (Hi+Ha)/3	10 =	3 700	
Steel pipe;	Length (m) =	lt =	34 50	Plastic Pipe .	Length (m)	lm =	5 00	Reducers.	Valv cuopling	0.2
	Diameter $\phi_1$	(m) =	0 0603		Diameter	¢₂ (m) =	0 0254	α	Packer:	0 12
	Roughness index		0 01		Roughness (		0.008		Union elbow	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUCEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME				ABSOPTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe Po Lh-Plo	t	Qt	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	UL = 10* As Pe	$K = \frac{Q 2}{2 \pi P c L} \cdot \ln \frac{2 L}{D}$
( kg/cm² )	( kg/cm² )	(kg/cm²)	(min)	(1)	(i/min)	(m³/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1.00	0.33149	4 37	10	320.00 706.00	32.00 70.60	5 33E-04	533.33	6.40 14 12	14.7	1 90E-04 2 58E-04
5.00	2.63875	11.06	10	903.00	90.30	1 51E-03	1505 00	18.06	163	2.12E-04
5.00	1 65446	7.05	10	715.00	71.50	1.19E-03	1191 67	14.30	203	2 63E-04
1.00	0 69985	4 00	10	465.00	46 50	7 75E-04	775.00	9.30	23.2	3 01E-04
P. =	$= \frac{10.34 * (n_1)^2}{(\phi_1)^2}$			$P_2 = \frac{10}{1000}$ $P_2 = 10000 \text{ Joss loss}$		<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*lı <sup>5.33</sup> ) pipe	m	$P_3 =$ P3= loss load	$\sum \alpha * (Q_1)$ on couplings,	$\mathbf{D}$
								valvies a	nd packer	
Pe (kg/cm <sup>2</sup> ) 			709	7 05				UES OF LU	IGEON UN	eo 250

## swissbering



# SWISSDOFING Swiseboring Overseas Corporation Ltd,

CLIENT. ELEC	CTRIC POWER D	TO A RUPOL MURIAT	C0,	DATE	10 10 10010	ore-2002		LUGEON T		6
PROJECT:TO	ROLA HYDROELI	ECTRIC COMP	LEX	SITE.	DAM SIT	E (right mar	gin)	TESTED B		O HERRERA
HOLE No .:	CDB-4			ELEVATIO	ON:	211.99	m.s.l	CHECKED		Geol.W. Hernánde
Packer type	Neumatic	Length (m) =	0.80		Water pump	. Bean R	loyal 535	Flood (I/min) =		
					Test depth	(m) from <sup>.</sup>	41 00	to	48 00	
Test length (cm) <sup>,</sup>		L* Cos X°=	700 00		Depth of hol	e (m)	48 00	· _ • • • • • •	Dıp X(°)=	0
Swivel H1 (m).		H1 =	2 20		Hole Diame	ter D (cm)	7 57	W.L Be	afore of test (m)=	44.5
Water level Ha (m)	44 5	Ha * Cos X ° =	44 50		Hydrostatic I	oad (kg/cm2)	Lh= (Hi+Ha)/	10 =	4 670	
Steel pipe,	Length (m) ≈	!t =	42 40	Plastic Pipe .	Length (m)	lm =	5 00	Reducers.	Valv cuopling:	02
	Diameter $\phi_1$	(m) =	0 0603		Diameter	$\phi_2$ (m) =	0 0254	α	Packer:	0.12
	Roughness index	= tn	0.01	<u> </u>	Roughness I	ndex n2	0 008		Union elbow	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD			LUGEON	PERMEABILITY
READING Po	PRESSURE	PRESSURE	TIME t	VOLUME	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	ABSOPTION	UNIT	
(kg/cm²)	Plo=P1+P2+P3 (kg/cm <sup>2</sup> )	(kg/cm²)	(min)	(1)	(i/min)	(m³/s)	(cm <sup>3</sup> /s)	(l/min/m)	UL = <u>10* Ae</u> Pe UL	2πΡεL. D (cm/s)
1.00	0 76865	4 90	10	482.00	48 20	8.03E-04	803.33	6 89	14 0	1.95E-04
5.00	1.91077	7.76	10	760.00 970.00	76 00 97 00	1.27E-03 1.62E-03	1266 67 1616.67	10 86 13.86	14 0 12.0	1.94E-04 1 66E-04
10.00 5 00	3.11247	<u>11.56</u> 7.76	10	760 00	76 00	1 27E-03	1266.67	10.86	14 0	1 94E-04
				620.00	62 00	1.03E-03	1033.33	8.86	20.1	2 79E-04
1 00	1 27171	4.40	10	TOTAL Pc=	Pc <sub>1</sub> + P	<sup>2</sup> c <sub>2</sub> + Pc <sub>3</sub>		<u>.</u>		
	$\frac{127171}{10.34 * (n_1)^2}$ $\frac{10.34 * (n_1)^2}{(\phi_1^{-5})^5}$ P1= loss load on	$(Q_1^2) * lt$ (33)		TOTAL Pc=	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5} 33}$	<u>m</u>	P3= loss load	$\sum \alpha * (Q_1)$ on couplings, and packer	)]
	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$		TOTAL Pc = $P_2 = \frac{10}{2}$	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5} 33}$		P3= loss load valvies a	on couplings, and packer	-
P <sub>1</sub> ==	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$ (33)		TOTAL Pc = $P_2 = \frac{10}{2}$	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5} 33}$		P3= loss load valvies a	on couplings, and packer JGEON UN	-
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$ (33)		TOTAL Pc = $P_2 = \frac{10}{2}$	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5} 33}$		P3= loss load valvies a	I on couplings, and packer JGEON UN	_
P, == 14 12 10	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$ (33)		TOTAL PC = $P_2 = \frac{10}{2}$ P2= loss loa	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * ln}{2}$ pipe	00 1 <b>1 10 10 10 10</b>	P3= loss load valvies a UES OF LL	I on couplings, and packer JGEON UN EON UNIT 150 21	 IT
P, == 14 12 10	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$ (33)		TOTAL PC = $P_2 = \frac{10}{2}$ P2= loss loa	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * ln}{2}$ pipe	00 1 <b>1 10 10 10 10</b>	P3= loss load valvies a UES OF LL	I on couplings, and packer JGEON UN EON UNIT 150 20 140	 IT
P, == 14 12 10	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$ (33)		TOTAL PC = $P_2 = \frac{10}{2}$ P2= loss loa	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * ln}{2}$ pipe	00 1 <b>1 10 10 10 10</b>	P3= loss load valvies a UES OF LL	I on couplings, and packer JGEON UN EON UNIT 150 20 140 140 140	 IT
14 12 10	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	Q (1/min)	776 77	TOTAL PC = $P_2 = \frac{10}{2}$ P2= loss loa	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * ln}{2}$ pipe		P3= loss load valvies a UES OF LL	I on couplings, and packer JGEON UN EON UNIT 150 20 140	 IT
14 12 10	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	Q (1/min)		TOTAL PC = $P_2 = \frac{10}{2}$ P2= loss loa	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * ln}{2}$ pipe	00 1 <b>1 10 10 10 10</b>	P3= loss load valvies a UES OF LL	I on couplings, and packer JGEON UN EON UNIT 150 20 140 140 140	 IT ·, 250 ·,
14 12 10 10 10 10 10 10 10 10 10 10	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	Q (1/min)	776 77	TOTAL PC = $P_2 = \frac{10}{2}$ P2= loss loa	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * ln}{2}$ pipe		P3= loss load valvies a UES OF LL	I on couplings, and packer JGEON UN EON UNIT 150 20 140 120 140	 IT ,,,,,,,,
14 12 10 (wy) e 6 4	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	Q (l/min)	776 77	TOTAL PC = $P_2 = \frac{10}{2}$ P2= loss loa	$Pc_{1} + P$ $34^{*}(n_{2})^{*}$ $(\phi_{1})^{*}$	$Pc_2 + Pc_3$ $\frac{2 * (Q_2^2) * ln}{2}$ pipe		P3= loss load valvies a	I on couplings, and packer JGEON UN EON UNIT 150 20 140 120 140	LT 00 250 

## swissbering

Swissboring Overseas Corporation Ltd,

PROJECT: TO	ROLA HYDROEL			n				11		
		ECTRIC COMP	LEX	SITE:	DAM SIT	E (right mar	gin)	TESTED B	Y JULIO I	RIVERA
HOLE No.:	CDB-4			ELEVATI	ION:	211.99	m.s.l	CHECKED	BY:	Geol.W. Hernánde
Packer type	Neumatic	Length (m) ≈	0 80	<u></u>	Water pump	er Bean F	loyal 535	Flood (i/min) =		
					Test depth	(m) from	65.00	to	70 00	
Test length (cm)		L*CosX°=	500 00		Depth of hol	le (m)	70 00		Dip X (%)=	0
Swivel H1 (m)		H1 =	2 50		Hole Diame	iter D (cm)	7.57	WL Be	fore of test (m)=	67 5
Vater level Ha (m)	67 5	Ha*CosX° ⊨	67 50		Hydrostatic	load (kg/cm2)	Lh= (Hi+Ha)/	0 =	7 000	<u> </u>
Steel pipe:	Length (m) =	lt =	66 70	Plastic Pipe .	Length (m)	lm =	5 00	<u>Reducers</u> ,	Valv, cuopling	: 02
	Diameter $\phi_1$	(m) ≃	0.0603	ľ	Diameter	φ <sub>2</sub> (m) =	0 0254	α	Packer	0 12
	Roughness index	=	0.01	<u> </u>	Roughness	index n2'	0 008		Union elbow	0.008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	pressure Pe <u>P</u> o -Lh-Plo	TIME	VOLUME		01.0/00000	00.0**00/0	ABSOPTION	UNIT 10*Ae	COEFICIENT
Po			t (mun)	Ot (I)	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q / L		$K = \frac{Q 2}{2 \pi P c L} \cdot \ln \frac{2 L}{D}$
( kg/cm <sup>2</sup> ) 1.00	( kg/cm <sup>2</sup> ) 0 62267	( kg/cm <sup>2</sup> ) 7.38	(min) 10	(1)	(l/min) 42.00	(m³/s) 7.00E-04	(cm³/s) 700.00	(//min/m) 8 40	UL 114	(cm/s)
5 00	1.27062	10.73	10	420.00	42.00 60.00	1 00E-04	1000.00	12 00	11.2	1.47E-04
10.00	2.54986	14 45	10	850.00	85 00	1.42E-03	1416.67	17.00	11.8	1 52E-04
5 00	1 63199	10.37	10	680.00	68 00	1 13E-03	1133 33	13.60	13.1	1 70E-04
1 00	0.81325	7 19	10	480.00	48 00	8 00E-04	800 00	9.60	13 4	1.73E-04
P <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1^5)^5}$ P1= loss load on			$P_2 = \frac{10}{1000000000000000000000000000000000$		$\frac{2^{2} * (Q_{2}^{2}) * lr}{(Q_{2}^{533})}$		P3= loss load	$\sum \alpha * (Q_1)$ on couplings, nd packer	)]
16 14 12 E 10			0 783	14 45		ų		LUGE 11.0 11 5 1: 	GEON UNI он UNIT 20 125 130	
Pe (kg/cm <sup>3</sup> )		7 <u>3</u> 4 719				PRESSURE RANGE				13 1 13 4
000	20.00	Q (i/min	-	80.00	100 00		PERMEA	ABILITY (LU)	) =	11.8

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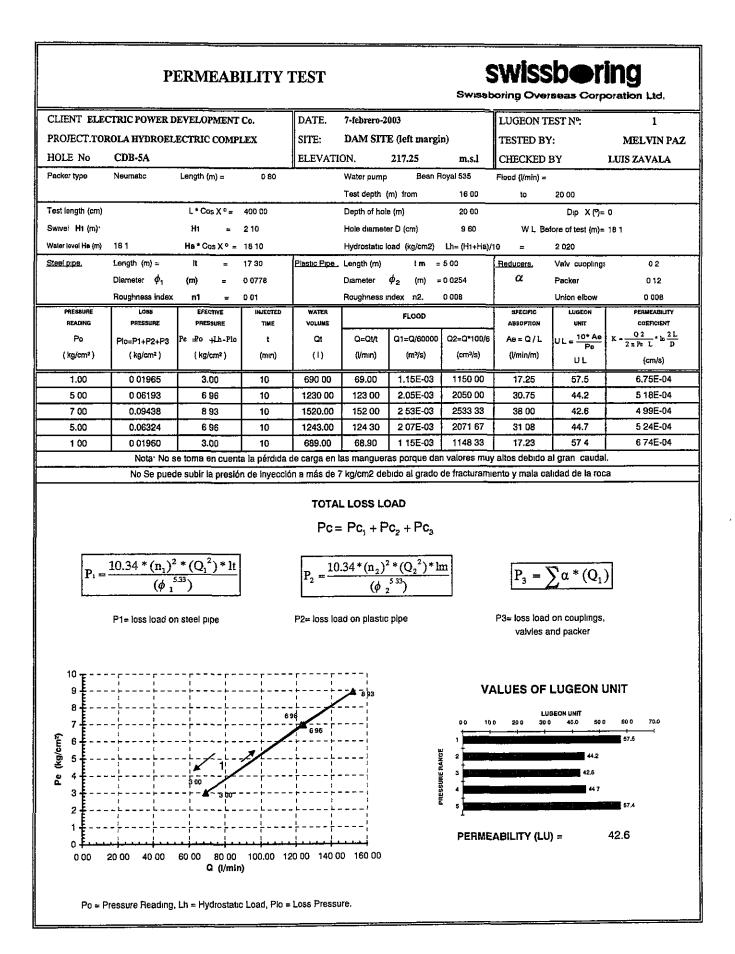
# SWISSDORING Swissboring Overseas Corporation Ltd.

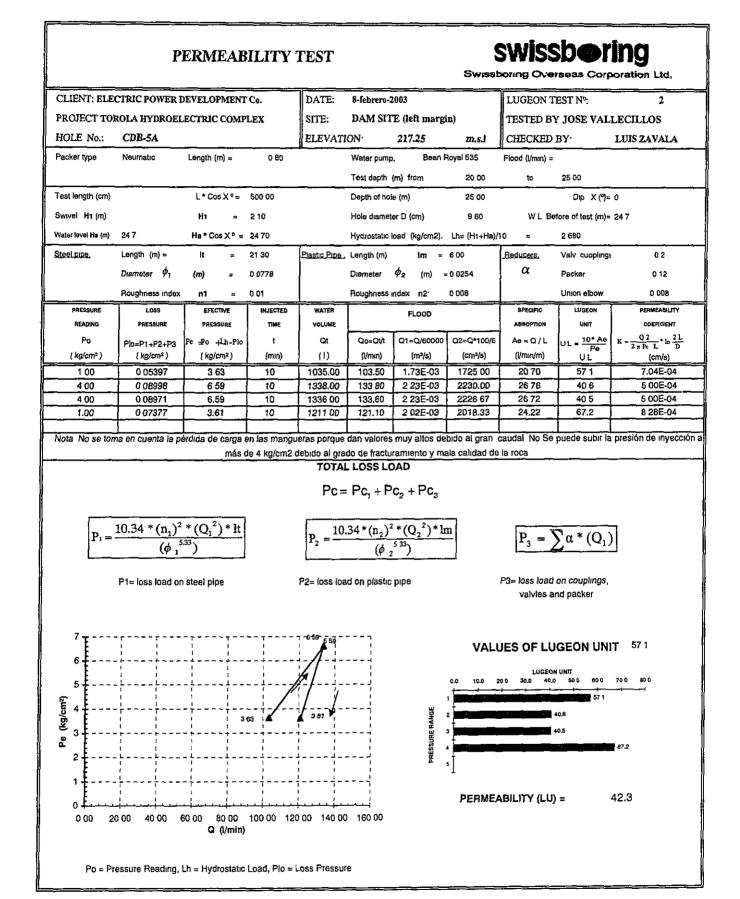
CLIENT: ELEO	CTRIC POWER D	EVELOPMENT	'Co.	DATE:	28-noviem	bre-2002		LUGEON T	EST №.	8
PROJECT: TOP	ROLA HYDROEL	ECTRIC COMP	LEX	SITE:	DAM SIT	E (right mar	gin)	TESTED BY	Y JULIO H	RIVERA
HOLE No .:	CDB-4			ELEVATI	ON:	211.99	m.s.l	CHECKED	BY:	Geol.W. Hernánde
Packer type	Neumatic	Length (m) =	0 80		Water pump	, Bean F	Royal 535	Flood (l/min) =		
					Test depth	(m) from	70 00	to•	75 00	
Test length (cm).		L*CosX°=	500 00		Depth of ho	e (m).	75.00		Dıp X(°)=	0
Swive! H1 (m)		H1 =	2.50		Hole Diame	nter D (cm).	7 57	W L Be	fore of test (m)=	72 5
Nater level Ha (m)	72 5	Ha * Cos X ° =	72.50		Hydrostatic	load (kg/cm2) <sup>.</sup>	Lh= (H+Ha)/	0 =	7 500	
Steel pipe.	Length (m) =	it =	71 70	Plastic Pipe .	Length (m)	lm =	5 00	Reducers.	Valv cuopling	. 0.2
	Diameter $\phi_1$	(m) =	0 0603		Diameter	$\phi_2$ (m) =	0.0254	α	Packer	0.12
	Roughness index	n1 =	D 01		Roughness	index n2	0 008		Union elbow	0.008
PRESSURE	1055	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME	ļ	<del></del>		ABSOPTION	UNIT	COEFICIENT
Po	Pio=P1+P2+P3	Pe Po 4Lh-Plo	t	Qt	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q / L	$UL = \frac{10^* \text{Ae}}{\text{Pe}}$	$K = \frac{Q 2}{2 \pi P c L} + \ln \frac{2 L}{D}$
( kg/cm² )	( kg/cm² )	{ kg/cm <sup>2</sup> }	(min)	(1)	(l/min)	(m²/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1.00	1 20264	7.30	10 10	580.00 690.00	58 00 69.00	9 67E-04 1 15E-03	966.67 1150 00	11 60 13.80	15.9	2.06E-04 1 66E-04
10.00	2 91484	10.59	10	903.00	90 30	1 51E-03	1505 00	18.06	12.4	1 60E-04
5.00	1 95757	10.54	10	740 00	74.00	1.23E-03	1233.33	14 80	14.0	1.82E-04
1 00	1.41890	7 08	10	630 00	63 00	1.05E-03	1050.00	12 60	17.8	2 31E-04
						·	<u> </u>			<b></b>
<b>P</b> <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$	$(Q_1) + n$		$P_2 = \frac{10}{2}$	.34*(n <sub>2</sub> ) (\$	$\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5 33}}$		$P_3 =$	$\sum \alpha * (\mathbf{Q}_1)$	
	P1= loss load or	n steel pipe		P2= loss loa	ad on plastic	pipė		P3= loss load valvies a	on couplings, and packer	
16 <del>-</del>			,		14 59		VAL	UES OF LL	JGEON UN	IT
14	·							LUG	EON UNIT	
12	·			<u></u>			00 †		10.0 150	
E 10	· • • • • • • • • • • • • • • • • • • •		*-/-/	/= +0-54		ų	ן 1 <b>איי איי</b> איי			15.9
Be (Kg/cm <sup>2</sup> )	 			·/			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		128	
2 6	i		20 7 08	. <b></b>					12.4	
4	,   						5			17.9
	   	   	   	l	]		L			~
2				1	]		PERME	ABILITY (LU	I) =	12.4
0 <del>- F</del> 0.00	20 00	40 00	60 D0	80.00	100.00			•		
		Q (l/mi			_					

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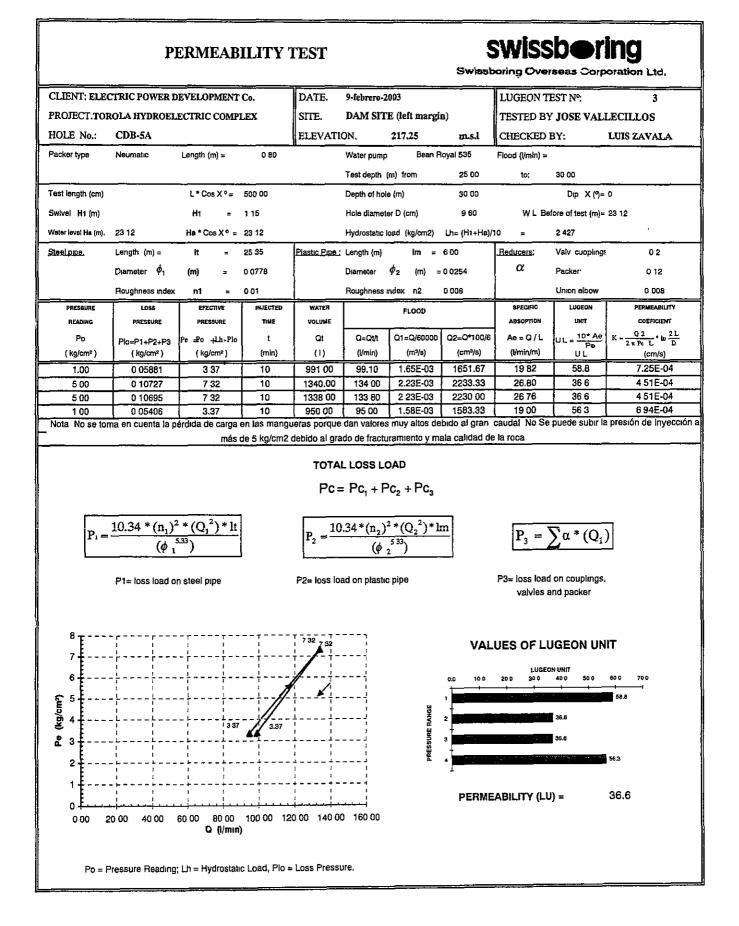
# SWISSDORING Swissboring Overseas Corporation Ltd.

