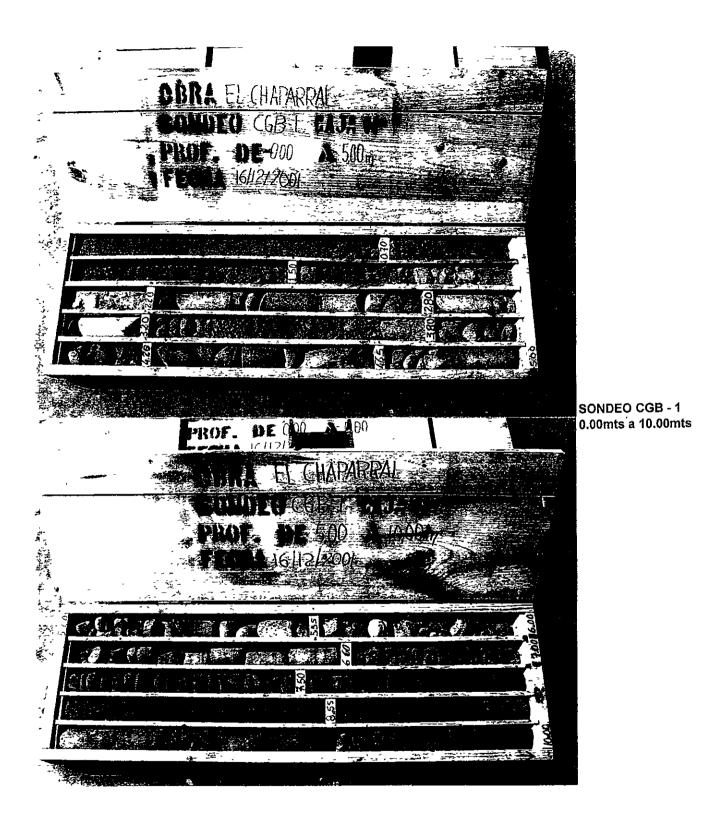
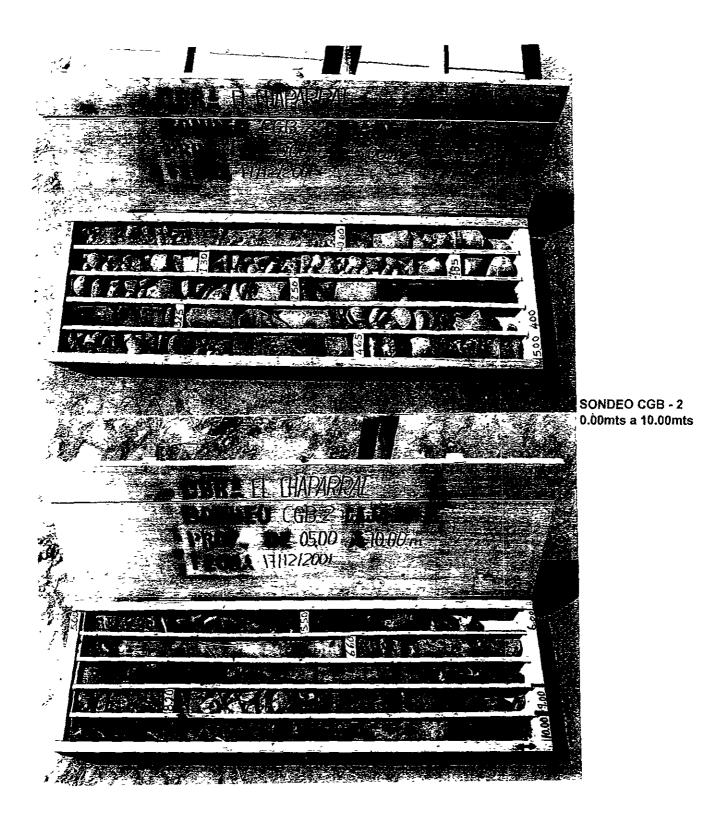
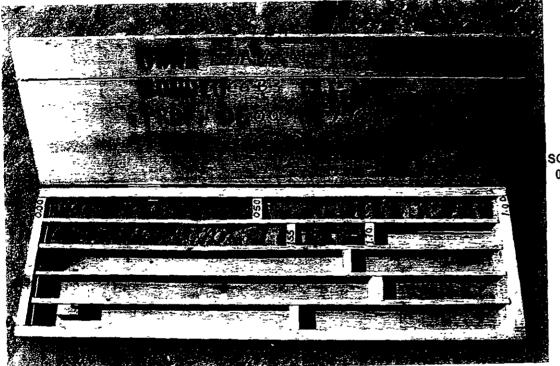
BORROW AREA