		·····	**************************************				SWISSE	ering Ove	iseas Corp	oration Ltd.
CLIENT: ELE	CTRIC POWER D	DEVELOPMENT	Co.	DATE:	30-noviem	bre-2002		LUGEON T	EST №.	9
PROJECT.TO	ROLA HYDROEL	ECTRIC COMP	LEX	SITE:	DAM SIT	E (right mar	gin)	TESTED BY	Y ERNES	TO HERRERA
HOLE No .:	CDB-4			ELEVATI	ON:	211.99	m.s.l	CHECKED	BY.	Geol.W. Hernández
Packer type.	Neumatic	Length (m) =	080		Water pump	) Bean F	Royal 535	Flood (I/min) =		
					Test depth	(m) from.	73 00	to'	80 00	
Test length (cm)		L* Cos X °=	700.00	<b></b>	Depth of ho	le (m)	80 00		Dıp X(9,≕	0
Swivel H1 (m)		H1 =	2 50		Hole Diame	eter D (cm).	7 57	W.L. Be	afore of test (m)=	76 5
Water level Ha (m)	76 5	Ha*Cos X°≈	76 50		Hydrostatic	load (kg/cm2):	Lh= (Hi+Ha)/	10 =	7 900	
Steel pipe;	Length (m) =		74 70	Plastic Pipe	Length (m)	im ⊨	5 00	Reducers.	Valv cuopling	02
	Diameter $\phi_1$	(m) =	0 0603		Diameter	φ <sub>2</sub> (m) =	0 0254	α	Packer	0.12
	Roughness index	n1 =	0 01		Roughness	index n2:	0 008		Union elbow	0 008
PAESSUAE	LOSS	EFECTIVE	INJECTED	WATER	<u>r</u>	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME				ABSOPTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe ₽o +Uh-Plo	t	Qt	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	$UL = \frac{10^* Ae}{Pe}$	$K = \frac{Q 2}{2 \pi Pe L} * \ln \frac{2L}{D}$
( kg/cm² )	( kg/cm <sup>2</sup> )	( kg/cm² )	(min)	(1)	(I/min)	(m³/s)	(cm³/s)	(l/min/m)	<u> </u>	(cm/s)
1.00	0.79580	8.10	10	470.00	47.00	7.83E-04	783.33	6.71 10.79	83	1.15E-04 1.38E-04
<u> </u>	2.05330	10.85	10	755.00 987.00	75.50 98.70	1.26E-03 1.65E-03	1258 33 1645 00	10.79	9.9	1.36E-04
5.00	1.89338	11.01	10	725.00	72.50	1.21E-03	1208 33	10.36	9.4	1.30E-04
1.00	0.76231	8.14	10	460.00	46.00	7.67E-04	766 67	6.57	81	1 12E-04
		<u> </u>		<u> </u>	<u> </u>	I		L	J	
<b>P</b> <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$			,	$Pc_{2} + Pc_{3}$ $\frac{2^{2} * (Q_{2}^{2}) * ls}{2^{5}}$	m	$P_3 = 2$	$\sum \alpha * (Q_1)$	)
	P1= loss load on			P2= loss loa				P3= loss load valvies a	on couplings, and packer	
<sup>16</sup> 7				14 39			VAL	UES OF LL	IGEON UN	т
14		 +						-		
12		+ +			• = =		00 2		EON UNIT 60 80	10.0 12.0
€ 10		+	10 85				1			
L C	81	14	× [			1				89
B 8	++- <b>-</b>	+ <b>4</b>   B10     I	· <b>4</b>				ц з <b>с</b>			98
£ 6	 1	₽+ I	<b>_</b>	<i>-</i>						94
4	 	 	·			ł	5 <b>5</b>		8.1	
2		, . 		<sup>¦</sup>			-			
E			1				PERME	ABILITY (LU	) =	9.8
0.00	20 00 40	 00 60 00 Q (l/mìn	<u>,</u>	100.00						
Po = F	Pressure Reading;	Lh = Hydrostatic	: Load, Plo =	Loss Pressur	'e					



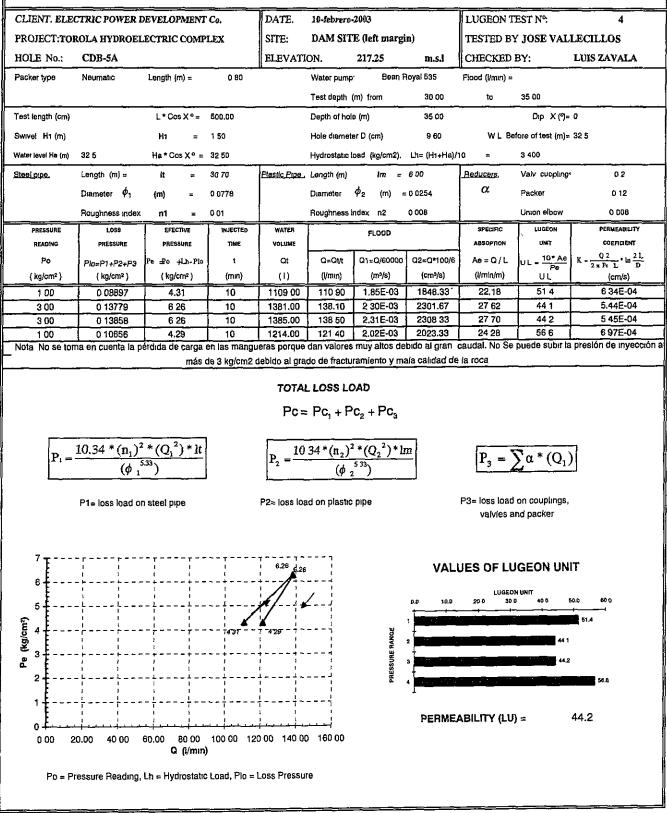


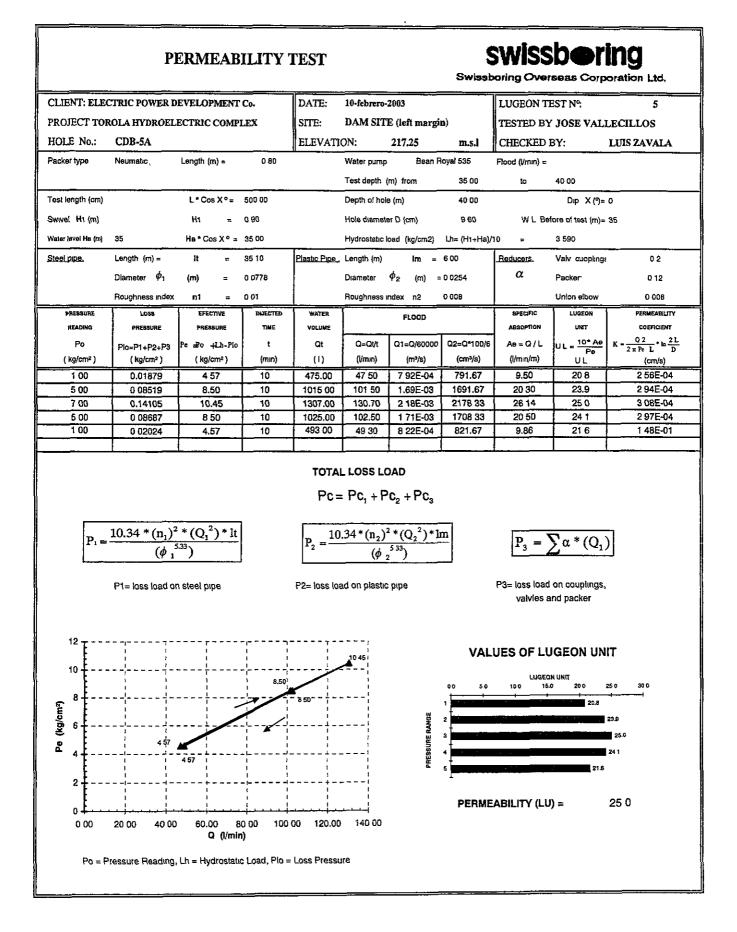
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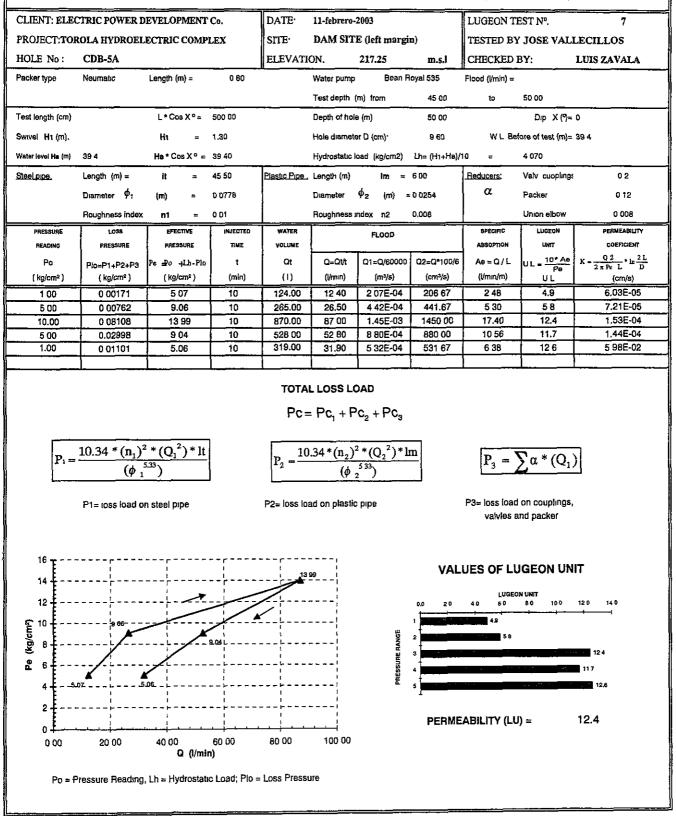


# Swissboring Overseas Corporation Ltd.

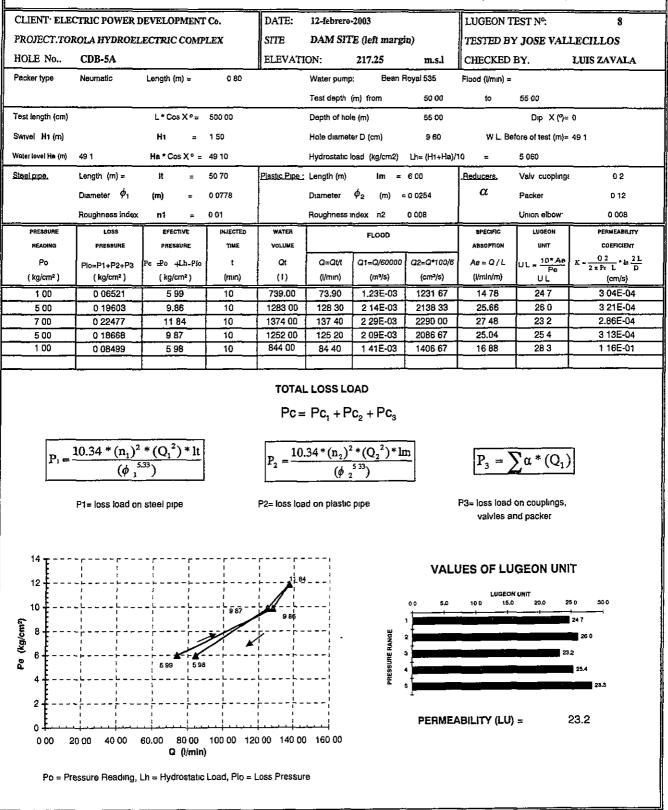
Packer type.         Neumatic         Length (m) =         0 B0         Water pump         Bean Royal 535         Flood (//min) =           Test length (cm)         L* Cos X ° =         500 00         Depth of hole (m)         40 00         to         45 00           Test length (cm)         L* Cos X ° =         500 00         Depth of hole (m)         45 00         Dip X (°)= 0           Swivel H1 (m)         H1 =         1 70         Hole diameter D (cm)         9 60         W L Before of test (m)= 39 55           Water level He (m)         39 55         Ha * Cos X ° =         39 55         Hydrostatic load (kg/cm2)         Lh= (H1+Ha)/10         =         4 125           Steel pips,         Length (m) =         tt         =         40 90         Plastic Pipe:         Length (m)         Im =         6 00         Beducars,         Valv cuoplings           Diameter $\phi_1$ (m)         =         0 0778         Diameter $\phi_2$ 0 098         Union elbow           PRESSURE         Resume         Pressure         Inter         volume         FLOOD         22-010/6         Ae = Q / L         UL =         10 * Ae $e^{-\frac{Q}{2 \times F}}$ Po         Pip=P1+P2+P3         Pe ± Po +Lh-Pio         t         Qt	0 2 0 12 0 12 0 008 ERMEABULITY COEPCIENT 2 2 1 10 21 D (cm/s) 2 99E-04 3 55E-04 3 44E-04
Packer type.         Neumatic         Length (m) =         0.80         Water pump         Bean Royal 535         Fload (l/min) =           Test depth (m)         1         Test depth (m) from         40.00         to         45.00           Fest length (cm)         L*Cos X* =         500.00         Depth of hole (m)         45.00         Dip X (?)= 0           Swivel H1 (m)         H1         =         170         Hole diameter D (cm)         9.60         W L Before of test (m)= 39.55           Maxer lavel He (m)         39.55         Ha * Cos X* =         39.55         Hydrostatic load (kg/cm2)         Line (H1+Ha)/10         =         4 125           Steal.pipta,         Length (m) =         tt         =         40.80         Plastic Pipe: Length (m)         Hn         =         6 00         Reducars,         Valv coupling:           Basel.pipta,         Length (m) =         n1         0 0778         Diameter $\phi_{(m)} = 0.0254$ Packer,         C         Packer,         Unon elbow           Postsuut         ressume         rescove         rescove<	0 2 0 12 0 006 ERMEABILITY 2 t 1 2 2 e 1 1 2 2 e 1 2 2 e 1 2 2 e 2
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	0 12 0 008 ERMEABILITY COEFICIENT 2 - In 21 (cm/s) 2 99E-04 3 56E-04
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	0 12 0 008 ERMEABILITY COEFICIENT 2 - In 21 (cm/s) 2 99E-04 3 56E-04
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 12 0 008 ERMEABILITY COEFICIENT 2 - In 21 (cm/s) 2 99E-04 3 56E-04
Water level Hs (m)       39 55       Ha*Cos X* = 39 55       Hydrastatic load (kg/cm2)       Lh= [H1+Ha]/10       =       4 125         Statil pipe,       Longth (m) =       tt       =       40 90       Plastic Pipe: Length (m)       Hn       =       6 00       Reducers,       Valv cuopling:         Diameter $\phi_1$ (m)       =       0 0778       Diameter $\phi_2$ (m)       =       0 254 $\alpha$ Packer.         Roughness index       n1       =       0 01       Roughness index       n2       0 008       Union elbow         PRESSURE       Exective       HA*Con X*       Ha*Con X*       Ha*Con X*       Exective       Ha*Con X*       How	0 12 0 008 ERMEABILITY COEFICIENT 2 - In 21 (cm/s) 2 99E-04 3 56E-04
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0 12 0 008 ERMEABILITY COEFICIENT 2 - In 21 (cm/s) 2 99E-04 3 56E-04
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	0 12 0 008 ERMEABILITY COEFICIENT 2 - In 21 (cm/s) 2 99E-04 3 56E-04
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0 008 ERMEABILITY COEFICIENT 2 2 2 2 2 99£-04
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	ERMEABILITY COEFICIENT $\frac{2}{D_e} \cdot \ln \frac{2I}{D}$ (cm/s) $2.99 \pm 0.4$ $3.56 \pm 0.4$
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	2 
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\frac{2}{(cm/s)} \cdot \ln \frac{21}{D}$ (cm/s) $\frac{299 \pm 04}{56 \pm 04}$
$\frac{(\text{kg/cm}^2)}{(\text{kg/cm}^2)} \frac{(\text{kg/cm}^2)}{(\text{kg/cm}^2)} \frac{(\text{min})}{(\text{min})} \frac{(1)}{(1)} \frac{(1/\text{min})}{(1/\text{min})} \frac{(\text{m}^3/\text{s})}{(\text{m}^3/\text{s})} \frac{(\text{cm}^3/\text{s})}{(1/28.33)} \frac{(1/28.43)}{12.34} \frac{24.3}{24.33} \frac{22}{25.00} \frac{1}{10.03678} \frac{5.09}{10.000} \frac{10.01}{129.600} \frac{1}{129.600} \frac{1}{129.600} \frac{1}{21.61-03} \frac{2160.00}{21.61-03} \frac{25.92}{21.61-03} \frac{28.9}{28.9} \frac{3}{33} \frac{1}{10.00} \frac{25.92}{28.9} \frac{28.9}{33} \frac{3}{10} \frac{1}{10.00} \frac{1}{10.0364} \frac{1}{10.000} \frac{1}{10.000} \frac{1}{1224.00} \frac{1}{1224.00} \frac{1}{1224.00} \frac{2.041-03}{2.041-03} \frac{2040.00}{2040.00} \frac{24.48}{24.48} \frac{27.3}{27.7} \frac{3}{33} \frac{3}{10.00} \frac{1}{10.0364} \frac{1}{5.09} \frac{1}{10} \frac{1}{10.000} $	(cm/s) 2 99E-04 3 56E-04
$\frac{1.00}{1.00} = \frac{10.3678}{10} = \frac{5.09}{10} = \frac{10}{10} = \frac{61700}{129600} = \frac{61.70}{103E-03} = \frac{102833}{102833} = \frac{12.34}{12.34} = \frac{24.3}{24.3} = \frac{2}{2}$ $\frac{5.00}{114408} = \frac{10}{11408} = \frac{10}{10} = \frac{10.34}{10} = \frac{10}{138800} = \frac{10}{122400} = \frac{10.34}{122400} = \frac{10.34}{12240} = \frac{10.34}{100} $	99E-04 56E-04
$\frac{100}{5.00} = \frac{1034}{9} = \frac{10}{9} = \frac{10}{10} = \frac{10}{12960} = \frac{10}{12960} = \frac{10}{21600} = \frac{1000}{2592} = \frac{1000}{20400} = \frac{1000}{200} = \frac{1000}{$	3 56E-04
$\frac{6\ \text{CO}}{6\ \text{CO}} = \frac{0.18517}{0.18517} + \frac{9\ \text{9}\ \text{9}\ \text{4}}{10} + \frac{10}{1398\ \text{00}} + \frac{138\ \text{80}}{138\ \text{80}} + \frac{2315.03}{2313.33} + \frac{27.76}{27.9} + \frac{27\ \text{9}}{33} + \frac{33}{33} + \frac{10}{10} + \frac{1224.00}{12240} + \frac{2315.03}{2040.00} + \frac{24.48}{24.48} + \frac{27.3}{33} + \frac{33}{33} + \frac{10}{10} + \frac{10.344}{509} + \frac{10}{509} + \frac{10}{590.00} + \frac{98350}{5900} + \frac{98350}{98350} + \frac{98333}{1180} + \frac{1180}{23.2} + \frac{232}{8} + \frac{10}{10} + \frac{10}{5900} + \frac{10}{5933} + \frac{1180}{1180} + \frac{23.2}{232} + \frac{10}{23} + \frac{10}{10} + \frac{10}{10$	
$\frac{500}{100} = \frac{10.34 * (n_1)^2 * (Q_1^2) * lt}{(\phi_1^{-5.33})}$ $\frac{500}{10} = \frac{10.34 * (n_1)^2 * (Q_1^2) * lt}{(\phi_1^{-5.33})}$ $\frac{100}{100} = \frac{10.34 * (n_2)^2 * (Q_1^2) * lt}{(\phi_1^{-5.33})}$ $\frac{100}{100} = \frac{10.34 * (n_2^2) * (Q_1^2) * lt}{(\phi_1^{-5.33})}$ $\frac{100}{100} = \frac{10.34 * (n_2^2) * (Q_2^2) * lm}{(\phi_2^{-5.33})}$ $\frac{100}{100} = \frac{10.34 * (n_2^2) * (Q_2^2) * lm}{(\phi_2^{-5.33})}$	
$\begin{array}{c} \text{TOTAL LOSS LOAD} \\ \text{Pc} = \text{Pc}_{1} + \text{Pc}_{2} + \text{Pc}_{3} \\ \hline P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{-2}) * \text{lt}}{(\phi_{1}^{-5.33})} \\ \hline P_{2} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{-2}) * \text{lm}}{(\phi_{2}^{-5.33})} \\ \hline P_{3} = \sum \alpha * (Q_{1}) \\ \hline \end{array}$	36E-04
$P_{c} = Pc_{1} + Pc_{2} + Pc_{3}$ $P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{2}) * lt}{(\phi_{1}^{5.33})}$ $P_{2} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}$ $P_{3} = \sum \alpha * (Q_{1})$	3 40E-02
valvies and packer	
12 VALUES OF LUGEON UNIT	
10	
8	5,0 H
2	
PERMEABILITY (LU) = 27.9	
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## swissboring

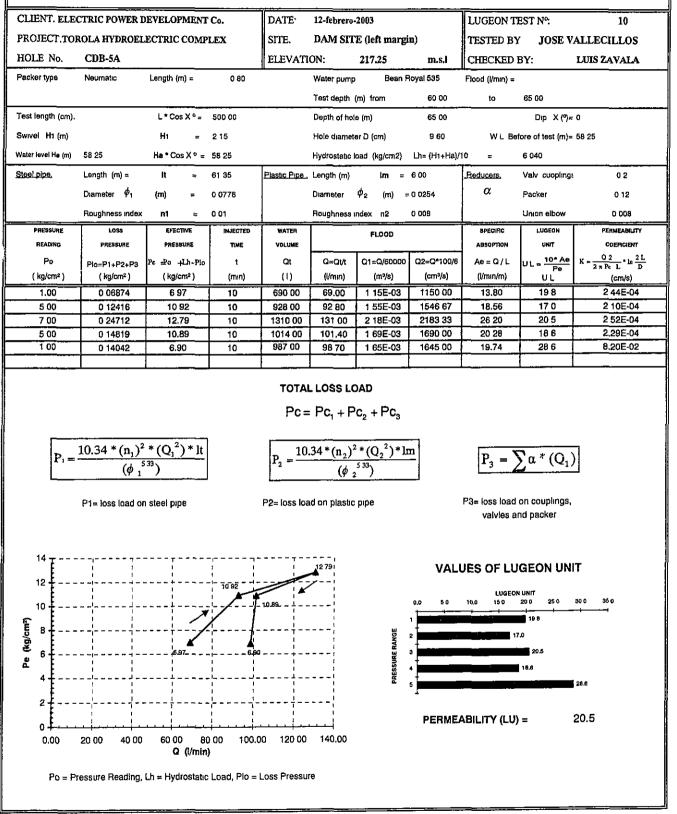


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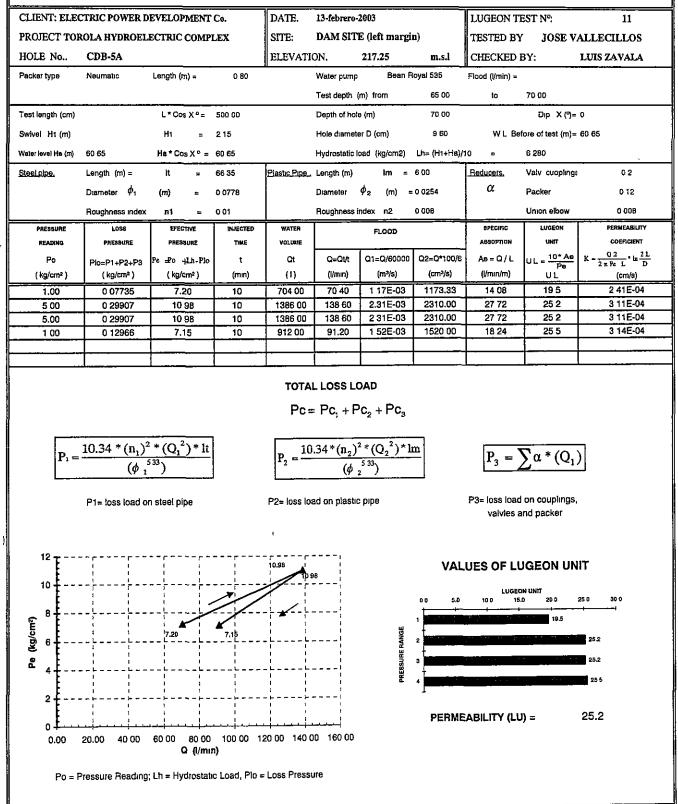


								r		oration Ltd.
CLIENT: F	ELECTRIC POWER D	DEVELOPMENT	Co.	DATE:	12-febrero-			LUGEON TI	EST №:	9
PROJECT.	TOROLA HYDROEL	ECTRIC COMP	LEX	SITE:	DAM SIT	E (left margi	n)	TESTED BY	JOSE V	ALLECILLOS
HOLE No	CDB-5A			ELEVATI	ON:	217.25	m.s.l	CHECKED I	BY	LUIS ZAVALA
Packer type	Neumatic	Length (m) =	0 80		Water pump	Bean R	oyal 535	Flood (l/min) =		
					Test depth (	m) from	55 00	to	60 00	
Test length (	cm).	L*Cos X°=	500 00		Depth of hole	e (m)	60 00		D⊮p X(®)≃	0
Swive: H1 (i	m)	H1 =	1 70		Hole diamete	ar D (cm)	9 60	W L Bet	iore of test (m)=	58 25
Nater level Hs	(m) 56 25	Ha*CosX° =	58 25		Hydrostatic is	oad (kg/cm2)	L⁄ɔ= (Hາ+Ha)/"	±0 ≠	5 995	
Steel pipe,	i.ength (m) =	lt =	55 90	Plastic Pipe_	Longth (m)	= ml	6 00	Reducers.	Valv cuoplings	0 2
	Diameter $\phi_1$	(m) =	0 0778		Diameter	φ <sub>2</sub> (m) =	0 0254	α	Packer	0 12
	Roughness index	n1 =	0 01		Roughness (	ndex n2	0 008		Union elbow	0 008
PRESSUR	E LOSS	EFECTIVE	INJECTED	WATER	[	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME				ABSOPTION	UNIT	COEFICIENT
Po	Pio≂P1+P2+P3	Pe -Po +Lh-Plo	t	Qt	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q / L	UL = <u>10* Ae</u> Pe	$K = \frac{Q 2}{2 \pi P \epsilon} \cdot \ln \frac{2 L}{D}$
( kg/cm²		( kg/cm² )	(min)	(1)	(l/min)	(m³/s)	(cm²/s)	(l/min/m)	UL	(cm/s)
1 00	0 08188	6.91	10	789 00	78 90	1 32E-03	1315 00	15 78	22.8	2 81E-04
5 00	0.13401	10.86	10	1010.00	101 00 132 10	1 68E-03 2 20E-03	1683 33 2201 67	20 20 26 42	18 6	2 29E-04 2.55E-04
5 00	0.13909	10 86	10	1029.00	102 90	1 72E-03	1715 00	20.58	19.0	2.34E-04
1 00	0 10412	6 89	10	890.00	89 00	1.48E-03	1483 33	17 80	25 8	9 36E-02
F	$P_1 = \frac{10.34 * (n_1)^2}{(\phi_1)^2}$	$\frac{(Q_1^2) * lt}{(Q_1^2)}$		$P_2 = \frac{10}{2}$	.34*(n <sub>2</sub> ) <sup>2</sup> (\$\$	$\frac{(Q_2^2)^* h}{(Q_2^2)^*}$	<u>n</u>	$P_3 = \sum_{i=1}^{n}$	$\sum \alpha * (Q_1)$	
	P1= loss load o	n steel pipe		P2= loss loa	ad on plastic	: ріре		P3= loss load valvies a	on couplings, nd packer	
<sup>14</sup> E		<b>-</b>			12 77		VAL	UES OF LL	IGEON UN	IT
14 T 12 T					12 77		VAL			iΥ
Ē			10 85 1	10.86	12 77		VAL		N UNIT	<b>IT</b> 25 0 50.0
12 10			10 86		12 77			LUGEO	N UNIT D 20.0 ;	
12 10			10 86		12 77	ANGE		LUGEO	N UNIT 0 20.0 : 	25 0 30.0
12 10			10 86		12 77	SURE RANGE		LUGEO	N UNIT 0 20.0 2 10.0 20.0 2 20.0 20.0 2 20.0 20.0 2 20.0 20.0	25 0 30.0 
12			10 86		12 77	PRESSURE RANGE		LUGEO	N UNIT 0 20.0 : 	25 0 30.0 
Pe (kg/cm²)			10 86		12 77	PRESSURE RANGE		LUGEO	N UNIT 0 20.0 2 10.0 20.0 2 20.0 20.0 2 20.0 20.0 2 20.0 20.0	25 0 30.0 
Pe (kg/cm²) 9 8 01 71			10 86			PRESSURE RANGE		LUGEO 10 0 154	N UNIT 0 20.0 2 2000 19.6 2017 19.6 19.0	25 0 30.0 
Pe (kg/cm <sup>2</sup> )           0         7           0         7		691	10 86			PRESSURE RANGE		LUGEO	N UNIT 0 20.0 2 2000 19.6 2017 19.6 19.0	250 30.5 
Pee (kg/cm <sup>2</sup> )           7           6           7           7           8           10           11           12           13           14           15           16           17           18           19           10           10           11           12           13           14           14           14           14           14           14           15           14           15           16           17           17           17           17           17           17           17           17           17           17           18           17           17           17           17           17           17           17           17           17           17      1		691	10 86 6 89		140 00	PRESSURE RANGE		LUGEO 10 0 154	N UNIT 0 20.0 2 2000 19.6 2017 19.6 19.0	25 0 50.0 
на (kg/cm <sup>2</sup> ) 12 12 10 10 10 10 10 10 10 10 10 10 10 10 10	) 20 00 40.00 	691 	10 86 6 89 0 00 100			PRESSURE RANGE		LUGEO 10 0 154	N UNIT 0 20.0 2 2000 19.6 2017 19.6 19.0	25 0 30.0 

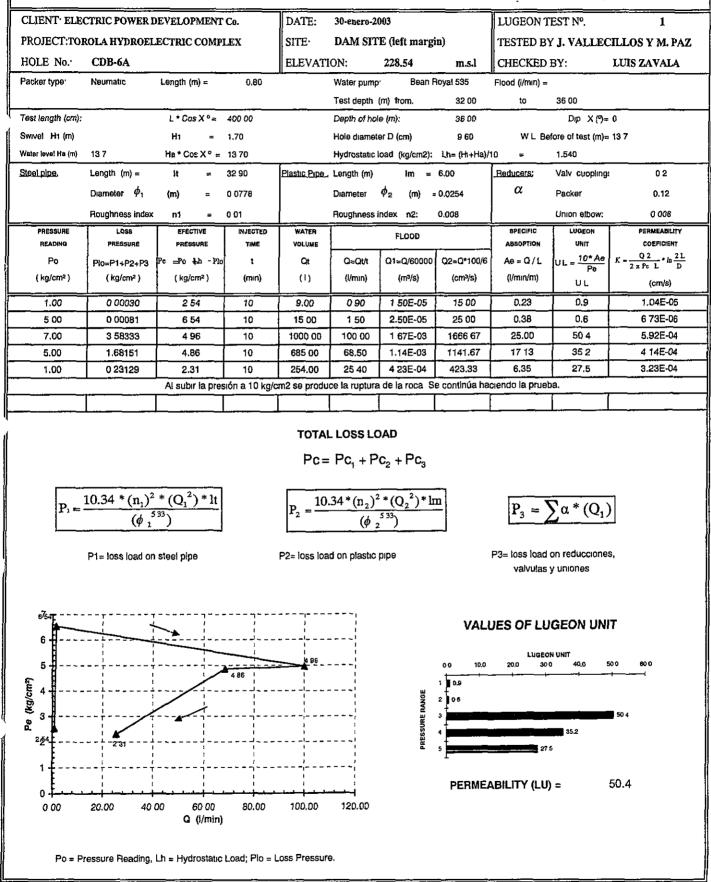
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# SWISSDORING Swissboring Overseas Corporation Ltd.

CLI	ENT:	ELECT	RIC POWER D	EVELOPMENT	Г <b>С</b> о.	DATE:	31-enero-2	003		LUGEON T	EST Nº:	2
PRO	JECT	TORO	LA HYDROEL	ECTRIC COMI	LEX	SITE	DAM SII	E (left margi	n)	TESTED BY	( J. VALLEC	CILLOS Y M. PAZ
HOL	ΕN	o. <b>·</b> (	CDB-6A			ELEVATI	ON:	228.54	m.s.l	CHECKED		LUIS ZAVALA
Packe	er type	) <b>P</b>	Veumatic	Length (m) =	0 80	_H	Water pump	) Bean F	loyal 535	Flood (I/min) =		
							Test depth	(m) from	36 00	to <sup>.</sup>	41 00	
Test l	ength	(cm).	·	L * Cos X ° ≖	500 00		Depth of ho	le (m) <sup>.</sup>	41 00		Dıp X(9)=	0
Swive	E H1	(m)·		H1 =	2 25		Hole diamet	er D (cm)	9 60	W L. Be	fore of test (m)=	33
Water I	evel Ha	a (m) 3	33	Ha*CosX° =	33.0D		Hydrostatic	load (kg/cm2)	Lh≈ (Hi+Ha)/	0 =	3.525	
Steel	DIDÐ;	L	.ength (m) =	lt =	37 45	Plastic Pipe	Longth (m)	lm =	6 00	Reducers.	Valv cuopling	0.2
		5	Diameter $\phi_1$	(m) =	0 0778		Diameter	$\phi_2$ (m) =	0.0254	α	Packer,	0 12
		F	Roughness index	= ta	0 01		Roughness	index n2'	0 008		Union elbow.	0 008
P	RESSUR		LOSS	EFECTIVE	INJECTED	WATER	T	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
I	READIN	•	PRESSURE	PRESSURE	TIME	VOLUME		PLOOD		ABSOPTION	UNIT	COEFICIENT
	Po		Plo=P1+P2+P3	Pe ≕Po ih -Pi	o t	Qt	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	As=Q/L	UL = 10* As	$K = \frac{Q 2}{2 \pi P c L} * \ln \frac{2 L}{D}$
(	kg/cm		( kg/cm² )	(kg/cm²)	(min)	(1)	(l/min)	(m³/s)	(cm³/s)	(l/min/m)	UL Pe	2 # Pe L D (cm/s)
	1.00		0 00003	4 52	10	3.00	0 30	5 00E-06	5.00	0.06	0.1	1 63E-06
	5 00		0.00023	8.52	10	8.00	0.80	1 33E-05	13.33	0.16	02	2 31E-06
	10 00	)	0.00036	13.52	10	10.00	1 00	1 67E-05	16.67	0 20	0.1	1.82E-06
	5.00		0 00018	8 52	10	7 00	0.70	1.17E-05	11 67	0 14	02	2.02E-06
	1 00		0 00000	4 52	10	1.00	0 10	1.67E-06	1.67	0 02	00	5.45E-07
	ľ		$\frac{0.34 * (n_1)^2}{(\phi_1)^5}$			$P_2 = -$ P2= loss los		<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*h <sup>533</sup> ) pipe	_	P3≂ loss load	$\sum_{n} \alpha * (Q_1)$	
	<sup>16</sup> Ŧ								VAL	UES OF LU		IT
	<sup>14</sup> E				- <b></b> !	13-52						
	12 🛉		+			- <i>4</i>			00	DI DI	NUNIT 1 0.2	0.2
ير. ال	10 Ē		+	   -		/			1		01	
no/E	8 E		   	     				NGE	2			0.2
Pe (kg/cm²)	°Ŧ							PRESSURE RANGE	3		01	
Pe	6ŧ				<b></b>			auss	4			0.2
	4 Ę	4 52	4 52					284	5	0.0		
	, E	- 12	4 44   		   				1			
	2 <b>f</b>								PERME	ABILITY (LU	) =	0.1
			····	+ · · · · · · · · · · · · · · · · · · ·	<u></u>		┵╍┙		, <b>L</b> . 100 <b>.</b>		,-	
	٥Ļ					1 00	1 20					
	<del>ب</del> ہ 0.00	0	0.20 0	40 0.60 Q (I/m		100	, 20					