1



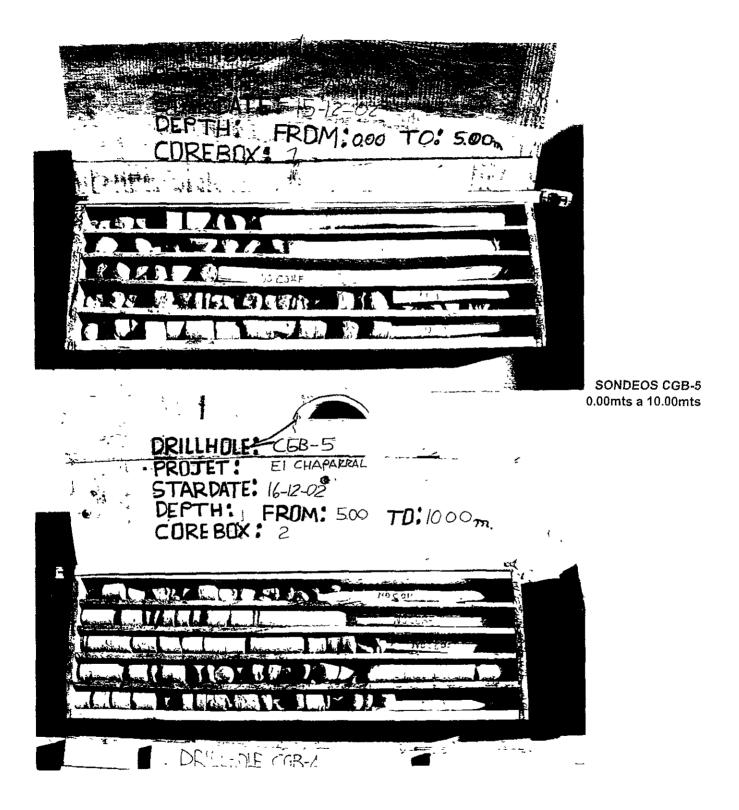




SONDEO CGB - 3 0.00mts a 1.70mts

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

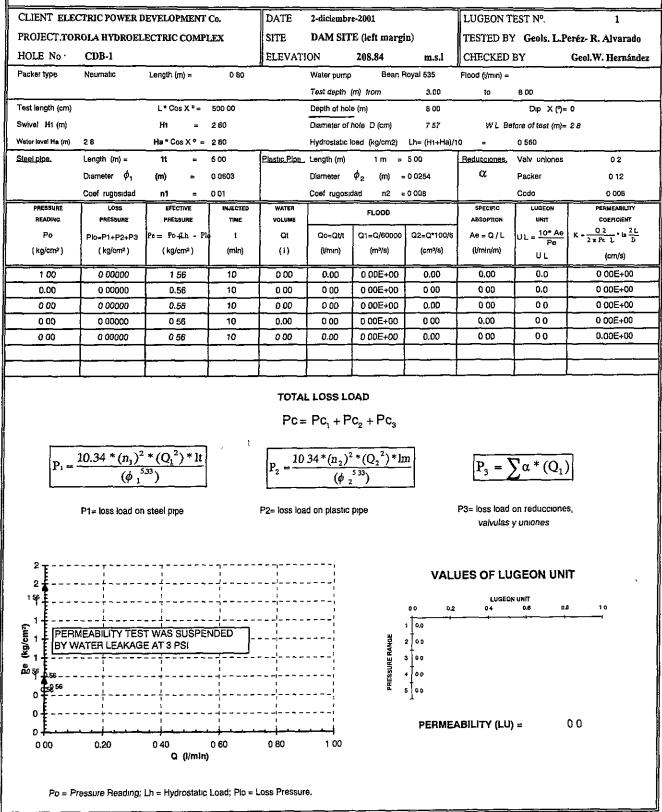


Appendix 7.5

Result of Permeability Test

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| 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 ≂ 0 | 0 315 | |
| Steel pipe, | Length (m) ≈ | 1t = | 5 00 | Plastic Pipe . | Length (m) | 1 m = | 5 00 | Reducciones. | Valv uniones | 02 |
| | Drameter ϕ_1 | (m) = | 0 0603 | | Diameter | φ ₂ (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 | | | | | | | | | |
| P ₁ = | $\frac{10.34 * (n_1)}{(\phi_1)}$ P1= loss load o | | | P2= loss los | | ² * (Q ₂ ²) * li ^{5 33}) pipe | | P3≖ loss load | $\sum_{n} \alpha * (Q_1)$ | |
| 6 - | | | | | 531 | | VAL: | | IGEON UN | 1T 1.2 1.4 |
| £4 ∔ | 331 | | 1 | | ¦ | | 1 00 | | ; — · · · · · · · · · · · · · · · · · · · | |
| Pe (kg/cm ²) | | - I I | , | _ _ _ - | | | | 0.5 | | |
| <u> </u> | | | | 1 | 1 | 1 | | | | 1.2 |
| ^a 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 ϕ_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 ²) | (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 ₂) ² | $\frac{2^{2} * (Q_{2}^{2}) * \ln Q_{2}}{\frac{5^{33}}{2}}$ | <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, |
| ¹² 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 ³) | × | -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 1 1 1 1 1 1 1 1 1 1 | 72 |
| 8 (kil/cm.) 8 | | 5,54 | | | | PRESSURE RANGE | | | 6.0 1 1 1 1 1 1 1 1 1 1 | |
| B (KR)(cm) | | 5,54 5,56 15,56 15,00 20,00 Q ((/min) | | 0 00 35 00 | | PRESSURE RANGE | | | 6.0 1 1 1 1 1 1 1 1 1 1 | 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 He (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 ϕ_1 | (m) = | 0 0603 | | Diameter | φ ₂ (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 ₂) (\$ | $PC_{2} + PC_{3}$ $\frac{2^{2} * (Q_{2}^{2}) * L}{2^{5} 3^{3}}$ 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 | ──────────────────────────────────── | | | | | | | | | |

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 | ϕ_2 (m) : | = 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 | └─── | | | 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 ²) | (kg/cm²) | (kg/cm ²) | (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 | ! 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 ²) | 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 | | K | | i | | | | · | | | |
| 1 | 1 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 ϕ_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 ²) | (kg/cm ²) | (kg/cm ²) | (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 ²)*b 533) pipe | - | P3= loss load | | |
| | | | | | | | | valvulas | y uniones | |
| 12 Ţ | · | | | 10 46 | | | VAL | UES OF LU | GEON UN | Г |
| 10 | | | | 10 46 | | | VAL | | | 1T 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.

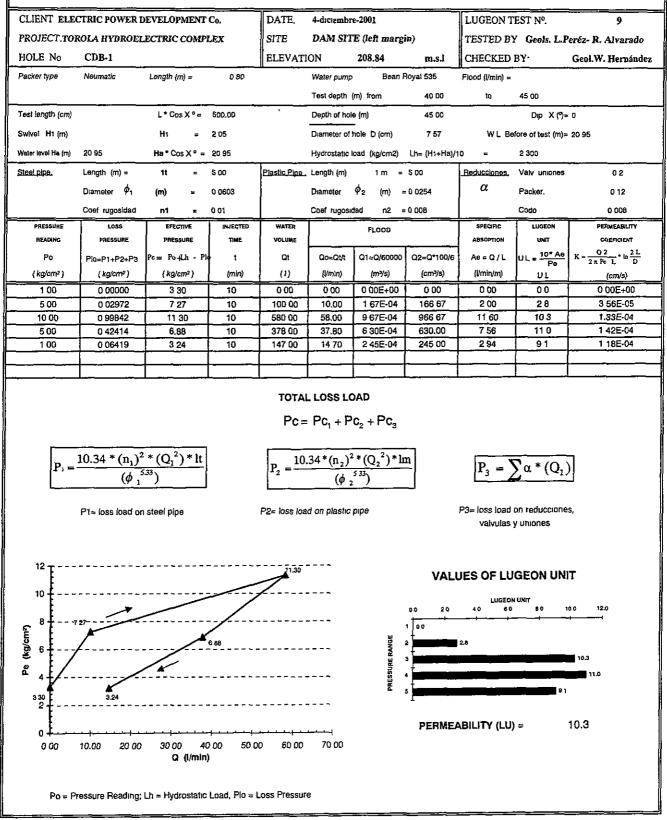
| CLIENT. ELE | CTRIC POWER D | E CELOT MELLA | C0. | DATE | • ••••• | re-2001 | | LUGEON T | EST N. | 7 |
|---|--|--------------------------|----------|---|--|--|-------------------|---|--|---|
| PROJECT, TOI | ROLA HYDROEL | ECTRIC COMP | LEX | SITE | DAM SIT | E (left marg | in) | TESTED B | Y Geols, 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 ϕ_1 | (m) = | 0,0603 | | Diameter | ¢ _{2 (} 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 | | r | 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 ²) | (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,) ² | * (Q ²) * lt | | Pc= | Pc ₁ + P | C ₂ + PC ₃ | | | | ٦ |
| P. = | $\frac{10.34 * (n_1)^2}{(\phi_1^{5})^5}$ | $(Q_1^2) * lt$ | | Pc= | Pc ₁ + 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# | , . | |
| P. = | 10.34 * $(\mathbf{n}_1)^2$ (ϕ_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 | , . | |
| | | | | $Pc = \frac{10}{P_2} = \frac{10}{2}$ | $\frac{\mathbf{PC}_{1} + \mathbf{P}}{\frac{34^{*}(\mathbf{n}_{2})^{2}}{(\phi_{2})^{2}}}$ | $c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * lr$ | - | 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 | _ \$, |
| 10 - | | | , | $Pc = \frac{10}{P_2} = \frac{10}{10}$ $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 | _ \$, |
| 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 ₂ + РС ₃ | 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 ₂ + РС ₃ | 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 ₂ + РС ₃ | 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 ₂ + РС ₃ | 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 ₂ + РС ₃ | | P3= 1055 load valvulas JES OF LU LUGEON 50 10.0 | ол reduccione y uniones GEON UNI кимп 150 136 13.6 | 200 T 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 ₂ + РС ₃ | | 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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| | | EVELOPMENT | Co. | DATE. | 3-diciembre | | | LUGEON T | EST Nº: | 8 |
|--------------------|-------------------------------------|----------------|----------|--------------------------------------|--|---|-------------------|-----------------|---------------------------------|---|
| PROJECTTO | ROLA HYDROEL | ECTRIC COMPI | EX | SITE | DAM SITI | 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. 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 ϕ_1 | (m) = | 0 0603 | | Diameter | φ _{2 (m) ≖} | 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 | | | . | 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 ₁ + 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 T | | 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, |

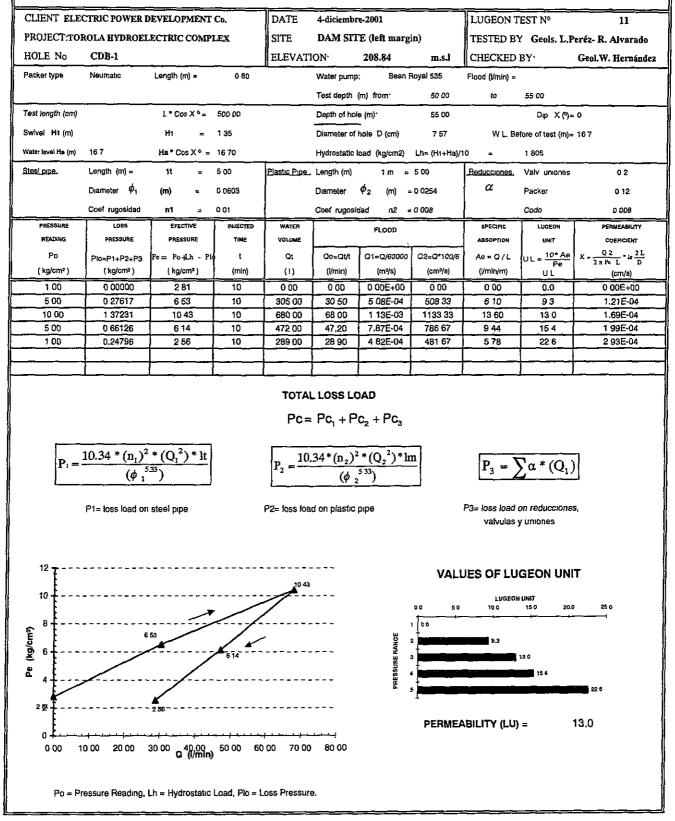
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|--------------------------|--------------------------------------|------------------------|---------------|---|-----------------|--|---------------------------|-----------------|---|---|
| CLIENT, ELE | CTRIC POWER D | EVELOPMENT | Co. | DATE | 4-diciembra | -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 ϕ_1 | (m) ≂ | 0 0603 | | Diameter | ¢ ₂ (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 ²) | (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 $ | | ² *(Q ₂ ²)*h ⁵³³) pipe | m | P3= loss load | $\sum_{\alpha} \alpha * (Q_1)$ on reduccione y uniones | |
| 12 - | | | | / | ±0 10 | | VAL | | | - |
| be (kg(cm ³) | 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 | | | | | |

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| 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 ϕ_1 | (m) ≖ | 0 0603 | | Diameter | ϕ_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 ^s /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 |
| | | | | | | | | | | |
| P ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1)^2}$ | $(Q_1^2)^*$ 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, |
| ¹² | | | | | 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 ²) 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 4 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 ≈ 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 ≈ 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 0 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 | | |) D |
| = \$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 | ∲ ₂ (m) = | 0 0254 | α | Packer | 0 12 |
| TIVE INJECTED | | Cost, rugosid | lad n2 = | 0 008 | | Codo | 0 008 |
| | WATER | | 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 ₂ ²)*In ^{5 33}) | _ | 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 ^{o.} | 14 |
| PROJECT.TOP | ROLA HYDROEL | ECTRIC COMPL | ÆΧ | 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 | <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 φ_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 ²) | (kg/cm ²) | (kg/cm²) | (min) | (1) | (l/min) | (m³/s) | (cm ³ /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 |
| P ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1)^2}$ P1= loss load of | | | $P_2 = \frac{10.}{2}$ P2= loss loa | | ² *(Q ₂ ²)*lı ⁵³³) spipe | | P3≃ loss load | $\sum \alpha * (Q_1)$ on reduccione y uniones | |
| 14 12 | ol | * | / | 14.6 | 36 | ANGE | VAL | | | 17 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 |) = | 6 0 |