#### swissbering PERMEABILITY TEST Swissboring Overseas Corporation Ltd. CLIENT: ELECTRIC POWER DEVELOPMENT Co. 31-enero-2003 DATE: LUGEON TEST Nº: PROJECT: TOROLA HYDROELECTRIC COMPLEX SITE: DAM SITE (left margin) TESTED BY J. VALLECILLOS Y M. PAZ HOLE No." CDB-6A **ELEVATION:** 228.54 CHECKED BY. LUIS ZAVALA m.s.l Packer type. Neumatic Length (m) = 0 80 Water pump Bean Royal 535 Flood (I/min) = 46 00 Test depth (m) from. 41 00 to Test length (cm) L\*Cos X°= 500 00 Depth of hole (m) 46.00 Dp X(?)≓0 Swivel H1 (m)\* H1 1.25 Hole diameter D (cm) 9.60 W L Before of test (m)= 11 26 Ŧ Wate: level He (m) 11.26 Ha \* Cos X ° ≈ 11 26 Hydrostatic load (kg/cm2) Lh= (Hi+Ha)/10 1.251 -Steel pipe, Length (m) = 41 45 Plastic Pipe, Length (m) 6.00 Reducers. Valv cuopling: lt im = = α Diameter $\phi_1$ $\phi_2$ 0 0778 Diameter = 0 0254 Packer. (m) (m) = Roughness index 0 01 Roughness index n2: 0.008 Union elbow n1 PRESSURE LOSS FFECTIVE INJECTED WATER SPECIFIC LUGEON FLOOD READING PRESSURE PRESSURE TIME VOLUME ABSOPTION UNIT UL = 10\* Ae $\frac{Q2}{2\pi Pc L} \cdot \ln \frac{2L}{D}$ Q1=Q/60000 Q2=Q\*100/6 Qt Q=Qt/t Ae = Q / L Po t =Po Lh - Pic Plo=P1+P2+P3 Pe (l/min) (cm<sup>3</sup>/s) υĽ ( kg/cm<sup>2</sup> ( kg/cm<sup>2</sup> ) {kg/cm<sup>2</sup>} (min) m $(m^3/s)$ (l/min/m) 0 02368 2 23 81.00 8 10 1.35E-04 135 00 1 62 73 1.00 10 0 69774 5 55 10 440.00 44 00 7 33E-04 733.33 8 80 15.8 5.00 1150 00 115.00 1.92E-03 1916.67 23.00 35.5 10.00 4.76533 6.49 10 1213.33 33.5 5.00 1 90982 4 34 10 728.00 72 80 1 21E-03 14.56 458 33 278 0.27261 1.98 10 275 00 27.50 4 58E-04 5 50 1.00 TOTAL LOSS LOAD $Pc = Pc_1 + Pc_2 + Pc_3$ $10.34 * (n_1)^2 * (Q_1^2) * lt$ $10.34*(n_2)^2*(Q_2^2)*lm$ $P_3 = \sum \alpha * (Q_1)$ $\mathbf{P}_1 =$ $(\phi_{2}^{533})$ (**φ**<sub>1</sub> P3= loss load on reducciones, P1= loss load on steel pipe P2= loss load on plastic pipe valvulas y uniones 7 VALUES OF LUGEON UNIT 6 LUGEON UNIT 5.0 100 150 20.0 250 30.0 35 0 5 173 (kg/cm<sup>2</sup>) 4 PRESSURE RANGE 15.8 35.5 3 Ъ 33 5 2 27.8 1 PERMEABILITY (LU) = 35.5 0 120.00 140.00 0.00 20 00 40 00 60.00 80.00 100.00

3

0.2

0 12

0 008

PERMEABUTTY

COEFICIENT

(cm/s) 8.96E-05

1.95E-04

4.37E-04

4.13E-04

3 43E-04

40 0

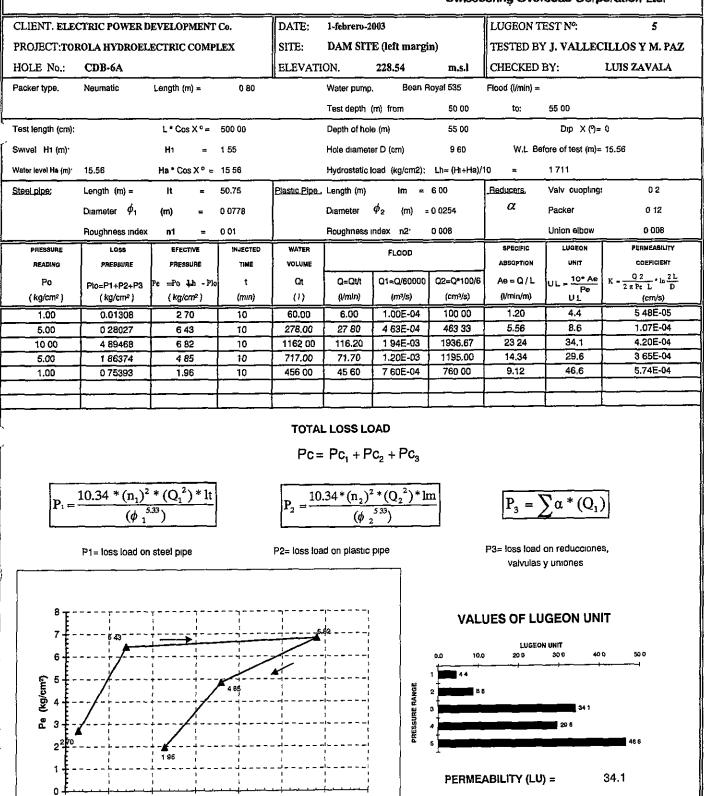
Po = Pressure Reading; Lh = Hydrostatic Load; Plo = Loss Pressure.

Q (i/min)

(m) == 00 ex n1 == 00	ELE <sup>3</sup> 0.80 0.00 80 7.35 0.00 Plastic 0778 01 INJECTED INJECTED INJECTED INJECTED (min) 10 10 49. 10 205 10 611 10 10 40. The second	VATION: Water pum Test depth Depth of ho Hole diame Hydrostatic Pipe. Length (m) Diameter Roughness rer tt Q=Qt/t ) ((/mm) 00 4.90 00 20.50 00 61 10 00 19.50 00 4.00 PC = PC <sub>1</sub> + 1	(m) from. le (m). ter D (cm) load (kg/cm2) im = $\phi_2$ (m) = index n2 FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	m.s.l Royal 535 46 00 50 00 9 60 Lh= (H+Ha)/1	CHECKED I Flood (I/min) = to W L Bei 10 = Reducers: C SPECIFIC ABSOPTION	BY. 50 00 Dip X (9= fore of test (m)= 3 815 Valv cuopling: Packer Union elbow Luceon UNIT	= 37 35 
$L * \cos X^{\circ} = 400$ H1 = 08 Ha * Cas X^{\circ} = 37 It = 46. (m) = 00 x n1 = 00 EFECTIVE PRESSURE RE PRESSURE RE PO \$\pm h - Plo (kg/cm <sup>2</sup> ) 481 866 12.47 868 481	0.80 0.80 0.00 80 7.35 3.00 Plastic 0778 01 INJECTED INJ	Water pum           Test depth           Depth of he           Hole diame           Hydrostatic           Pipe         Length (m)           Diameter           Roughness           Imme           VME           VME           VME           VME           VME           VME           VME           VME           Roughness           VME	p         Bean F           (m) from.         Im           Ie (m).         Im           ter D (cm)         Im           toad (kg/cm2)         Im           Im         Im $\phi_2$ (m)         Im           Index n2         FLOOD           Q1=Q/60000         (m <sup>3</sup> /s)           8.17E-05         3.42E-04           1.02E-03         3.25E-04           6 67E-05         GAD           PC2 + PC3	Aoyal 535 $46 DO$ $50 00$ $9 60$ $Lh = (H + Ha)/1$ $6.00$ $0 0254$ $0 008$ $Q2=Q^*100/6$ $(cm^3/s)$ $81 67$ $341 67$ $1018.33$ $325.00$	Flood (I/min) = to W L Bet 10 = Reducers: C SPECIFIC ABSOPTION Ae = Q / L (I/min/m) 1 23 5 13 15 28 4.88	50 00         Dip X (%)=         fore of test (m)=         3 815         Valv cuopling:         Packer         Union elbow         Lucaeon         UNIT         UL = 10* Ae         Pe         UL         2.5         5.9         12 3         5.6	$\begin{array}{c} 0\\ = 37\ 35\\ \pm & 0\ 2\\ 0\ 12\\ 0.008\\ \hline \\ \hline \\ K = \frac{Q\ 2}{2\ \pi\ Pc\ L} \cdot \frac{21}{D}\\ (cm/s)\\ \hline \\ \hline \\ 2.99E-05\\ \hline \\ 6.94E-05\\ \hline \\ 1.44E-04\\ \hline \\ 6\ 59E-05\\ \end{array}$
$L * \cos X^{\circ} = 400$ H1 = 08 Ha * Cas X^{\circ} = 37 It = 46. (m) = 00 x n1 = 00 EFECTIVE PRESSURE RE PRESSURE RE PO \$\pm h - Plo (kg/cm <sup>2</sup> ) 481 866 12.47 868 481	00 00 80 7 35 5.00 Plastic 0778 01 INJECTED WAY TIME VOLL t CC (min) (1 10 49, 10 205 10 611 10 195 10 40, 	Test depth           Depth of ho           Hole diame           Hydrostatic           Pipe         Length (m)           Diameter           Roughness           ren           VME           It         Q=Qt/t           )         (I/min)           00         4.90           .00         20.50           .00         61 10           .00         19.50           00         4.00           QUAL         LOSS L           PC =         PC <sub>1</sub> + I	(m) from. le (m). ter D (cm) load (kg/cm2) im = $\phi_2$ (m) = index n2 FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	46 00 50 00 9 60 Lh= (H+Ha)/1 6.00 0 0254 0 008 C2=Q*100/6 (cm³/s) 81 67 341 67 1018.33 325.00	to W L Bet 10 = Reducers: C SPECIFIC ABSOPTION Ae = C / L (//min/m) 1 23 5 13 15 28 4.88	Dip X (%)= fore of test (m)= 3 815 Valv cuopling: Packer Union elbow $UL = \frac{10^{+} \text{Ae}}{\text{Pe}}$ UL 2.5 5.9 12 3 5.6	$ \begin{array}{c} 37 \ 35 \\ \hline \\ & 0 \ 2 \\ 0 \ 12 \\ 0.008 \\ \hline \\ K = \frac{Q \ 2}{2 \ \pi \ Pc \ L} * \ln \frac{21}{D} \\ (cm/s) \\ \hline \\ \hline \\ 2.99E-05 \\ \hline \\ 6.94E-05 \\ \hline \\ 1.44E-04 \\ \hline \\ 6 \ 59E-05 \\ \hline \end{array} $
H1 = 0.8 Ha * Cas X ° = 37 It = 46. (m) $= 0.0$ ex n1 = 0.0 EFECTIVE PRESSURE 3 Pe =Po $\frac{1}{2}$ h - Plo (kg/cm <sup>2</sup> ) 4.81 8.66 12.47 8.68 4.81	80 7 35 5.00 Plastic 0778 01 INJECTED WAY TIME VOLI t CC (min) (1 10 49. 10 205 10 611 10 195 10 40. The second se	Depth of ht Hole diame Hydrostatic Pipe. Length (m) Diameter Roughness TER UME Q=Qt/t (//mun) 00 4.90 00 20.50 00 61 10 00 19.50 00 4.00 OTAL LOSS L PC = PC <sub>1</sub> + 1	$\begin{array}{r} \text{le (m).} \\ \text{ter D (cm)} \\ \text{ter D (cm)} \\ \text{im } = \\ \phi_2  (m) = \\ \text{index n2} \\ \hline \\ \text{FLOOD} \\ \hline \\ Q1 = Q/60000 \\ (m^3/s) \\ \hline \\ 8.17E-05 \\ 3.42E-04 \\ 1.02E-03 \\ 3.25E-04 \\ \hline \\ 6.67E-05 \\ \hline \\ OAD \\ \hline \\ PC_2 + PC_3 \\ \hline \end{array}$	50 00 9 60 Lh= (H+Ha)/1 6.00 0 0254 0 008 0 2=Q*100/6 (cm%/s) 81 67 341 67 1018.33 325.00	W L Bet 10 = Reducers: <i>Q</i> <i>SPECIFIC</i> ABSOPTION Ae = Q / L (//min/m) 1 23 5 13 15 28 4.88	Dip X (%)= fore of test (m)= 3 815 Valv cuopling: Packer Union elbow $UL = \frac{10^{+} \text{Ae}}{\text{Pe}}$ UL 2.5 5.9 12 3 5.6	$ \begin{array}{c} 37 \ 35 \\ \hline \\ & 0 \ 2 \\ 0 \ 12 \\ 0.008 \\ \hline \\ K = \frac{Q \ 2}{2 \ \pi \ Pc \ L} * \ln \frac{21}{D} \\ (cm/s) \\ \hline \\ \hline \\ 2.99E-05 \\ \hline \\ 6.94E-05 \\ \hline \\ 1.44E-04 \\ \hline \\ 6 \ 59E-05 \\ \hline \end{array} $
H1 = 08 Ha * Cas X ° = 37 It = 46. (m) $= 00$ error 00 (m) $= 00$ error 00 error 00 error 00 error 00 (kg/cm <sup>2</sup> ) 481 866 12.47 868 481 0 0 0 0 0 0 0 0 0 0 0 0 0	80 7 35 5.00 Plastic 0778 01 INJECTED WAY TIME VOLI t CC (min) (1 10 49. 10 205 10 611 10 195 10 40. The second se	Hole diame Hydrostatic Pipe. Length (m) Diameter Roughness tt Q=Qt/t ) (l/min) 00 4.90 .00 20.50 .00 61 10 .00 19.50 00 4.00 COTAL LOSS L PC = PC <sub>1</sub> + l	ter D (cm) totad (kg/cm2) im = $\phi_2$ (m) = index n2 FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.22E-04 6.67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	9 60 Lh= (H+Ha)/1 6.00 0 0254 0 008 C2=Q*100/6 (cm <sup>3</sup> /s) 81 67 341 67 1018.33 325.00	10 = <u>Reducers:</u> <i>Q</i> SPECIFIC ABSOPTION Aθ = Q / L (//min/m) 1 23 5 13 15 28 4.88	fore of test (m)= 3 815 Valv cuopling: Packer Union elbow $UL = \frac{10^{\circ} \text{ Ae}}{\text{Pe}}$ UL 2.5 5.9 12 3 5.6	$ \begin{array}{c} 37 \ 35 \\ \hline \\ & 0 \ 2 \\ 0 \ 12 \\ 0.008 \\ \hline \\ K = \frac{Q \ 2}{2 \ \pi \ Pc \ L} * \ln \frac{21}{D} \\ (cm/s) \\ \hline \\ \hline \\ 2.99E-05 \\ \hline \\ 6.94E-05 \\ \hline \\ 1.44E-04 \\ \hline \\ 6 \ 59E-05 \\ \hline \end{array} $
Ha * Cos X ° = 37 It = 46. (m) $\approx$ 00 px n1 = 00 EFECTIVE PRESSURE PRESSURE PRESSURE PRESSURE PRESSURE PRESSURE PRESSURE PRESSURE PRESSURE PRESSURE PRESSURE A 81 A 81	Y 35       3:00     Plastic       0778     01       INJECTED     WAT       TIME     VOLI       t     CC       (min)     (11       10     49.       10     611       10     195       10     40.	Hydrostatu Pipe Length (m) Diameter Roughness ren tt Q=Qt/t (//mn) 00 4.90 .00 20.50 .00 61 10 .00 19.50 00 4.00 .00 19.55 00 4.00 .00 PC = PC <sub>1</sub> + 1	$\frac{\log d}{(kg/cm2)}$ im = $\frac{\phi_2}{m}$ index n2 FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD C2 + PC3	Lh≃ (H:+Ha)/1 6.00 0 0254 0 008 Q2=Q*100/6 (cm%/s) 81 67 341 67 1018.33 325.00	10 = <u>Reducers:</u> <i>Q</i> SPECIFIC ABSOPTION Aθ = Q / L (//min/m) 1 23 5 13 15 28 4.88	3 815 Valv cuopling: Packer Union elbow Luceon Unit UL = <u>10* Ae</u> UL 2.5 5.9 12.3 5.6	$\begin{array}{c} & 0.2 \\ & 0.12 \\ & 0.008 \end{array}$
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	B.00         Plastic           0778         01           INJECTED         WA1           TIME         VOLI           t         CC           (min)         (11           10         49.           10         611           10         49.           10         611           10         195           10         40.	Pipe. Length (m) Diameter Roughness ren t Q=Qt/t ) (l/mm) 00 4.90 .00 20.50 .00 61 10 00 19.50 00 4.00 COTAL LOSS L PC = PC <sub>1</sub> + l	$im = \phi_2$ (m) = index n2 FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	6.00 0 0254 0 008	Reducers:         Q           SPECIFIC         ABSOPTION           AP = Q / L         (l/min/m)           1 23         5 13           15 28         4.88	Valv cuopling: Packer Union elbow $UL = \frac{10^{\circ} \text{ Ae}}{\text{Pe}}$ UL 2.5 5.9 12.3 5.6	$0.12$ 0.008 PERMEABUJTY coEFICIENT $K = \frac{Q.2}{2 \pi Pc L} \cdot la \frac{21}{D}$ (cm/s) 2.99E-05 6.94E-05 1.44E-04 6.59E-05
(m) = 00 x n1 = 00 EFECTIVE PRESSURE 3 Pe =Po \$h - Pio (kg/cm <sup>2</sup> ) 4 81 8 66 12,47 8 68 4 81 	0778 01 INJECTED WAT TIME VOLU t CC (min) (11 10 49, 10 205 10 611 10 195 10 40, The second seco	Diameter Roughness ren tt Q=Qt/t ) (//m/n) 00 4.90 00 20.50 00 61 10 00 19.50 00 4.00 OTAL LOSS L PC = PC <sub>1</sub> + 1		0 0254 0 008 Q2=Q*100/6 (cm%)s) 81 67 341 67 1018.33 325.00	Q SPECIFIC ABSOPTION $A \theta = Q / L$ (l/min/m) 1 23 5 13 15 28 4.88	Packer Unron elbow UNIT UL = 10* Ae UL 2.5 5.9 12.3 5.6	$0.12$ 0.008 PERMEABUJTY coEFICIENT $K = \frac{Q.2}{2 \pi Pc L} \cdot la \frac{21}{D}$ (cm/s) 2.99E-05 6.94E-05 1.44E-04 6.59E-05
ax     n1     =     0.0       EFECTIVE     PRESSURE       3     Pe     =Po     \$h       Pe     =Po     \$h     Plo       (kg/cm²)     4.81       8     66       12.47     8.68       4.81	01 INJECTED WAY TIME VOLI t CC (min) (1 10 49, 10 205 10 611 10 195 10 40, The second	Roughness           ren         Q=Qt/t           it         Q=Qt/t           )         (l/mm)           00         4.90           .00         20.50           .00         61 10           00         19.50           00         4.00	INDEX N2 FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	0 008 Q2=Q*100/6 (cm³/s) 81 67 341 67 1018.33 325.00	SPECIFIC ABSOPTION A0 = Q / L (l/min/m) 1 23 5 13 15 28 4.88	Union elbow LUGEON UNIT UL = $\frac{10^{+} \text{Ae}}{\text{Pe}}$ UL 2.5 5.9 12.3 5.6	$\begin{array}{c} 0.008 \\ \hline \\ $
EFECTIVE PRESSURE PE =P0 & h - Pio (kg/cm <sup>2</sup> ) 4 81 8 66 12.47 8 68 4 81	INJECTED WAT TIME VOLU t CC (min) (11 10 49, 10 205 10 611 10 195 10 40. The second	$\begin{array}{c c} & & \\ \hline ref{ref} & \\ \hline voltametric{}{} voltametric{}{$	FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	Q2=Q*100/6 (cm%s) 81 67 341 67 1018.33 325.00	ABSOPTION Ae = Q / L (l/min/m) 1 23 5 13 15 28 4.88	$UL = \frac{10^{*} \text{ Ae}}{\text{Pe}}$ $UL = \frac{10^{*} \text{ Ae}}{\text{UL}}$ $2.5$ $5.9$ $12.3$ $5.6$	$\begin{tabular}{ c c c c c } \hline $PERMEABILITY$ & $coeFicIeNT$ & $coeFicIeNT$ & $x$ - $\frac{Q}{2\pi}Pe $ L$ & $is$ $\frac{21}{D}$ & $(cm/s)$ & $(cm/s)$ & $(cm/s)$ & $2.99E-05$ & $6.94E-05$ & $1.44E-04$ & $6.59E-05$ & $1.4E-04$ & $
PRESSURE PRESSURE Pe =Po th - Plo (kg/cm <sup>2</sup> ) 4 81 8 66 12,47 8 68 4 81 	TIME         VOL           t         C           (min)         (1)           10         49.           10         205           10         611           10         195           10         40.           -         -           -         -           -         -	$\begin{array}{c c} & & \\ \hline ref{ref} & \\ \hline voltametric{}{} voltametric{}{$	FLOOD Q1=Q/60000 (m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	(cm%s) 81 67 341 67 1018.33 325.00	ABSOPTION Ae = Q / L (l/min/m) 1 23 5 13 15 28 4.88	UNIT $UL = \frac{10^{+} \text{ Ae}}{Pe}$ UL 2.5 5.9 12.3 5.6	$\begin{array}{c} \text{COEFICIENT} \\ \text{K} = \frac{Q \ 2}{2 \ \pi \ \text{Pe} \ L} \cdot \ln \frac{21}{D} \\ \hline \\ (cm/s) \end{array}$
Pe =Po ↓h - Plo (kg/cm <sup>2</sup> ) 4 81 8 66 12,47 8 68 4 81	t C (min) (1 10 49, 10 205 10 611 10 195 10 40. Th	$\begin{array}{c c} \mathbf{x} & \mathbf{Q} = \mathbf{Q} \mathbf{t} \mathbf{t} \\ \mathbf{y} & (\mathbf{y} - \mathbf{y} \mathbf{n}) \\ \mathbf{z} 0 & 4 \cdot 9 0 \\ \mathbf{z} 0 0 & 2 0 \cdot 5 0 \\ \mathbf{z} 0 0 & 1 0 \\ \mathbf{z} 0 0 & 1 1 0 \\ \mathbf{z} 0 0 & 1 9 \cdot 5 0 \\ \mathbf{z} 0 0 & 4 \cdot 0 \\ \mathbf{z} 0 0 & \mathbf{z} 1 0 \\ \mathbf{z} 0 0 0 \\ \mathbf{z} 0 0 \\ \mathbf{z} 0 \mathbf{z} 1 \mathbf{z} 0 \\ \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \\ \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z} \mathbf{z}$	$\begin{array}{c} Q1 = Q/60000 \\ (m^3/s) \\ \hline 8.17E-05 \\ \hline 3.42E-04 \\ \hline 1.02E-03 \\ \hline 3.25E-04 \\ \hline 6.67E-05 \\ \hline \hline \\ OAD \\ \hline \\ PC_2 + PC_3 \end{array}$	(cm%s) 81 67 341 67 1018.33 325.00	Ae = Q / L (l/min/m) 1 23 5 13 15 28 4.88	$UL = \frac{10^{+} \text{Ae}}{\text{Pe}}$ $UL$ $2.5$ $5.9$ $12.3$ $5.6$	$K = \frac{Q 2}{2 \pi Pe L} * \ln \frac{21}{D}$ (cm/s) 2.99E-05 6.94E-05 1.44E-04 6.59E-05
(kg/cm <sup>2</sup> ) 4 81 8 66 12,47 8 68 4 81	(min) (1 10 49, 10 205 10 611 10 195 10 40, The second seco	) $(l/mn)$ 00 4.90 00 20.50 00 61 10 00 19.50 00 4.00 OTAL LOSS L PC = PC <sub>1</sub> + l	(m <sup>3</sup> /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	(cm%s) 81 67 341 67 1018.33 325.00	(l/min/m) 1 23 5 13 15 28 4.88	UL 2.5 5.9 12 3 5.6	(cm/s) 2.99E-05 6.94E-05 1.44E-04 6 59E-05
4 81           8 66           12,47           8 68           4 81	10 49. 10 205 10 611 10 195 10 40. Tr	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	81 67 341 67 1018.33 325.00	(l/min/m) 1 23 5 13 15 28 4.88	UL 2.5 5.9 12 3 5.6	(cm/s) 2.99E-05 6.94E-05 1.44E-04 6 59E-05
8 66           12.47           8 68           4 81	10 205 10 611 10 195 10 40.	$\begin{array}{cccc} 0.00 & 20.50 \\ 0.00 & 61 10 \\ 0.00 & 19.50 \\ 0.00 & 4.00 \\ \end{array}$ $\begin{array}{c} 0.00 & 4.00 \\ \end{array}$ $\begin{array}{c} 0.00 & 0.00 \\ \end{array}$ $\begin{array}{c} 0.00 & 0.00 \\ \end{array}$	$\begin{array}{c} 3.42E-04 \\ 1.02E-03 \\ 3.25E-04 \\ 6.67E-05 \\ \end{array}$ $OAD$ $\begin{array}{c} OAD \\ PC_2 + PC_3 \\ \end{array}$	341 67 1018.33 325.00	5 13 15 28 4.88	5.9 12 3 5.6	6.94E-05 1.44E-04 6 59E-05
12.47 <u>8 68</u> <u>4 81</u>	10 611 10 195 10 40.	00 61 10 00 19.50 00 4.00 00 00 00 00 00 00 00 00 00 00 00 00 0	1.02E-03 3.25E-04 6 67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	1018.33 325.00	15 28 4.88	12 3 5.6	1.44E-04 6 59E-05
8 68	10 195 10 40.	00 19.50 00 4.00 OTAL LOSS L PC = PC <sub>1</sub> + I	3.25E-04 6 67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>	325,00	4.88	5.6	6 59E-05
4 81	10 40.	$\begin{array}{c} 00 \\ \hline 4.00 \\ \hline \end{array}$ $\begin{array}{c} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 $	6 67E-05 OAD PC <sub>2</sub> + PC <sub>3</sub>			· · · · · · · · · · · · · · · · · · ·	<b></b>
	T	OTAL LOSS L $Pc = Pc_1 + I$	OAD $Pc_2 + Pc_3$			<u></u>	
$\frac{)^{2} * (Q_{1}^{2}) * lt}{\binom{5.33}{1}}$	i i	Pc= Pc <sub>1</sub> + I	Pc <sub>2</sub> + Pc <sub>3</sub>	· · · · · · · · ·		<u> </u>	<u> </u>
on steel pipe	<u> </u>	(¢ iss load on plasti	$\frac{(Q_2^2)^{*}}{2^{5}}$		P3= loss load	$\sum \alpha * (Q_1)$ on reduccione y uniones	
		12 47		VAL	UES OF LU		IT
		1 1 2 1		00 2.0			12.0 14.0
	<b>-</b>	1 1 1		+ <u> </u>			
				2	5.9		
		   1 	E RAM	3			12.3
			SSUR	4	56		
			ů H	5 21			
				<u> </u>			
	i i			PERME	ABILITY (LU	) =	12.3
	00 50.00	60 00 70 00		, 1176		,	
	Q (l/min)	00 30.00 40.00 50.00 Ω (l/min)	00 \$0.00 40.00 50.00 60 00 70 00	00 30.00 40.00 50.00 60 00 70 00 Q (l/min)	PERME 00 30.00 40.00 50.00 60 00 70 00 Q (I/min)	00 20 40 6.0 0 20 60 70 00 0 20 60 70 70 00 0 20 60 70 70 70 70 70 70 70 70 70 70 70 70 70	8 66       25         9 4       25         9 4       5.9         9 4       5.9         9 4       5.9         9 4       5.9         9 5       5