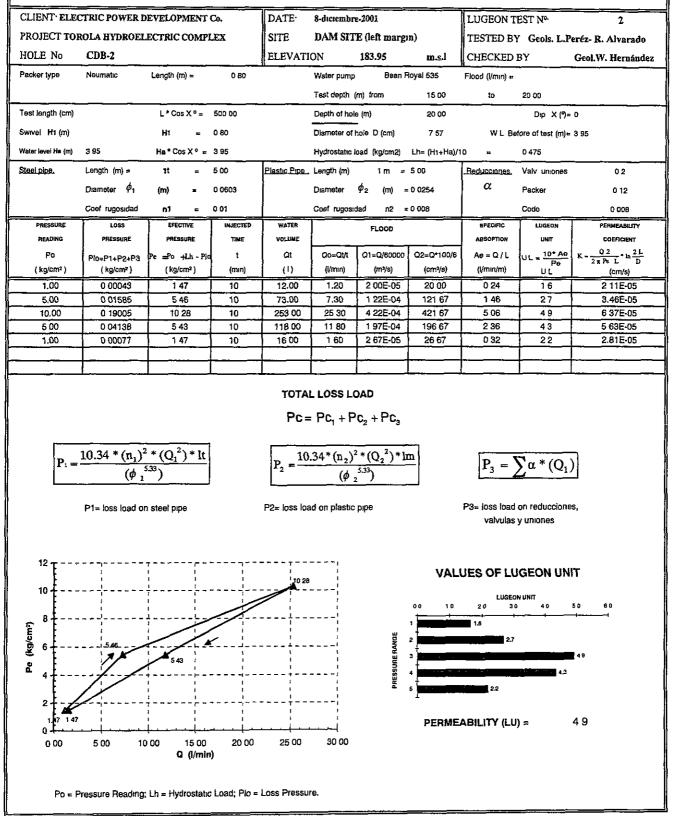
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Swissboring Overseas Corporation Ltd.

| 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 ϕ_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 | - | <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 ₂ ²) * Ir ^{5 33}) pipe | | P3= loss load valvulas | | |
| 6 5 6 | | | / | 563 | ~ | | VALU | JES OF LU | | T 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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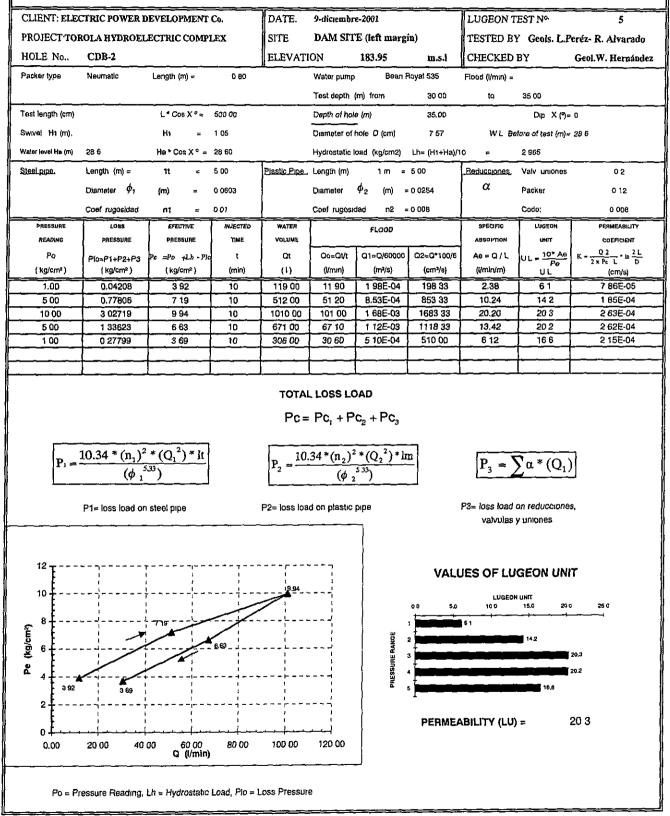
| CLIENT ELF | ECTRIC POWER I | DEVELOPMENT | Co. | DATE. | 8-diciembr | e-2001 | | LUGEON T | EST № | 3 | |
|--------------------------------------|--|------------------|--------------|--|---|--|--------------|--|--|---|--|
| PROJECT.TOROLA HYDROELECTRIC COMPLEX | | | | | DAM SIT | E (left marg | in) | 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 8 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 ϕ_1 | (m) = | 0 0603 | } | Diameter | ϕ_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 | | | | 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 ³ /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 ₁ + P | | _ | | | | |
| P ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1^5)^2}$ | 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 | | |

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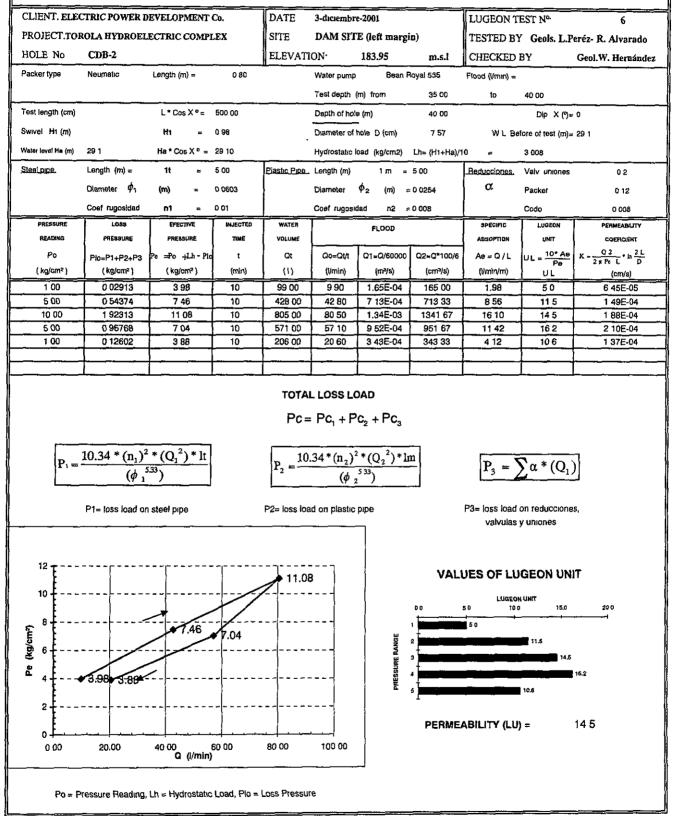
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| CLIENT ELECTRIC POWER DEVELOPMENT Co. | | | | | DATE. 9-diciembre-2001 | | | | LUGEON TEST Nº: 4 | | | |
|---|--|---------------------|----------|----------------------|--|--|-------------------|---------------------------------------|--------------------------------------|---|--|--|
| 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 ϕ_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 ²) Pe (kg/cm ²) Antherite (kg/cm ²) 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 |) = | 25 8 | | |

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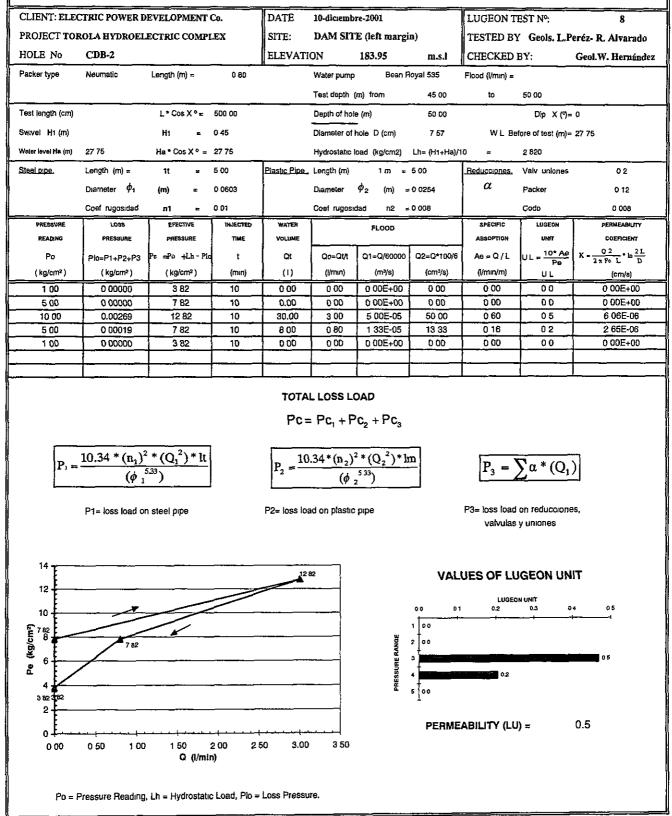
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| CLIENT ELE | CTRIC POWER I | DEVELOPMENT | Co. | DATE | 10-diciemb | ore-2001 | , | LUGEON T | EST Nº. | 7 | |
|---|--------------------------|--|--------------|----------------------|------------------------------|--------------------------|----------------------|---|--|---|--|
| PROJECT TOROLA HYDROELECTRIC COMPLEX | | | | | SITE- DAM SITE (left margin) | | | | TESTED BY Geols. L.Peréz- R. Alvarado | | |
| HOLE No. | CDB-2 | | | 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 ϕ_1 | (m) = | 0 0603 | 1 | Diameter | φ ₂ (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 | | + | | 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 ³ /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 | |
| | | | _ | <u>1</u> | | l | I | <u> </u> | <u> </u> | | |
| | | | | TOTAI | LOSSLO | DAD | | | | | |
| | | | | Pc= | PC ₁ + P | $C_2 + PC_3$ | | | | | |
| | $10.24 * (r)^{2}$ | 2 * (O ²) * It | | — 10 | 24*1- 1 | 2 * (O ²) *1 | | | | - | |
| $\mathbf{P}_1 =$ | $\frac{10.34}{(h^{-3})}$ | $\frac{2 * (Q_1^2) * lt}{533}$ | | $P_2 = \frac{10}{2}$ | . <u>34 (ll₂)</u> | $\frac{1}{5^{5}33}$ | <u>"</u>] | $P_3 = \sum_{i=1}^{n}$ | $\sum \alpha * (Q_1)$ |) | |
| L | | | | L | (\V : | | | L | - | | |
| | 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 | | | | | | | . | | |
| | | 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 ³) | 4.92 | 874 | 8.35 | | | Pressure range | | ABILITY (LU) | ان والمحديد بي الأوكار معالم البوكار معالم | 11.6 | |
| be (kg/cm ²) be (kg/cm ²) be 4 be (kg/cm ²) | 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 ²) be (kg/cm ²) be 4 be (kg/cm ²) | 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 | |

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| 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 ϕ_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 ₁ + P | | L | L_, | 4 | ,,_, | |
| | $\overline{10.34*(n,)^2}$ | $*(Q_{1}^{2})*$ lt | | Pc= | Pc ₁ + P | c ₂ + Pc ₃ | n | | ······ | ٦ | |
| P1 =- | $\frac{10.34 * (n_1)^2}{(\phi_1)^5}$ | $\frac{*(Q_1^2)*1t}{^{33}}$ | | Pc= | Pc ₁ + P | c ₂ + Pc ₃ | <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 ₁ + P | | n | P ₃ = 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 ₁ = | | ····· | | $Pc = \frac{10}{P_2} = \frac{10}{2}$ | $Pc_1 + P$ $34*(n_2)^2$ $(\phi_2$ | $c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$ | n | P3= loss load | | _ | |
| P ₁ = - | | ····· | | $Pc = \frac{10}{P_2} = \frac{10}{2}$ | $Pc_1 + P$ $34*(n_2)^2$ $(\phi_2$ | $c_2 + Pc_3$ $\frac{1}{2} * (Q_2^2) * \ln \frac{1}{2}$ | _ | P3= loss load valvulas | on reduccione y uniones | s , | |
| 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 | s , | |
| 14 | | ····· | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{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 | s , | |
| 14 12 10 | P1= loss load on | steel pipe | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{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 12 10 | | steel pipe | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{2}) d on plastic | С ₂ + РС ₃ | VALI | PS= loss load valvulas JES OF LU | on reduccione y uniones IGEON UNI 10 50 | s. IT | |
| 14 12 10 | P1= loss load on | steel pipe | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{2}) d on plastic | С ₂ + РС ₃ | 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 | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{2}) d on plastic | С ₂ + РС ₃ | VAL | PS= loss load valvulas JES OF LU | on reduccione y uniones IGEON UNI N UNIT 40 50 137 | □ S, IT 60 70 →1 | |
| 14 12 10 | P1= loss load on | steel pipe | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{2}) d on plastic | С ₂ + РС ₃ ³ * (Q ₂ ²) * Ш ^{5 33}) ріре | VAL | 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 ³) | P1= loss load on | steel pipe | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{2}) d on plastic | С ₂ + РС ₃ | VAL | 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 | | $Pc = \frac{10}{P_2 = 10}$ $P2 = loss loss$ | $Pc_{1} + P$ $34^{*}(n_{2})^{2}$ (ϕ_{2}) d on plastic | С ₂ + РС ₃ | | 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 ₂ + РС ₃ | | 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 ϕ_1 | | 0 0603 | | Diameter | <u>ـ</u> | 0 0254 | α | | |
| | | * ** | | { | | - • • | | | 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 ²) | re ⊒ro +∪n - Pio (kg/cm²) | (min) | (1) | (Vmin) | (m ³ /s) | (cm ² /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 | $\sum_{i=1}^{n} \alpha * (Q_i)$ | ل 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 ²) | / | 7 8 | 3 | | | PRESSURE RANGE | 3 | | 8.8 | 10.2 |
| 4 424 2 | 4 20 | | | | | PAG | 5 | | 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 | | | | | |