## swissboring

Swissboring Overseas Corporation Ltd.



Po = Pressure Reading; Lh = Hydrostatic Load, Plo = Loss Pressure

60 00 80. G (l/mìn)

80.00

120.00

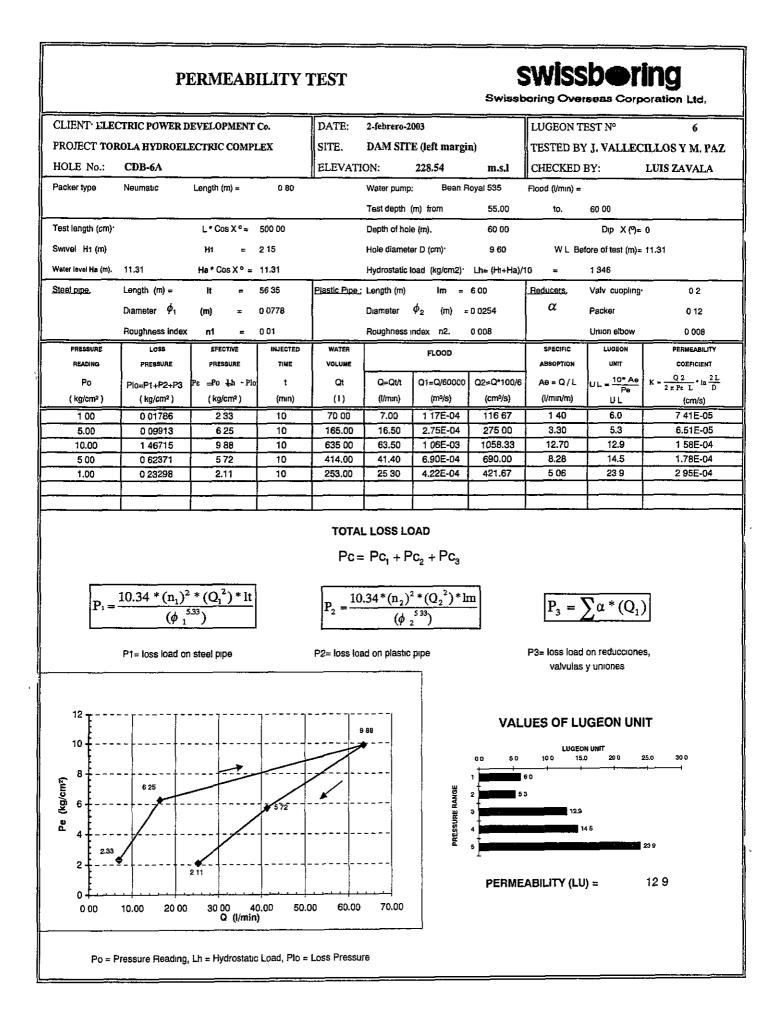
100 00

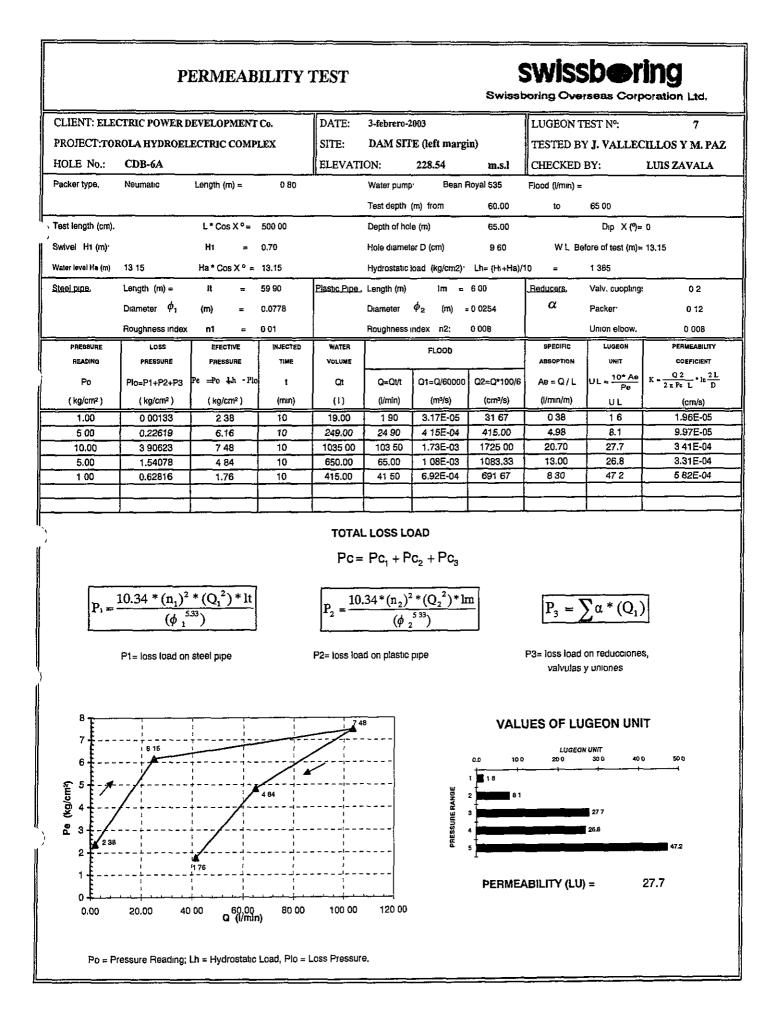
140 00

0.00

20.00

40.00





	P1	ERMEAB	ULITY	FEST						ing poration Ltd.
CLIENT: ELEC	TRIC POWER D	EVELOPMENT	Co.	DATE:	3-febrero-2	003		LUGEON T	EST №:	8
PROJECT TOF	OLA HYDROEL	ECTRIC COMPI	EX	SITE	DAM SIT	E (left margi	n)	TESTED BY	( J. VALLEC	LLOS Y M. PAZ
HOLE No.:	CDB-6A			ELEVATI	ON:	228.54	m.s.l	CHECKED	BY:	LUIS ZAVALA
Packer type	Neumatic	Length (m) =	0 80	<u>.u.</u>	Water pump	· Bean R	loyal 535	Flood (l/min) =		
		/			Test depth	(m) from	65 00	to	70 00	
Test length (cm)		L * Cos X ° =	500.00		Depth of hol		70 00		Dup X (%=	<u> </u>
• • •					•					
Swivel H1 (m)		H1 ≠	1 15		Hole diamet	er D (cm)	9 60	W L Be	fore of test (m)=	13 59
Water level Ha (m)	13.59	Ha * Cos X ° =	13 59		Hydrostatic	load (kg/cm2) <sup>.</sup>	Lh= (Hi+Ha)/	10 =	1 474	
Steel pipe:	Length (m) =	it =	65 35	Plastic Pipe :	Length (m)	lm =	6 00	Reducers:	Valv cuopling	. 02
	Diameter $\phi_1$	(m) =	0 0778		Diameter	$\phi_2$ (m) =	0 0254	α	Packer	0 12
	Roughness Index	n1 =	0 01		Roughness	index n2	0 008		Union elbow	0.008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	1			SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME		FLOOD		ABSOPTION	UNIT	COEFICIENT
Po	Pio=P1+P2+P3	Pe ⊫Po ∔uh -Pio	t	Qt	Q=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	UL = 10* Ae	$K = \frac{Q2}{2\pi Pe L} \cdot \ln \frac{2L}{D}$
( kg/cm <sup>2</sup> )	(kg/cm²)	( kg/cm <sup>2</sup> )	(min)	(1)	(l/m:n)	(mº/s)	(cm³/s)	(l/min/m)	Pe UL	(cm/s)
1.00	0.00917	2 46	10	50 00	5 00	8 33E-05	83.33	1.00	41	5.00E-05
5.00	0.04761	6 43	10	114 00	11 40	1 90E-04	190 00	2.28	35	4.37E-05
10.00	3.57923	7 89	10	989 00	98 90	1 65E-03	1648 33	19.78	25 1	3 09E-04
5.00	1.33510	5 14	10	604 00	60 40	1 01E-03	1006 67	12.08	23 5	2 90E-04
1.00	0.29734	2 18	10	285 00	28 50	4.75E-04	475 00	5 70	26 2	3 23E-04
	]								<b>.</b>	

$$Pc = Pc_1 + Pc_2 + Pc_3$$

$$\mathbf{P}_{1} = \frac{10.34 * (\mathbf{n}_{1})^{2} * (\mathbf{Q}_{1}^{2}) * \mathbf{lt}}{(\phi_{1}^{5.33})}$$

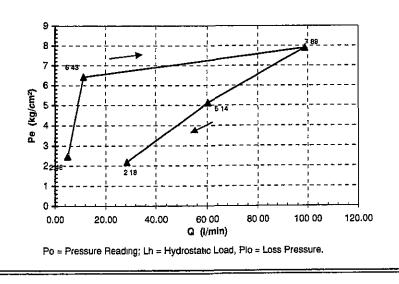
P1= loss load on steel pipe

 $P_2 = \frac{10.34^* (n_2)^2 * (Q_2^2)^* \text{lm}}{(Q_2^2)^* \text{lm}}$  $(\phi_{2}^{533})$ 

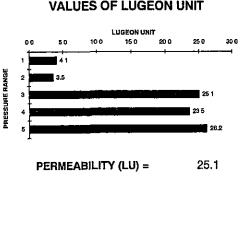
P2= loss load on plastic pipe

 $\mathbf{P}_3 = \sum \alpha^* (\mathbf{Q}_1)$ 

P3= loss load on reducciones, valvulas y uniones

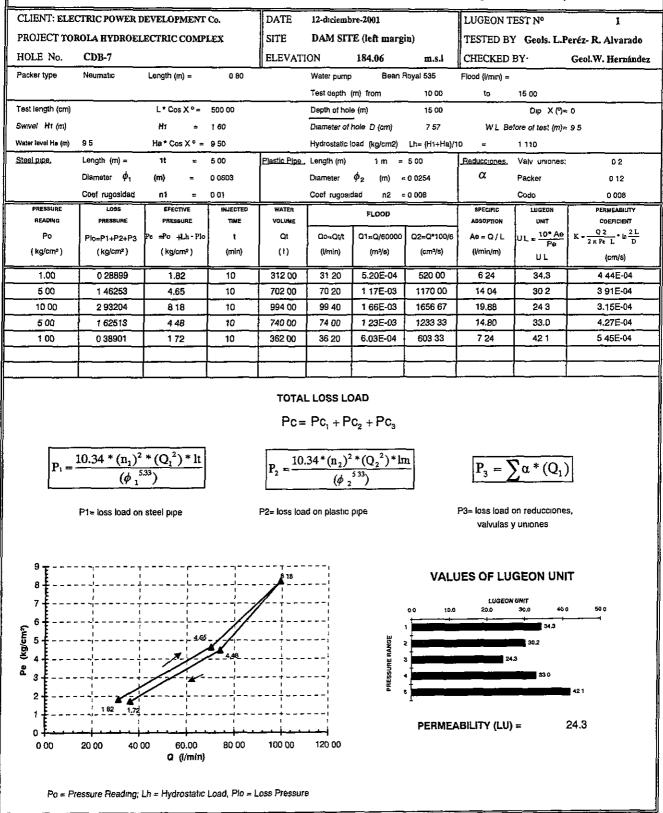


VALUES OF LUGEON UNIT



## swissbering

Swissboring Overseas Corporation Ltd.