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|--------------------------------------|-----------------------|---|-----------------------|-----------|---------------------------------------|---------------------------------|----------------------|----------------------|-----------------|-----------------------|---|
| 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 7 | 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 ϕ_1 | (m) = | 0.0603 | | Diameter | ϕ_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 ²) | (kg/cm ²) | (ກາກ) | (I) | (l/min) | (m ³ /s) | (cm ³ /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 ϕ_2 (m) = 0.0254 α 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 ϕ_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 ϕ_1 (m) = 0.0603 Diameter ϕ_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) = | |

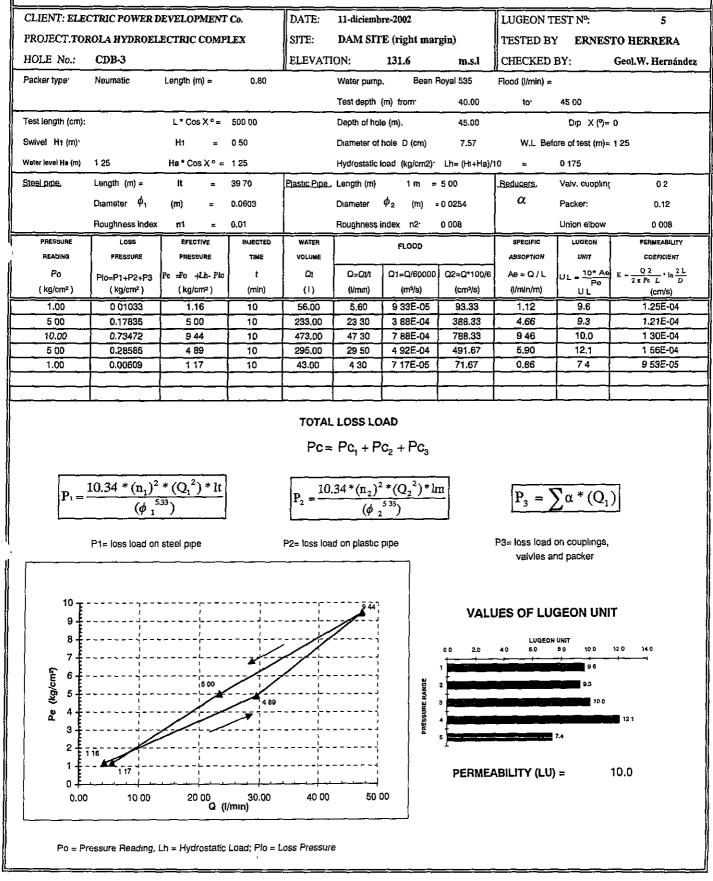
swissbering

| 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 ϕ_1 | (m) = | 0.0603 | 1 | Diameter | ϕ_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 | | , | , | 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 ²) | | (kg/cm²) | (min) | (1) | (l/min) | (m³/s) | (cm ³ /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 | | ² *(Q ₂ ²)*1 ^{5.33}) pipe | | P3= loss load | $\sum \alpha * (Q_1)$ on couplings, nd packer | <u>/</u> |
| 12 - 10 - - | | | | | 016 | | VAL | ues of Lu | GEON UNI | T |
| 8 | | | | | | | | LUGEO | 10000 4050 | 60 70 |
| Pe (kg/cm ³) | | 5,29 | | | | PRESSURE RANGE | 2 000 3 000 4 000 5 00 | | 44 4 | |
| 2 | 1 32 4 | | | 4 | | | PERME | ABILITY (LU) |) = | 4.4 |
| 0.00 | 5.00 | 10.00 Q (I/m m | 15 00) | 20.00 | 25.00 | | | | | |
| | | | | | | | | | | |

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| PRESSURE PRI READING PRI P ³ D Plo=P ³ (kg/cm ²) (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 ²) (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 = ϕ_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 ϕ_1 (m) ress index n1 Loss Erect ersure Pressi 1+P2+P3 Pe $\Rightarrow 0$ $\Rightarrow 1$ g/cm ²) (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 ²) (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 ϕ_1 (m) tess index n1 Loss EFECT ESSURE PRESSI 1+P2+P3 Pe ± 0 ± 1 g/cm ²) (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 ²) (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) [,] hole D (cm) [,] load (kg/cm2) [,] im = ϕ_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> 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 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 ϕ_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 ^o = 1.20 = 35 20 = 0 0603 = 0 01 TVE INJECTE URE TIME Lb- Plo 1 m ²) (min) 2 10 | D WATER VOLUME Qt | Depth of hol Diameter of Hydrostatic Length (m) Diameter Roughness | ie (m) [,] hole D (cm) [,] ioad (kg/cm2) [,] im = ϕ_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 ϕ_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 ^o = 1.20 = 35 20 = 0 0603 = 0 01 TVE INJECTE URE TIME Lb- Plo 1 m ²) (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 ϕ_1 (m) bess index n1 Loss EFECT cssure Pressing 1+P2+P3 Pe = Po +1 g/cm ²) (kg/cr D0084 1.12 D0630 5.1 D2347 10 f | X ^o = 1.20 = 35 20 = 0.0603 = 0.01 INJECTE TIME ILb-Plo t m ²) 2 10 | D WATER VOLUME Qt | Hydrostatic Length (m) Diameter Roughness | load (kg/cm2) Im = ϕ_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 ϕ_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 ²) (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 ²) (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 ²) (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 ²) (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> | (ϕ) ad on plastic | ² *(Q ₂ ²)*li ⁵³³) pipe | | P3= loss load | | |
| 12 | | | 10 10 | | | VAL | | | 17 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) ^{6.00} | 8 00 lo = Loss Pressu | 10 00 ire. | | - | | | |