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## swissbering

Swissbonng Overseas Corporation Ltd.

OI IENZE DI D	OTINIO DOVINDO D		~							
	CTRIC POWER D			DATE	12-diciemb			LUGEON T		2
	ROLA HYDROEL	ECTRIC COMPI	ÆX	SITE	DAM SIT	E (left margi	n)	TESTED BY	Geols. L.P	eréz- R. Alvarado
HOLE No	CDB-7			ELEVATI	ON	184.06	m.s.l	CHECKED	BY.	Geol.W. Hernández
Packer type	Neumatic	Length (m) ≂	0 80		Water pump	Bean F	Royal 535	Flood (l/min) =		
					Test depth (	m) from	15 00	to	20 00	
Test length (cm)		L * Cos X ° =	500 00		Depth of hole	e (m)	20 00		Dip X (?)=	٥
Swivel H1 (m)		H1 =	2 70		Diameter of I	- hole D (cm)	7 57	WL Be	fore of test (m)=	10 25
Water levei Hs (m)	10 25	Ha*CosX° ≠	10 25		Hydrostatic I	oad (kg/cm2)	Lh= (H1+Ha)/1	0 =	1 295	
Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe .	Length (m)	1 តេ =	5 00	Beducciones.	Valv, uniones	02
	Diameter $\phi_1$	(m) =	0 0603	1	Diameter	\$\$2 (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	n1 =	0 01		Coef rugosk	iad n2 =	0 008		Codo	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	<u> </u>	FLOOD	··· ,· <mark>-</mark> .	SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME			<b>.</b>	ABSOPTION	UNIT	COERCIENT
Po	Plo=P1+P2+P3	Pe =Po +Lh -Plo	t	Cat	Qo=Qt/t	Q1=Q/60000	Q2¤Q*100/6	Ae=Q/L	$UL = \frac{10*Ae}{Pe}$	$K = \frac{Q 2}{2 \pi P e L} \cdot \ln \frac{2 L}{D}$
(kg/cm²)	(kg/cm²)	( kg/cm² )	(nin)	(1)	(I/min)	(m³/s)	(cm³/s)	(l/min/m)	UL Pe	(cm/s)
1 00	0 00526	2 29	10	42 00	4 20	7 00E-05	70 00	0 84	37	4 75E-05
5 00	0.13346	6 16	10	212 00	21 20	3.53E-04	353 33	4 24 13 20	69 132	8 91E-05 1 71E-04
10 00 5.00	1 29279 0.55652	10 00 5 74	10 10	660 00 433 00	66 00 43 30	1 10E-03 7 22E-04	1100.00 721 67	8 66	15 1	1 95E-04
1 00	0 04868	2 25	10	128 00	12 80	2 13E-04	213 33	2 56	11.4	1 48E-04
				Pc=	L LOSS LC : PC <sub>1</sub> + P	c <sub>2</sub> + Pc <sub>3</sub>		<u> </u>	<u>I</u>	
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$	$\frac{(Q_1^2) * lt}{(33)}$		Pc=	: Pc <sub>1</sub> + P	c <sub>2</sub> + Pc <sub>3</sub>	<u>m</u>	$P_3 = $	$\sum \alpha * (Q_1)$	)
P <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1^2)^2}$			Pc=	$Pc_1 + P$ .34*(n <sub>2</sub> ) <sup>2</sup> ( $\phi$	$c_2 + Pc_3$ $\frac{2^{2} (Q_2^{2}) + h}{2^{5}}$	<u>m</u>	P3= loss load	$\sum \alpha * (Q_1)$	
P <sub>1</sub> =				$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	$c_2 + Pc_3$ $\frac{2^{2} (Q_2^{2}) + h}{2^{5}}$		P3= loss load	on reduccione y uniones	s,
		n steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$Pc_1 + P$ .34*(n <sub>2</sub> ) <sup>2</sup> ( $\phi$	$c_2 + Pc_3$ $\frac{2^{2} \cdot (Q_2^{2}) \cdot h}{2^{533}}$		P3= loss load valvulas	on reduccione y uniones JGEON UN	s,
12 <del>-</del> 10		n steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	$c_2 + Pc_3$ $\frac{2^{2} \cdot (Q_2^{2}) \cdot h}{2^{533}}$	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN	s,
12	P1= loss load or	n steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN	s, IT
12		n steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LU	on reduccione y uniones JGEON UN	IT 140 180 → →
12	P1= loss load or	n steel pipe	574	$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN	IT 140 180 132
12 10 8 6	P1= loss load or	n steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	$c_2 + Pc_3$ $\frac{2^{2} \cdot (Q_2^{2}) \cdot h}{2^{533}}$	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN N UNIT 100 12.0	IT 140 180 → → →
12 10 8 6 4	P1= loss load or	n steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN	IT 140 160 132
12	P1= loss load or	n steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{2}$	$= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LL LUGEO 40 80 80 137 69	on reduccione y uniones JGEON UN N UNIT 100 12.0	IT 140 180 132 132 151
12 10 8 6 8 9 9 2	P1= loss load or	1 \$166  pipe	574	$Pc = 10$ $P_2 = 10$ $P2 = loss los$	$PC_{1} + P$ <u>.34*(n_2)</u> ( $\phi$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN N UNIT 100 12.0	IT 140 160 132
12 10 8 6 2 2 2 2 2	P1= loss load or	1 \$166  pipe	574	$Pc = 10$ $P_2 = 10$ $P2 = loss los$	$PC_{1} + P$ <u>.34*(n_2)</u> ( $\phi$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LL LUGEO 40 80 80 137 69	on reduccione y uniones JGEON UN N UNIT 100 12.0	IT 140 180 132 151
12 10 B 6 2 2 2 2 2 2	P1= loss load or	1 \$166  pipe	574	$Pc = 10$ $P_2 = 10$ $P2 = loss los$	$PC_{1} + P$ <u>.34*(n_2)</u> ( $\phi$ ad on plastic	C <sub>2</sub> + PC <sub>3</sub>	VAL	P3= loss load valvulas UES OF LL LUGEO 40 80 80 137 69	on reduccione y uniones JGEON UN N UNIT 100 12.0	IT 140 180 132 132 151

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## SWISSDOTING Swissboring Overseas Corporation Ltd,

INVIEUT ION	IOLA HYDROEL	ECTRIC COMP	LEX	SITE	DAM SIT	E (left margi	in)	TESTED B	Y Gents T F	eréz- R. Alvarado
HOLE No	CDB-7	Source could		ELEVATI		184.06	m.s.1	CHECKED		Geol, W. Hergand
Packer type	Neumatic	Length (m) =	0 80		Water pump	<u> </u>	loyal 535	Flood (l/min) =		
					Test depth	m) from	20 00	to	25 00	
est length (cm)		L * Cos X ° =	500 00		Depth of hol	e (m)	25 00	<u> </u>	 Dıp X(۳)=	: 0
wive) H1 (m)		H1 =	0 95		Diameter of	- hole D (cm)	7 57	W L Be	ofore of test (m)=	10 25
/ater level Ha (m)	10 25	Ha*CosX° =	1D 25		Hydrostatic I	oad (kg/cm2)	Lh= (H1+Ha)/1	ID ≈	1 120	
teel pipe.	Length (m) =	 1t =	5 00	Plastic Pipe	Length (m)	1 m =	5 00	Reducciones.	Valv uniones	02
	Diameter $\phi_1$	(m) =	0 0603	ł	Diameter	$\phi_2$ (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	n1 =	0 01		Coef rugosia	iad n2 =	0 008		Codo	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PREASURE	TIME	VOLUME				ABSOPTION		COERCIENT
Po (kg/cm²)	Plo=P1+P2+P3 (kg/cm²)	Pe ≕Po +/Lh-Plo (kg/cm²)	) t (min)	(1)	} Qo=Qt/t (l/mìn)	Q1≂Q/60000 (m³/s)	Q2=Q*100/6 (cm³/s)	Ae = Q / L (/m:n/m)	$UL = \frac{10^* Ae}{Pe}$ UL	
1 00	0 00000	2 12	1 10	0.00		0 00E+00	0 00	0 00	00	(cm/s) 0 00E+00
5 00	0 00251	6 12	10	29 00	2 90	4 83E-05	48 33	0.58	09	1 23E-05
10 00	0 03340	11 09	10	106 00	10 60	1 77E-04	176 67	2.12	19	2 48E-05
<u> </u>	0 00715	6_11 2_12	10	49 00	<u>4 90</u> 0.00	8 17E-05 0 00E+00	81 67 0 00	0 98	16	2 08E-05 0 00E+00
			<u> </u>							
L	$\frac{10.34 * (n_1)^2}{(\phi_1^5}$ P1= loss load on			$P_2 = \frac{10}{2}$ P2= loss loa		*(Q <sub>2</sub> <sup>2</sup> )*lr <sup>5 33</sup> )		$P_3 =$ P3= loss load	$\sum \alpha * (Q_1)$	_J
12		, <b> _ .</b> .			,				y uniones	_
10	1 1 1	1 I 1 I 1 I	)   		ا <del>تر</del> ب ا		VALI	JES OF LU	GEON UN	1
		T	/		1 1 1		00 0.5	LUGEO: 3 0	N UNIT 1.5 2.0	) 2.5
e <sup>8</sup>			<u> </u>		!		1 00		~+ +	1
ка стан	6 12			<b>b</b>	, ł	ANGE		6.0		
÷	1/	611	4 1	1		PRESSURE RANGE			1.	9
* 4 <del></del>				- <b>- + -</b> I	;	RESS			1.6	
2	·	, <b>.</b>		<del>,</del>	1		5 00			
2 2.122.12		1 1	1		1		DEDME/			19
0 <u>+ · · · ·</u> 0 00	200 40	00 600 10 Ci (l/min)	<u>,_,,</u> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	10 00	 12 00		r Crivick		, -	. •
o È	200 40	00 600 Ci(l/min)		10 00	 12 00		PERMEA	BILITY (LU)	) =	

## swissbering

s

Packer type         Neumatic         Length (m) =         0.80         Water pump         Bean Royal 535         Flood (l/min) =           Test depth         (m) from         25.00         to         30.00           Test length (cm)         L * Cos X ° =         500.00         Depth of hole (m)         30.00         Dip X (%)= 0           Swivel Hs (m)         H1         =         1.10         Diameter of hole D (cm)         7.57         W L Before of test (m)= 11.05           Water level Hs (m)         11.05         Ha * Cos X ° ±         11.05         Hydrostatic load (kg/cm2)         Lh= (H1+Ha)/10         =         1.215										•	oration Ltd.
$\frac{\text{HOLE No}}{\text{Poscher type}}  \frac{\text{COB-7}}{\text{Neutralize}}  \frac{\text{ELEVATION: } 184.06 \\ \text{m.s.II}}{\text{CHECKED BY. Geol, W. Hermádel Poscher type}}  \frac{\text{Neutralize}}{\text{Neutralize}}  \frac{\text{CHECKED BY. Geol, W. Hermádel Poscher type}}{\text{Neutralize}}  \frac{\text{CHECKED BY. Geol, W. Hermádel Poscher type}}{\text{Neutralize}}  \frac{\text{Text despt. (in (n) term } 200 \\ \text{to 30.00} \\ \text{Despender of hole (n) } 30.00 \\ \text{Despender of hole (n) } 10 \\ \text{Despender of hole (n) } $	CLIENT ELEC	CTRIC POWER D	EVELOPMENT	Co.	DA'TE <sup>.</sup>	12-diciembi	re-2001	<u></u>	LUGEON T	EST Nº.	4
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	PROJECT TOP	ROLA HYDROEL	ECTRIC COMPL	EX	SITE:	DAM SIT	E (left margi	n)	TESTED BY	Geols. L.P	eréz- R. Alvarado
$\frac{1}{100} + \frac{1}{100} + \frac{1}$	HOLE No	CDB-7			ELEVATI	ON:	184.06	m.s.l	CHECKED	BY.	Geol.W. Hernánde
Test length (cm) L * Cos X* = 500 00 Sweel Hi (m) Hi = 1 10 Sweel Hi (m) Hi = 0 10 Dameter Of los D (cm) Dameter Of los D (cm) Ploap 1 sport of los d	Packer type	Neumatic	Length (m) =	0 80	<u>11</u>	Water pump	Bean A	loyal 535	Flood (I/min) =		
Test length (cm) L * Cos X* = 500 00 Sweel Hi (m) Hi = 1 10 Sweel Hi (m) Hi = 0 10 Dameter Of los D (cm) Dameter Of los D (cm) Ploap 1 sport of los d						Test depth if	m) from	25 00		30.00	
With Hit (m)       H       n       10       Dameter of hole D (cm)       757       W Lecture of test (m) = 11 05         Water wardta (m)       11 05       Ha * Cox X* = 11 05       Hydrostalic load (ngcm2)       Libe (H+Hag17)       -       1215         Sting (ppb, Place) Largeht (m)       11 m       6 00       Exation (ppa, Largeht (m)       11 m       6 00       Exation (ppa, Largeht (m)       11 m       6 00       Diameter d/s (m)       0 028       Code       0 028         Teasure       Index       Index       Values (m)       Index       0 000       Code (ngcoldad n2 = 0008)       Code 0       0 028         Teasure       Index       Index       Values (m)       Index       Values (m)       Index       0 00       Code 0       0 028         Teasure       Index       Values (m)       Index       Values (m)       Index       Values (m)       Index       Values (m)       Index       0 00         Teasure       Index       Values (m)       Values (m)       Values (m)	Test (epoth (cm)		I * Cos XP-	500.00	·			<u> </u>			
Water weet He (m)         11 00         He* Cos X* + 11 05         Phydrostalic load (bg/orm2)         Line (H+H-lay10)         1 215           Sized (pp, L)         Length (m)         1         5 00         Eladic Ega.         Length (m)         1 m         6 00         Cost         Phydrostalic load (bg/orm2)         Line (H+H-lay10)         1 215           Diameter $\phi_1$ (m)         -         0 0003         Diameter $\phi_2$ (m)         1 m         6 00         Code         Diameter $\phi_2$ (m)         -         215           Teacher         O code         Diameter $\phi_1$ movement         Numbers         Water         Diameter $\phi_2$ (m)         0 0054 $\alpha$ Diameter $\phi_2$ $\alpha$	• • •						•				
$\begin{aligned} \underbrace{\text{Sitest}_{pope}}{\text{Diameter}}  \underbrace{\text{A}}_{q}  (m) = 0.0003 \\ \hline \text{Diameter}  \underbrace{\text{A}}_{q}  (m) = 0.0003 \\ \hline \text{Cost}_{pope}(m)  \text{Im} = 6.00 \\ \hline \text{Diameter}  \underbrace{\text{A}}_{q}  (m) = 0.0003 \\ \hline \text{Cost}_{pope}(m) = 0.0254 \\ \hline \text{Cost}_{pope}(m)  \text{Cost}_{pope}(m)  \text{Im} = 6.00 \\ \hline \text{Cost}_{pope}(m)  \text{Cost}_{pope}(m)  \text{Cost}_{pope}(m) \\ \hline \text{FLOOD}  \text{Second}  \text{Diameter}  \underbrace{\text{A}}_{q} = 0.008 \\ \hline \text{Cost}_{pope}(m)  \text{Cost}_{q} = 0.008 \\ \hline \text{Cost}_{q$										, ,	11 05
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			Ha*CosXº ≠	11 05	<del></del>		oad (kg/cm2)	Lh= (H1+Ba)/1	0 =	1 215	
$\frac{1}{100} = \frac{10.34 + (n_1)^2 + (Q_3^2) + 1!}{(\phi_1^2 - 33)}$ $P_1 = \log \log d \text{ at stell ppe}$ $P_2 = \log \log \log d \text{ ppe}$ $P_2 = \log d \text{ ppe}$ $P_2 = \log d$	Steel pipe.	Length (m) =	1t =	5 00	Plastic Pipe .	Length (m)	1m =	5 00	1	Valv uniones	02
$\frac{1000}{1000} = \frac{1000}{1000} = \frac{1000}{1000$		Diameter $\phi_1$	(m) =	0 0603		Diameter	$\phi_2$ (m) =	0 0254	α	Packer	0 12
$\frac{P_{12} C_{11} P_{22} P_{23} P_{2} P_{23} P_{3} P_{4} P_{3} P_{3} P_{3} P_{4} P_{3} P_{3} P_{4} P_{3} P_{3} P_{4} P_{3} P_{3} P_{3} P_{4} P_{3} P_{3} P_{3} P_{4} P_{3} P_{3} P_{4} P_{3} P_{4} P_{3} P_{4} P_{3} P_{4} P_{3} P_{4} P_{3} P_{4} P_{$		Coef rugosidad	n1 =	0 01		Coef rugosid	iad n2 =	0 008		Codo	D OOB
$\begin{array}{c c} P_{0} & P_{10,p21+P_{24},P_{24}} & P_{2} = P_{0} + A_{1} - P_{10} & 1 & O_{1} & O_{0} - O_{0} + O_{0} & O_{1} - O_{0} + O_{0} + O_{1} + P_{1} + P_{2}	PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEABILITY
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	READING	PRESSURE	PRESSURE	TIME	VOLUME		1	· · · · · · · · · · · · · · · · · · ·	ABSOPTION		
$\frac{1}{100}  0  00172  2  21  10  2400  240  4  00E-05  40  00  0  48  22  2  281E05 \\ \hline 5  00  0  36891  585  10  853  00  588C04  588E033  706  121  1  56E-04 \\ \hline 10  00  1  28496  9  933  10  658  00  658  00  10E-03  1096  657  1316  133  1  72E-04 \\ \hline 5  00  0  128496  5  772  10  409  00  62E-04  681  67  818  143  1  18E-04 \\ \hline 100  0  0  11760  2  10  10  199  00  19.90  3  32E-04  831  67  3  98  190  2  46E-04 \\ \hline 100  0  0  11760  2  10  10  199  00  19.90  3  32E-04  831  67  3  98  190  2  46E-04 \\ \hline Pc = Pc_1 + Pc_2 + Pc_3 \\ \hline \hline P_1 = \frac{10.34  (n_1)^2  (Q_1^2)  11}{(\phi_1^{-533})} \\ \hline P_2 =  \log  \log  0  \log  (e_2^{-533}) \\ \hline P_2 = \log  \log  \log  0  \log  (e_2^{-533}) \\ \hline P_3 = \log  \log  0  150  200 \\ \hline P_4 = \log  \log  0  \log  150  100  199 \\ \hline P_4 = \log  \log  \log  150  10$		t	1		{	1	í í	í í			$K = \frac{Q 2}{2 \pi P c L} + \ln \frac{2 L}{D}$
$\frac{500}{98991} \frac{585}{585} \frac{10}{10} \frac{35300}{586} \frac{3530}{586} \frac{586}{580} \frac{588}{1006} \frac{588}{33} \frac{706}{121} \frac{1}{133} \frac{1}{133} \frac{1}{12264} \frac{1}{12665} \frac{1}{1316} \frac{1}{133} \frac{1}{12264} \frac{1}{12264} \frac{1}{100} \frac{1}{1006} \frac{1}{1316} \frac{1}{133} \frac{1}{12264} \frac{1}{12264} \frac{1}{100} \frac{1}{100$					<u></u>					÷	
$\frac{1000}{500} \frac{128496}{9.95} \frac{9.95}{5.72} \frac{10}{10} \frac{409.00}{409.00} \frac{40.90}{40.90} \frac{6.82E-04}{6.82E-04} \frac{681.67}{6.81.67} \frac{8.18}{8.18} \frac{14.3}{14.3} \frac{1.72E-04}{1.85E-04}$ $\frac{100}{100} \frac{0.11760}{0.11760} \frac{2.10}{10} \frac{10}{19.90} \frac{1.9.00}{19.90} \frac{3.32E-04}{3.31.67} \frac{3.98}{3.98} \frac{19.0}{19.0} \frac{2.46E-04}{2.46E-04}$ $\frac{100}{100} \frac{10.34 * (n_1)^2 * (Q_1^2) * 1t}{(\phi_1^{-5.33})}$ $P_1 = \log $			<u> </u>			<u> </u>					
$\frac{500}{100} = \frac{0.49655}{100} = \frac{572}{10} = 10$ $\frac{40900}{1990} = \frac{40900}{1990} = \frac{6.82E-04}{33167} = \frac{818}{14.3} = \frac{14.3}{1.85E-04}$ $\frac{185E-04}{33167} = \frac{190}{2.46E-04}$ $\frac{1900}{1990} = \frac{10.34 \times (n_1)^2 \times (Q_1^2) \times 1t}{(d_1^{-533})}$ $P_2 = PC_1 + PC_2 + PC_3$ $P_2 = \frac{10.34 \times (n_2)^2 \times (Q_2^{-2}) \times 1m}{(d_2^{-533})}$ $P_{1= loss load on steel pipe}$ $P_{2= loss load on plastic pipe}$ $P_{3= \sum \alpha \times (Q_1)$ $P_{3= \sum \alpha \times (Q_1)}$ $P_{3= \sum \alpha \times (Q_1)$ $P_{3= \sum \alpha \times (Q_1)$ $P_{3= \sum \alpha \times (Q_1)}$ $P_{3= \sum \alpha \times (Q_1)$ $P_{3= \sum \alpha \times (Q_1)}$ $P_{3= \sum \alpha \times (Q_1)$ $P_{3= \sum \alpha \times (Q_1)}$ $P_{3= \sum $										· · ·	
TOTAL LOSS LOAD $PC = PC_{1} + PC_{2} + PC_{3}$ $\boxed{P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{2}) * It}{(\phi_{1}^{5.33})}}$ $P_{1} = loss load on steel ppe$ $P2 = loss load on plastic ppe$ $VALUES OF LUGEON UNIT$ $Uueeon UNIT$			· · · · · · · · · · · · · · · · · · ·			<u> </u>				· · · · · · · · · · · · · · · · · · ·	
$Pc = Pc_{1} + Pc_{2} + Pc_{3}$ $\boxed{P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{2}) * lt}{(\phi_{1}^{5.33})}}$ $P_{1} = loss load on steel pipe$ $P_{2} = loss load on plastic pipe$ $P_{2} = loss load on plastic pipe$ $P_{2} = loss load on plastic pipe$ $P_{3} = \sum \alpha * (Q_{1})$ $P_{3} = loss load on reducciones, valvulas y uniones$ $VALUES OF LUGEON UNIT$ $UUEEON UNIT$ $UUEEON UNIT$ $UUEEON UNIT$ $UUEEON UNIT$ $P_{3} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}$ $P_{3} = loss load on reducciones, valvulas y uniones$ $P_{4} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}$ $P_{3} = loss load on reducciones, valvulas y uniones$ $P_{4} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{4} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{4} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, valvulas y uniones$ $P_{5} = loss load on reducciones, v$	1 00	0 11760	2 10	10	199 00	19.90	3 32E-04	331 67	3 98	19 0	2 46E-04
$Pc = Pc_{1} + Pc_{2} + Pc_{3}$ $\boxed{P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{2}) * lt}{(\phi_{1}^{5.33})}}$ $\boxed{P_{2} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}}$ $\boxed{P_{2} = loss load on plastic pipe}$ $P_{2} = loss load on plastic pipe$ $P_{3} = loss load on reducciones, valvulas y uniones$ $VALUES OF LUGEON UNIT$ $\underbrace{Uaeon UniT}_{100$	<del></del> .				I				ł		
10 8 6 5 85 5 72 2 2 2 2 2 2 2 2 2 2 2 2 2	<u>.                                </u>		1				DAD			1	
	P. =			L	$Pc = \frac{10}{P_2} = \frac{10}{P_2}$	$Pc_1 + P$ .34*(n <sub>2</sub> ) <sup>2</sup> ( $\phi_2$	$c_2 + Pc_3$ $\frac{2^2 * (Q_2^2) * ln}{2^{533}}$	n	P3= loss load	on reduccione	_