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| 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 ϕ_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 ²) | (kg/cm ²) | (min) | (1) | (i/min) | (m ⁹ /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.) ² | $*(0^2)*$ lt |] | Pc= | | ² c ₂ + Pc ₃ | | · | | - |
| 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 ₁ + 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 |

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| 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 ϕ_1 | (m) = | 0.0603 | 1 | | φ ₂ (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 ²) | (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 | | | $P_2 = \frac{10}{1000000000000000000000000000000000$ | | ² * (Q ₂ ²) * lr ^{5 33}) pipe | — | P3= loss load | $\sum \alpha * (Q_1)$ on couplings, and packer | |
| 12 10 8 | | | | | | | | | | |
| be (kg/cm ²) | | 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 | | | | | |

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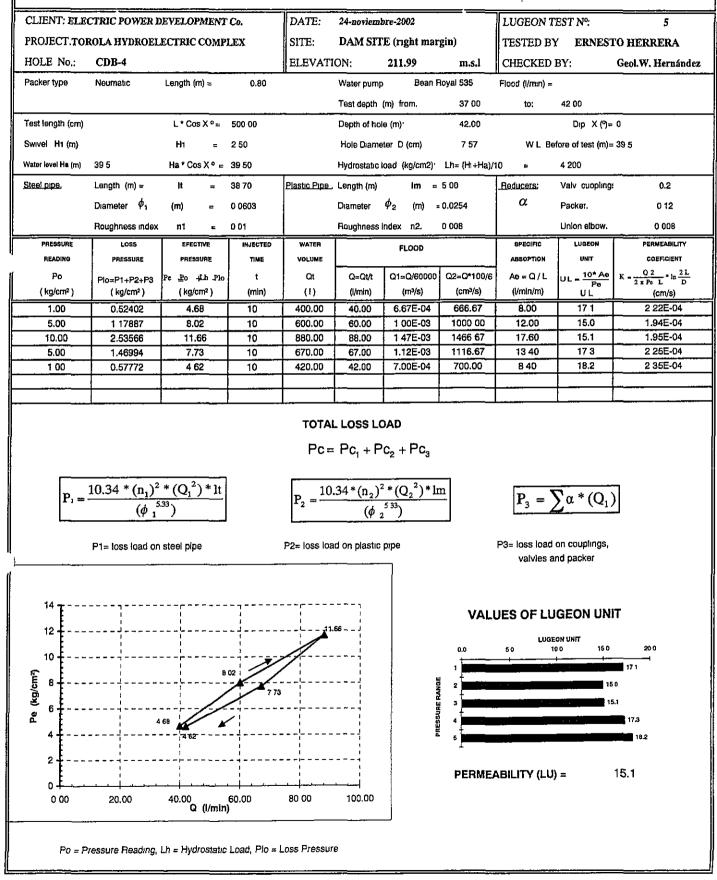
| CLIE | NT ELE | CTRIC POWER D | EVELOPMENT | Co | DATE: | 23-noviem | bre-2002 | | LUGEON T | EST Nº: | 2 |
|-------------|-------------------------|--------------------------------------|-------------------|-------------|--|------------------|--|-------------------|-------------------------|-------------------------|---|
| 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 [.] | 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) [.] | 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 ϕ_1 | (m) = | 0 0603 | | Diameter | φ ₂ (m) ≖ | 0 0254 | α | Packer [.] | 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 ²) 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 ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1)^5}$ | | | $P_2 = \frac{10}{1000000000000000000000000000000000$ | | ² *(Q ₂ ²)*li ^{5 33}) 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 | · | | | | | | 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 0 0 00 | 20 00 Pressure Reading, | 40 00 Q (l/mir | 60 00 | | | | PERME | ABILİTY (LL | ו) ≠ | 15.6 |

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| | 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 [.] | 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 ϕ_1 | (m) = | 0 0603 | } | Drameter | ϕ_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 ²) | (kg/cm ²) 0.89431 | (kg/cm ²) 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> |
| | $\frac{10.34 * (n_1)^2}{(\phi_1^5)^2}$ | | | $P_2 =$ | | ² *(Q ₂ ²)*b ^{5 33}) pipe | | P3= loss load | | <u> </u> |
| | | | | | | | | valvies a | nd packer | |
| 12 - | | r 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 | K 6 551 A | 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 | | 1 € 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 ²) | | | 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 ²) | | 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 [.] | 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 ϕ_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. = | $= \frac{10.34 * (n_1)^2}{(\phi_1)^2}$ | | | $P_2 = \frac{10}{1000}$ $P_2 = 10000 \text{ Joss loss}$ | | ² *(Q ₂ ²)*lı ^{5.33}) pipe | m | $P_3 =$ P3= loss load | $\sum \alpha * (Q_1)$ on couplings, | \mathbf{D} |
| | | | | | | | | valvies a | nd packer | |
| Pe (kg/cm ²) | | | 709 | 7 05 | | | | UES OF LU | IGEON UN | eo 250 |

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| 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 [.] | 41 00 | to | 48 00 | |
| Test length (cm) [,] | | 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 ϕ_1 | (m) = | 0 0603 | | Diameter | ϕ_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 ²) | (kg/cm²) | (min) | (1) | (i/min) | (m³/s) | (cm ³ /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 ₁ + P | ² c ₂ + Pc ₃ | | <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 ₁ == | $\frac{10.34 * (n_1)^2}{(\phi_1^5)}$ | $(Q_1^2) * lt$ (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 1 10 10 10 10 | 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 1 10 10 10 10 | 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 1 10 10 10 10 | 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 1 10 10 10 10 | 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 |