Po = Pressure Reading, Lh = Hydrostatic Load, Plo = Loss Pressure.

30 00 40 0 Q (i/min)

40 00

0 00

10 00

20 00

3

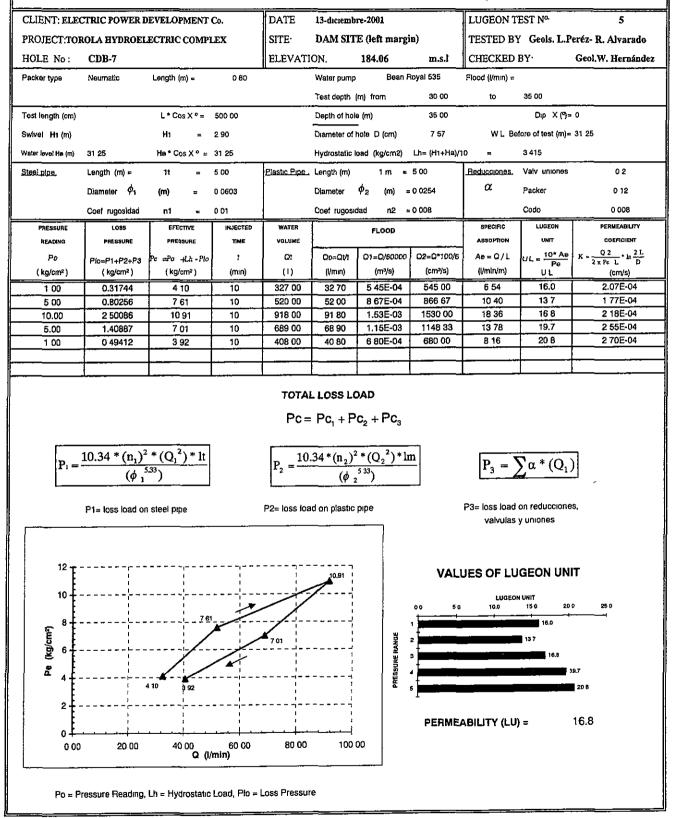
7-5-62

70 00

50 00 60 00

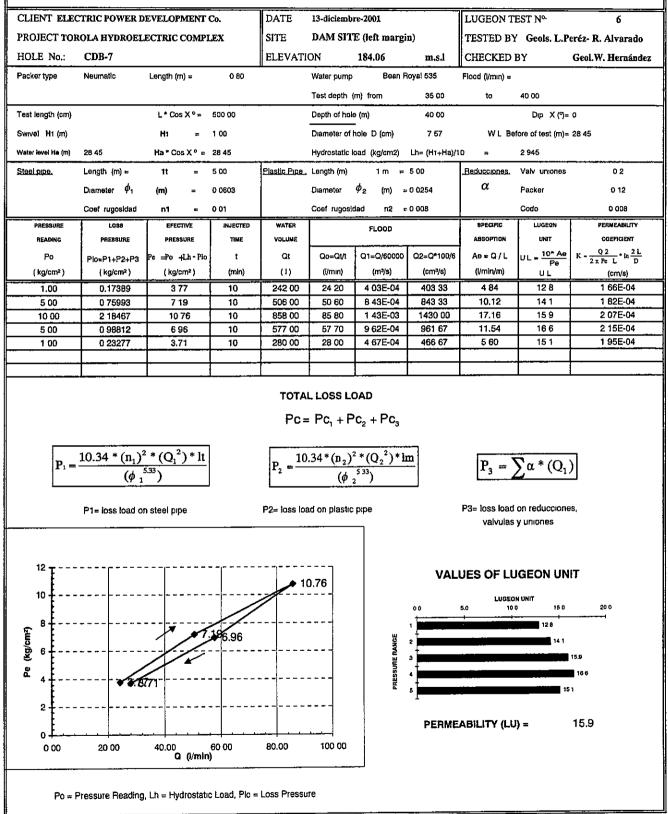
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CLIENT FLEC	TRIC POWER D	EVEL OPMENT	<u> </u>	DATE	13-diciemh	2001		LUGEON T	TOT N10	7
	OLA HYDROEL			SITE		_	:\	i i		
HOLE No.	CDB-7	ECTRIC COMP.	LEA	Ê		E (left marg		11		Peréz- R. Alvarado
				ELEVATI		184.06	m.s.l	CHECKED	BY	Geol.W. Hernández
Packer type	Neumatic	Length (m) ≖	080		Water pump	Bean 1	Royal 595	Flood (Vmin) =		
<u> </u>					Test depth	(m) from	40 00	to	45 00	
Test length (cm)		L≛CosXº≂	500 00		Depth of hol	e (m)	45 00		Dup X(*)=	= 0
Swive: H1 (m)		H1 =	2 20		Diameter of	- hote D (cm)	7 57	W L Be	ofore of test (m)=	= 24 15
Water level Hs (m)	24 15	Ha*CosX* =	24 15		Hydrostatic	icad (kg/cm2)	Lh= (H1+Ha)/	10 =	2 635	
Steel pipe.	Length (m) ≈	11 =	5 00	Plastic Pipe	Length (m)	1m =	5 00	Reducciones.	Valv uniones	02
	Diameter $\phi_1$	(m) =	0 0603		Diameter	φ <sub>2 (m)</sub> =	= 0 0254	α	Packer	0 12
	Coef rugosidad	nt =	0 01	1	Coel rugosi	dad n2 =	0 008	}	Codo	0.008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER	<u> </u>	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME		1000		ABSOPTION		COEFICIENT
Po	Plo=P1+P2+P3	Pe =Po +Lh-Plo	t	Qt	Qo=Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae=Q/L	UL = <u>10* As</u> Pe	$K = \frac{Q 2}{2 \pi P c L} + \ln \frac{2 L}{D}$
(kg/cm²)	( kg/cm² )	( kg/cm² )	(min)	(1)	(l/min)	(m³/s)	(cm³/s)	(l/min/m)	UL	(cm/s)
1 00	0 00000	3 64	10	0 00	0.00	0 00E+00	0 00	0.00	00	0.00E+00
5 00	0 00234	7 63	10	28 00	2 80	4 67E-05	46 67	0.56	07	9 50E-06
10 00 5 00	0.00805	12 63 7 63	10	52 00 30 00	520 300	8 67E-05 5 00E-05	86 67 50 00	<u> </u>	80	1.07E-05 1 02E-05
1 00	0 00209	3 63	10	2 00	0 20	3 33E-06	3 33	0.04	08	1 43E-06
	$\frac{0.34 * (n_1)^2}{(\phi_1^{5.})^5}$ P1= loss load on			$P_2 = \frac{10}{2}$ P2= loss loa		* (Q <sub>2</sub> <sup>2</sup> )*ln 5 <sup>33</sup> )		P3= loss load	$\sum_{n=1}^{\infty} \alpha^{*} (Q_{1})$	_ <b>_</b>
14				12	63		<b>VAL</b> (			
10 8 4 3 4 3 5 6 4 3 5 6 2 0 0		763	3			RESSURE RANGE		ABILITY (LU)		 ∎ o.a D.a 0 8
0 00	1.00 2 essure Reading, L	00 3 00 Q (i/min _h = Hiydrostatic		5 00 oss Pressure	6 00					

### SWISSDORING Swissboring Overseas Corporation Ltd.

		EVELOPMENT		DATE	13-diciemb			LUGEON T	EST No.	8
ROJECT TOP	ROLA HYDROEL	ECTRIC COMPI	LEX	SITE	DAM SIT	E (left margi	<b>n</b> )	TESTED BY	Geols. L.P	eréz- R. Alvarado
IOLE No.	CDB-7			ELEVATI	ON	184.06	m.s.l	CHECKED	ВҮ	Geol.W. Hernánde:
acker type	Neumatic	Length (m) ≃	0 60		Water pump	Bean A	loyal 535	Flood (l/min) =		
					Test depth (	(m) from	45 00	to	50 00	
est length (cm)		L* Cos X ° =	500 00		Depth of hole	s (m)	50 00		Dip X{⁰}=	0
wivel Ht (m)		H1 =	1 05		Diameter of	hole D (cm)	7 57	W L Be	dore of test (m)=	26 35
Vater level He (m)	26 35	Ha*CosX° =	26 35		Hydrostatic !	oad (kg/cm2)	Lh= (H1+Ha)/1	l0 ≈	2 740	
iteel pipe.	Length (m) =	1t =	5 00	Plastic Pipe	Length (m)	1m =	5 00	Reducciones.	Valv uniones	0 2
	Diameter $\phi_1$	(m) =	0 0603		Diameter	φ <sub>2</sub> (m) =	0 0254	α	Packer	0 12
	Coef rugosidad	n1 =	O 01		Coef rugosi	dad n2 ⊭	0 008	}	Codo	0 008
PRESSURE	LOSS	EFECTIVE	INJECTED	WATER		FLOOD		SPECIFIC	LUGEON	PERMEAGULTY
Reading	PREBSURE	PRESSURE	TIME	VOLUME		r		ABSOPTION	UNIT	COEFICIENT
Po	Plo=P1+P2+P3	Pe =Po +Lh-Plo	t	Ct	Qo≓Qt/t	Q1=Q/60000	Q2≂Q*100/6	Ae≂Q/L	$\Psi L = \frac{10*Ae}{Pe}$	$K = \frac{Q 2}{2 \pi P \epsilon L} * \ln \frac{2 L}{D}$
(kg/cm²)	(kg/cm²)	(kg/cm <sup>2</sup> )	(min)	(1)	(Vmin)	(m²/s)	(cm²/s)	(i/min/m)	UL	(cm/s)
1.00	0 00202	3 74	10	26 00	2 60	4 33E-05 1 45E-04	43 33 145 00	0 52	14	1 80E-05 2 92E-05
<u> </u>	0 02250	7 72	10	87 00	8 70	3 37E-04	336 67	4 04	32	4 15E-05
5 00	0 03999	7 70	10	116 00	11 60	1 93E-04	193.33	2 32	30	3 90E-05
1 00	0 00234	3 74	10	28 00	2.80	4 67E-05	46 67	0.56	15	1 94E-05
								L	ļ	
<b></b>	$10.34 * (n.)^2$	<sup>2</sup> * (0, <sup>2</sup> ) * <sup>1</sup>			, 	$Pc_2 + Pc_3$	m	<b></b>		<b></b> 1
P. =	$\frac{10.34*(n_1)^2}{(\phi_1)^2}$			$P_2 = \frac{10}{2}$	$\frac{1.34*(n_2)}{(\phi_1)}$	$\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$	m	L	$\sum \alpha * (Q_1)$	<b></b> -
P. =	$\frac{10.34 * (n_1)^2}{(\phi_1)^2}$				$\frac{1.34*(n_2)}{(\phi_1)}$	$\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$	m	P3= loss load	$\sum \alpha * (Q_1, \dots, Q_n)$ on reduccione y uniones	<b></b> -
				$P_2 = \frac{10}{2}$	$\frac{1.34*(n_2)}{(\phi_1)}$	$\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$		P3= loss load	on reduccione y uniones	
<sup>14</sup>				$P_2 = \frac{10}{2}$	$.34*(n_2)$ ( $\phi$	$\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN	 95. IT
				$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	$\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$		P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN	
<sup>14</sup>				$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*l <sub>1</sub> <sup>533</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN JGEON UNIT 2.0 25	 95. IT
14 12 10				$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*l <sub>1</sub> <sup>533</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN	 95. IT
14 12 10		n steel pipe	.70	$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*l <sub>1</sub> <sup>533</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN JGEON UNIT 2.0 25	25, 25, 21 <b>T</b> 30 55
14 12 10		n steel pipe		$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	$\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN JGEON UNIT 2.0 25	 25, 11T 
14 12 12 12 10 10 10 10 10 10 10 10 10 10 10 10 10		n steel pipe		$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*l <sub>1</sub> <sup>533</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL 10 15	on reduccione y uniones JGEON UN JGEON UNIT 2.0 25	 25, 11T 
14 12 10 8 8 4 4		n steel pipe		$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*l <sub>1</sub> <sup>533</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN 2.0 25 2.3	
Le (kg/cm <sup>2</sup> ) 16 (kg/cm <sup>2</sup> ) 10	P1= loss load or	n steel pipe		$P_2 = \frac{10}{1000}$ P2= loss los	$.34*(n_2)$ ( $\phi$	<sup>2</sup> *(Q <sub>2</sub> <sup>2</sup> )*l <sub>1</sub> <sup>533</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL 10 15	on reduccione y uniones JGEON UN 2.0 25 2.3	 25, 11T 
14 12 10 8 6 4 2 0 0	P1= loss load or	n steel pipe	.70	$P_2 = \frac{10}{12}$ $P_2 = \log $	.34 * (n <sub>2</sub> ) (φ ad on plastic	<sup>2</sup> * (Q <sub>2</sub> <sup>2</sup> ) * lu <sup>5</sup> <sup>33</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN 2.0 25 2.3	
14 12 10 10 10 10 10 10 10 10 10 10 10 10 10	P1= loss load or	1 steel pipe		$P_2 = \frac{10}{1000}$ P2= loss los	.34 * (n <sub>2</sub> ) (φ ad on plastic	<sup>2</sup> * (Q <sub>2</sub> <sup>2</sup> ) * lu <sup>5</sup> <sup>33</sup> ) pipe	VAL	P3= loss load valvulas UES OF LL	on reduccione y uniones JGEON UN 2.0 25 2.3	

### swissboring

							Swisst	oring Ove	rseas Corp	oration Ltd.
CLIENT. ELEC	CTRIC POWER I	DEVELOPMENT	Co.	DATE.	5-noviemb	re-2002		LUGEON T	EST Nº:	1
PROJECT:TOP	ROLA HYDROEL	ECTRIC COMP	LEX	SITE:	DAM SII	E (right mar	rgin)	TESTED B	Y:	
HOLE No .:	CDB-8			ELEVATI		196.43	m.s.l	CHECKED	RY∙	ERNESTO HERRERA Geol.W. Hernández
Packer type	Neumatic	Length (m) =	0.80		Water pump		Royal 535	Flood (l/min) =		
		congat (iii) -			Test depth		15.00	to	21 00	
Test length (cm):		L* Cos X *=	600.00	<u> </u>	Depth of hol		21.00		Dip X (%)=	
Swivel H1 (m)		H1 =	0 75		Hole Diame		7 57	W I Be	======================================	
Water level Ha (m)	18	Ha*CosX° =				load (kg/cm2)			1 875	
Steel pipe:	Longth (m) =	lt =	14 95	Plastic Pipe :		1m =		Reducers;	Valv cuopling	02
,	Diameter $\phi_1$	(m) =	0 0603		Diameter		0 0254	α	Packer	0 12
	Roughness index	n1 =	0.01		Roughness		0 008		Union elbow	0 008
PRESSURE	LOBS	EFECTIVE	INJECTED	WATER	<u></u>	FLOOD		SPECIFIC	LUGEON	PERMEABILITY
READING	PRESSURE	PRESSURE	TIME	VOLUME	- <u></u>	··		ABSOPTION	UNIT	COEFICIENT
Po	Pio=P1+P2+P3	Pe <u>P</u> o +Lh-Plo	t	Qt	Q⊭Qt/t	Q1=Q/60000	Q2≈Q*100/6	Ae = Q/L	$UL = \frac{10*Ae}{Pe}$	$K = \frac{Q 2}{2 \pi P e L} * ln \frac{2 L}{D}$
( kg/cm <sup>2</sup> )	(kg/cm²)	(kg/cm²)	(min)	(1)	(l/m#1)	(m³/s)	(cm³/s)	(i/min/m)	UL	(cm/s)
1.00	0 40309	2,47	10	363 00	36 30	6 05E-04	605 00	6.05	24.5	3.29E-04
5.00	1 13060	5 74	10	608.00	60.80	1.01E-03	1013.33	10 13	17 6	2.37E-04
10.00	2 71945	9,16	10	943 00	94.30	1 57E-03	1571 67	15.72	17.2	2.31E-04
5 00	1.43506	5 44	10	685.00	68 50	1 14E-03	1141.67	11 42	210	2.82E-04
1.00	0 45342	2 42	10	385 00	38.50	6 42E-04	641 67	6.42	26.5	3 56E-04
$\mathbf{P}_1 = -$	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2) * lt$		$P_2 = \frac{10}{2}$	$34^*(n_2)^2$	$\frac{2^{*}(Q_{2}^{2})^{*}h}{5^{5}}$	m	$P_3 =$	$\sum \alpha * (Q_1)$	2]
<b></b>	P1= loss load on			P2= loss loa				P3= loss load valvies a	on couplings, nd packer	
10 <b>-</b> 9 <b>-</b>					9 16		VAL	JES OF LU	GEON UNI	Т
8				/-/			00 50	LUGE01 10:0 15 (		5.0 300
7	; 		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	/_/	 1		00 50			
б б б б б б б б б б с б с б с б с б с с б с		!	<u>574</u>	<b>/</b>	;	B	2		17 6	: ==
b 5				44		PRESSURE RANGE	3		17.2	
e 4		///		<u>1</u>	· [	ssua	4		21 0	
3 - [						384				26.5
2		2 42		<u>1</u>			T			
1				<del>;</del> <b>-</b> -	i		PERME/	ABILITY (LU)	) =	17.2
0 <del>F · ·</del>	20.00	40 00 Q (l/mir	60.00 60)	80.00	100.00					
Po = Pr	ressure Reading;	Lh = Hydrostatic	Load, Plo = I	Loss Pressure	9					

### SWISSDORING Swissboring Overseas Corporation Ltd.

CLIENT: ELE	CTRIC POWER D	EVELOPMENT	Co.	DATE:	5-diciembro	e-2002		LUGEON T	EST Nº:	2
PROJECT:TOI	ROLA HYDROELI	ECTRIC COMPI	LEX	SITE:	DAM SIT	E (right mar <sub>i</sub>	gin)	TESTED BY	ť:	JULIO RIVERA
HOLE No.:	CDB-8			ELEVATI	ON:	196.43	m.s.l	CHECKED	BY:	Geol.W. Hernández
Packer type	Neumatic	Length (m) =	0 80	<b>n</b>	Water pump	Bean P	loyal 535	Flood (I/min) =		
					Test depth	(m) from	20 00	to.	25 00	
Test length (cm)		L * Cos X º =	500 00	·	Depth of hol	e (m)	25.00		Dip X (°)≃	0
Swivel Ht (m)		H1 =	1 00		Hole Diame	iter D (cm).	7 57	W L Be	fore of test (m)=	22 15
Nater level Ha (m)	22.15	Ha*CosX° =	22 15			load (kg/cm2),	Lh⊭ (Ht+Ha)/:		2.315	
Steel pipe:	Length (m) =	lt =	25.20	Plastic Pipe		im =		Beducers;	Valv cuopling	02
	Diameter $\phi_1$		0 0603	There are the set	• • • •	φ <sub>2</sub> (m) =		α	Packer:	0 12
	Roughness index	1	0.01		Roughness	index n2	0 008		Union elbow	0 008
PRESSURE	LOSS PRESSURE	EFECTIVE	INJECTED TIME	WATER VOLUME		FLOOD		SPECIFIC ABSOPTION	LUGEON	COEFICIENT
Po		Pe Lo +Lh-Plo	t	Qt	Q≖Qt/t	Q1=Q/60000	Q2=Q*100/6	Ae = Q/L		$K = \frac{Q 2}{2 \pi P \epsilon L} \cdot \ln \frac{2L}{D}$
(kg/cm²)	Plo=P1+P2+P3 (kg/cm <sup>2</sup> )	(kg/cm <sup>2</sup> )	(min)	(1)	(l/min)	(m²/s)	(cm³/s)	(l/min/m)	UL Pe	Crm/s)
1.00	1.29094	2.02	10	640 00	64 00	1.07E-03	1066.67	12 80	63 2	8 19E-04
5 00	1 99185	5.32	10	795.00	79 50	1.33E-03	1325.00	15.90	29 9	3 87E-04
10 00	3 77165	8 54	10	1094 00	109 40	1.82E-03	1823 33	21 88	25.6	3 32E-04
5.00	2 44050	4.87	10	880.00 760.00	88 00 76 00	1.47E-03	1466 67 1266.67	17 60 15 20	36 1	4.68E-04 1.32E-03
	1.02000	1.50								
	$10.34 * (n_{*})^{2}$	$*(0,^2)*$ lt	I	Pc=		Pc <sub>2</sub> + Pc <sub>3</sub>	m	,		
P <sub>1</sub> =	$\frac{10.34 * (n_1)^2}{(\phi_1^5)}$	$(Q_1^2)^*$ lt	I	Pc=	= Pc, + P		m	P <sub>3</sub> = )	$\sum \alpha * (Q_1)$	)]
P1 =	$\frac{10.34 * (n_1)^2}{(\phi_1^{5})^5}$ P1= loss load on		I	Pc=	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi_1)}$	$Pc_{2} + Pc_{3}$ $\frac{2*(Q_{2}^{2})*h}{2}$	<u>m</u>	P3= loss load	$\sum \alpha * (Q_1)$ on couplings,	)]
9 <b>T</b>				$Pc =$ $P_2 = \frac{10}{2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi_1)}$	$Pc_{2} + Pc_{3}$ $\frac{2*(Q_{2}^{2})*h}{2}$		P3= loss load valvies a	on couplings,	
9 <b>-</b>				$Pc =$ $P_2 = \frac{10}{2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_{2} + Pc_{3}$ $\frac{2*(Q_{2}^{2})*h}{2}$		P3= loss load valvies a	on couplings, and packer JGEON UN	
9 <del>-</del>				$Pc =$ $P_2 = \frac{10}{2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_{2} + Pc_{3}$ $\frac{2*(Q_{2}^{2})*h}{2}$		P3= loss load valvies a	on couplings, and packer JGEON UN	
9 <b>-</b>			5.52	$Pc =$ $P_2 = \frac{10}{2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$	VAL	P3= loss load valvies a UES OF LL	on couplings, and packer JGEON UN	IT
9 <b>-</b>				$Pc =$ $P_2 = \frac{10}{2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$	VAL	P3= loss load valvies a UES OF LL	on couplings, and packer JGEON UN	IT
(kg/cm <sup>2</sup> ) 8 7 7 7 7				$Pc = \frac{10}{P_2} = \frac{10}{P_2}$ $P2 = \log \log \log \frac{10}{P_2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$	<b>VAL</b>	P3= loss load valvies a UES OF LL 400 C0 22.9 22.6	on couplings, and packer JGEON UN	IT
(kg/cm <sup>2</sup> ) 8 7 7 7 7			5.52	$Pc = \frac{10}{P_2} = \frac{10}{P_2}$ $P2 = \log \log \log \frac{10}{P_2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_2 + Pc_3$ $\frac{2^{2} * (Q_2^{2}) * h}{2^{5.33}}$	VAL	P3= loss load valvies a UES OF LL	on couplings, and packer JGEON UN	□ IT 
9 (kg/cm <sup>2</sup> ) 9 7 7 7     		steel pipe		$Pc = \frac{10}{P_2} = \frac{10}{P_2}$ $P2 = \log \log \log \frac{10}{P_2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$	VAL	P3= loss load valvies a UES OF LL 400 C0 22.9 22.6	on couplings, and packer JGEON UN	IT
Pe (kg/cm <sup>2</sup> ) 9 4 2 2 2 2 2 2 2 2 2 2 2			5.52	$Pc = \frac{10}{P_2} = \frac{10}{P_2}$ $P2 = \log \log \log \frac{10}{P_2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$	VAL	P3= loss load valvies a UES OF LL 40 c C0 22.9 25 6 36 1	on couplings, and packer JGEON UN N UNIT 0 80 0 1 63.2	IT 000 1200 1017
9 <b>Francisco (Ka</b> ) 9 <b>Francisco (Ka</b> ) 7 <b>6 7 6</b> 7 <b>6 7 6</b> 7 <b>6 7 7 7</b> 7 <b>6 7 7</b> 7 <b>6 7</b> 7 <b>7</b> 7 <b>7777777777777</b>		steel pipe	5.52	$Pc = \frac{10}{P_2} = \frac{10}{P_2}$ $P2 = \log \log \log \frac{10}{P_2}$	$= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ and on plastic	$Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$	VAL	P3= loss load valvies a UES OF LL 400 C0 22.9 22.6	on couplings, and packer JGEON UN N UNIT 0 80 0 1 63.2	□ IT 
9 (kg/cm <sup>2</sup> ) 9 Free (kg/cm <sup>2</sup> ) 7 6 7 6 7 6 7 7 7 7 7 7 7 7 7 7	P1= loss load on	steel pipe	5.52	Pc =	$= Pc_1 + F$ $34*(n_2)$ ( $\phi$ ad on plastic	$Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$	VAL	P3= loss load valvies a UES OF LL 40 c C0 22.9 25 6 36 1	on couplings, and packer JGEON UN N UNIT 0 80 0 1 63.2	IT 000 1200 1017

Appendix 7.6

### Water Level in Drillhole after Drilling

Appendix 7.6.1: Monthly Water Level in Drillhole

Appendix 7.6.2: Water Level in Drillhole measured by CEL

Appendix 7.6.1

Monthly Water Level in Drillhole

\*

Drillhole	CDB-1	3-1	CDB-2	-2	CDB-3	- 3	CDR- 4		CDB-E							[
	Denth	Flevation Denth	1	Elevation Darth		1			žΓ		ןרָ וּבָ		0.05-7		CDB-8	p
	70.00	208.84	le	102 05	2		÷	Clevation Uepth	5	Elevation Depth	-	Elevation Depth	Depth	5	Depth 1	Elevation
	22.22	10.007	20.00	00.00	20.00	130	80.00	C+777	00.07	225.45	/0 00	219	50.00	184.06	50 00	204.33
Der 18 01	E0 20	156 51	40 60													
	02.20	100.04	90.24	141.3/									40.10	143.96		
Apr 03 02			41.26	142.69				   					40.84	112 20		
May 03 02			41.49	142.46		   							11 46	110.60		
June 08 02	46.77	162.07	40.05	143.90		   							00 00	151 77		
July 04 02	63.11	145.73	41.31	142.64									02.20	11.101		
Aug. 01 02	50.12	158.72	33.78	150 17				   					20.00	148.38		
Sept. 05 02	59.86	148.98	41.46	142.49			ļ						40.87	143.19		
Oct. 03 02	40.39	168.45	39.57	144.38									30.09	141.37		
P Nov 01 02	60.50	148 34	40.15	142.80									32.48	80.101		
Der 07 09	61.01	03 61											35 00	149.06		
	17.10	-1'	09.24				/6.08	146.37	68.8	156.65			35.04	149.02		
uan U9 U3	07.20		39.98		1.97	134.03	76.77	145.68	69.62	155.83	46.99	172.01	35.88	148.18	49.88	154 45
rep vo us	62.45	146.39	40.27	143.68	2.05	133.95	77.28	145.17	69.62	155.83	47.44	171.56	35.93	148.13	49.89	154 44
Apr 11 03	63.16	145.68	41.26	142.69	3.1	132.9	78.04	144,41	70.51	154.94	49.63	169.37	37.01	146.95	50 03	150 5
May 09 03	63.29	145.55	41.53	142.42	3 06	132.94	77.8	144.65	70.49	154.96	49.43	169.57	38 29	115 71	20.00	15050
Jun 04 03	63.02	145.82	41.03	142.92	0.36	135.64	76.1	146.35	69.66	155 79	46.51	179.40	20.00	115 20	10.00	100.02
Jul 09 03	49.64	159.20	40.33	143,62	1,25	134.75	76.09	146.36	60.7	155.75	36.96	10011	11 10	140.00	49.00	104.40
Aug 15 03	62.64	146.20	40.89	143.06			76 46	145.00	80.60	155 76	00.00	1 10 01 1		149.00	49.13	2 001
Sep 19 03	34.81	174.03	38.48	Ľ			01.01		0.00	01.001	40.74	1771	20.05	148.44	49.84	154.49
0~+ 11 03	11 15						14 10	148.27	1/0.60	100.78	20.37	198.63	28.83	155.23	45.14	159.19
	1 44.13		39.18	144.//			75.19	147 26	69.68	155.77	44.01	174.99	34.8	149 26	47.89	156.44

Monthly Water level in Drillhole after Drilling

339 (340)

Appendix 7.6.2

Water Level in Drillhole measured by CEL

		I	A	<b>-</b>	[		r—		Į	Į	<b>_</b>	i —	1	[	[			[	<b>—</b>	
	h de tubo	0.42	NIVEL DEL AGUA	62.26	62.30	62.40	68.56	62.45	62.48	62.60	63.16	63.29	63 02	49.64	62.64	34.81	44.15			
CDB-1			LECTURA	62.68	62.72	62.82	68.98	62.87	62.90	63.02	63.58	63.71	63.44	50.06	63.06	35.23	44.57			
POZO # CDB-1			HORA													11:00	11:00			
		ELEV. I UBU	FECHA	09/Ene./03	21/Ene./03	30/Ene./03	03/Feb./ 03	06/Feb./ 03	14/Feb./ 03	25/Feb./ 03	11/Abr./03	09/May /03	04/Jun./03	09/Jul./03	15/Ago./03	19/Sep./03	14/Oct./03			
		1							_		_	احب			_	_				

## LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

LECTURAS PIEZOMETRICAS

**PROYECTO: El Chaparral, río Torola** 

### POZO # CDB-2

,

## LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

### POZO # CDB-3

			h de tubo
ELEV. TUBO			0.95
FECHA	HORA	LECTURA	NIVEL DEL AGUA
09/Enc./03		2.92	1.97
21/Enc./03		2.75	1.80
30/Ene./03		2.94	1.99
03/Feb./ 03		3.04	2.09
06/Feb./ 03		3.00	2.05
14/Feb./ 03	· · · · · · · · · · · · · · · · · · ·	3.01	2.06
25/Feb./ 03		3.04	2.09
11/Abr./03		4.05	3.10
09/May./03		4.01	3.06
04/Jun./03		0.59	-0.36
09/Jul./03		2.20	1.25
15/Ago./03		XXX	XXX
19/Sep./03		XXX	XXX
14/Oct./03			
	-		

## LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

### POZO # CDB-4

ELEV. TUBO FECHA	HORA	LECTURA	h de tubo 0.74 NIVEL DEL AGUA
09/Ene./03		77 51	76.77
21/Ene./03 30/Ene./03		77.94	77.20
03/Feb./ 03		77.75	77.01
06/Feb./ 03		78.02	77.28
14/Feb./ 03		77.95	77.21
25/Feb./ 03		77.74	77.00
11/Abr./03		78.78	78.04
09/May./03		78.54	77.80
04/Jun./03		76.84	76.10
09/Jul./03		76 83	76.09
15/Ago./03		77.20	76.46
19/Sep./03	13:15	74.92	74.18
14/Oct./03	13:45	76.53	75.79

LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

## POZO # CDB-5

# LECTURAS PIEZOMETRICAS **PROYECTO: El Chaparral, río Torola**

## POZ0 # CDB-6

h de tubo a aç

ELEV. TUBO			л ае гиро 0.95
FECHA	HORA	LECTURA	NIVEL DEL AGUA
09/Ene./03		47.94	46.99
21/Ene./03		48.05	47.10
30/Ene./03		47.78	46.83
03/Feb./ 03		49.40	48.45
06/Feb./ 03		48.39	47.44
14/Feb./ 03		49.65	48.70
25/Feb./ 03		49.40	48.45
11/Abr./03		50.58	49.63
09/May./03		50.38	49.43
04/Jun./03		47.46	46.51
09/Jul./03		37.81	36.86
15/Ago./03		47.74	46.79
19/Sep./03	15:00	21.32	20.37
14/Oct./03	13:40	44.96	44.01

LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

## **POZO # CDB-7**

ELEV. TUBO			h de tubo
FECHA	HORA	LECTURA	NIVEL DEL AGUA
09/Ene./03		36.18	35.88
21/Ene./03		36.15	35.85
30/Ene./03		35.30	35.00
03/Feb./ 03		50.95	50.65
06/Feb./ 03		36.23	35.93
14/Feb./ 03		36.21	35.91
25/Feb./ 03		36.18	35.88
11/Abr./03		37.51	37.21
09/May./03		38.62	38.32
04/Jun./03		38.98	38.68
09/Jul./03		34.71	34.41
15/Ago./03		35.92	35.62
19/Sep./03	11:20	29.13	28.83
14/Oct./03	11:15	35.10	34.80

# LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

## POZO # CDB-8

ELEV. TUBO			h de tubo <b>0.90</b>
FECHA	HORA	LECTURA	NIVEL DEL AGUA
09/Ene./03		50.78	49.88
21/Enc./03		50.70	49.80
30/Ene./03		50.81	49.91
03/Feb./ 03		50.74	49.84
06/Feb./ 03		50.79	49,89
14/Feb./ 03		50.81	49,91
25/Feb./ 03		50.78	49.88
11/Abr./03		51.73	50.83
09/May./03		51.71	50.81
04/Jun./03		50.75	49.85
09/Jul./03		50.03	49.13
15/Ago./03		50.74	49.84
19/Sep./03	13:25	46.04	45.14
14/Oct./03	13:40	48.79	47.89
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