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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 ϕ_1 | (m) ≃ | 0.0603 | ľ | Diameter | φ ₂ (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 ²) 1.00 | (kg/cm ²) 0 62267 | (kg/cm ²) 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 ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1^5)^5}$ 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 ³) | | 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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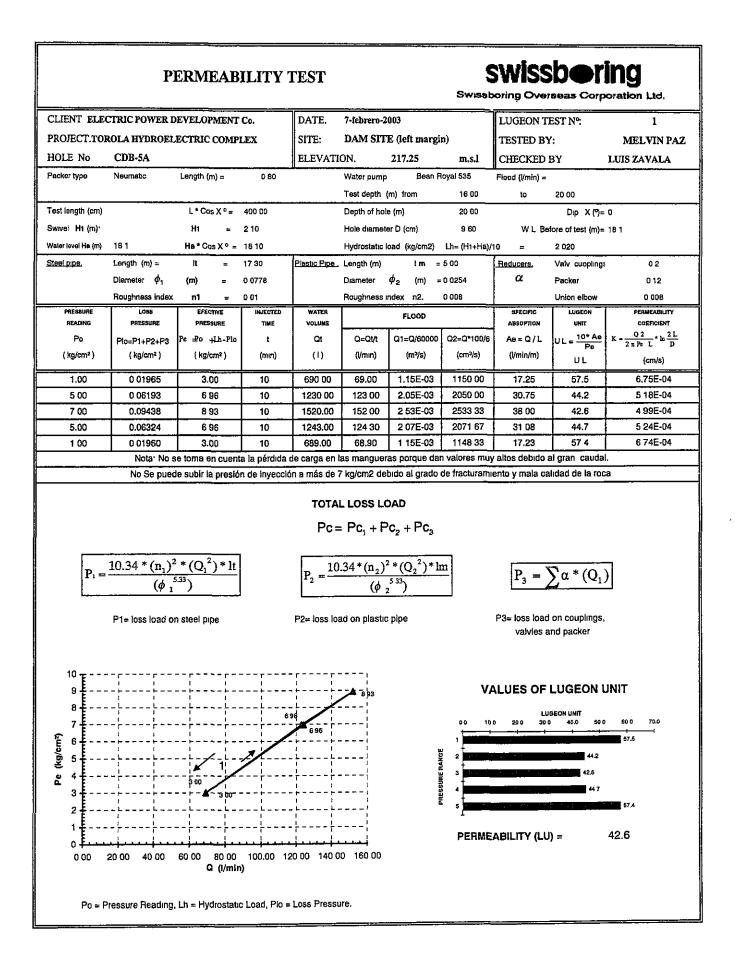
SWISSDORING Swissboring Overseas Corporation Ltd.

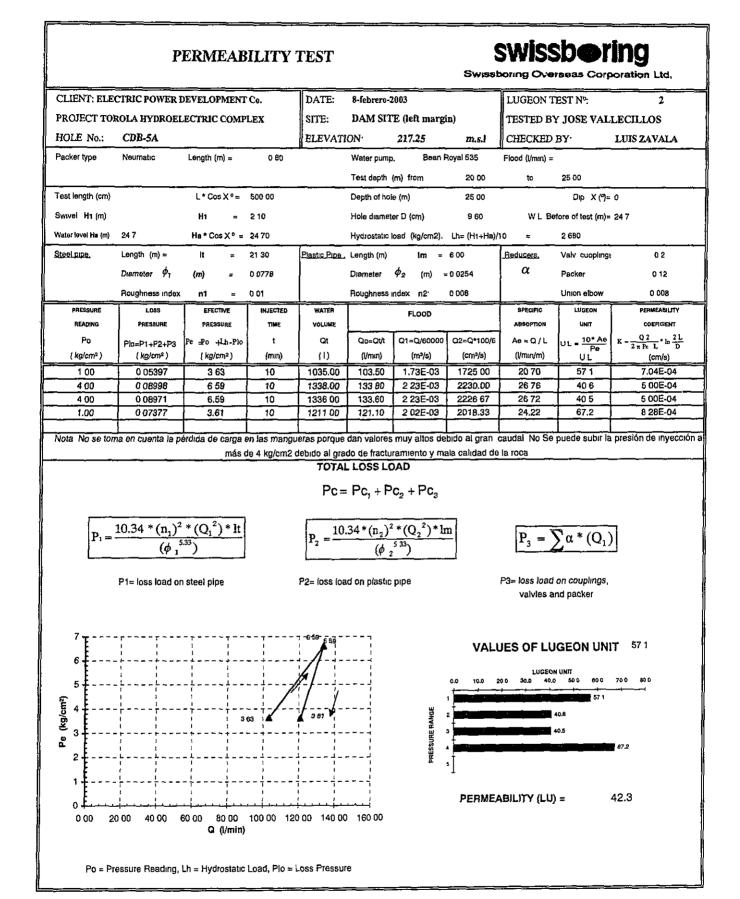
| CLIENT: ELEO | CTRIC POWER D | EVELOPMENT | 'Co. | DATE: | 28-noviem | bre-2002 | | LUGEON T | EST №. | 8 |
|--------------------------|---|------------------------|-----------|----------------------|------------------------------|--|---------------------------------------|----------------------------|---|---|
| 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) [.] | 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 ϕ_1 | (m) = | 0 0603 | | Diameter | ϕ_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 | | | 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 ² } | (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> | | | |
| P ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1)^2}$ | $(Q_1) + n$ | | $P_2 = \frac{10}{2}$ | .34*(n ₂) (\$ | $\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5 33}}$ | | $P_3 =$ | $\sum \alpha * (\mathbf{Q}_1)$ | |
| | P1= loss load or | n steel pipe | | P2= loss loa | ad on plastic | pipė | | P3= loss load valvies a | on couplings, and packer | |
| 16 - | | | , | | 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 איי איי איי | | | 15.9 |
| Be (Kg/cm ²) | | | | ·/ | | | 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 | . | | | | | 12.4 | |
| 4 | , | | | | | | 5 | | | 17.9 |
| | | | | l |] | | L | | | ~ |
| 2 | | | | 1 |] | | PERME | ABILITY (LU | I) = | 12.4 |
| 0 - F 0.00 | 20 00 | 40 00 | 60 D0 | 80.00 | 100.00 | | | • | | |
| | | Q (l/mi | | | _ | | | | | |
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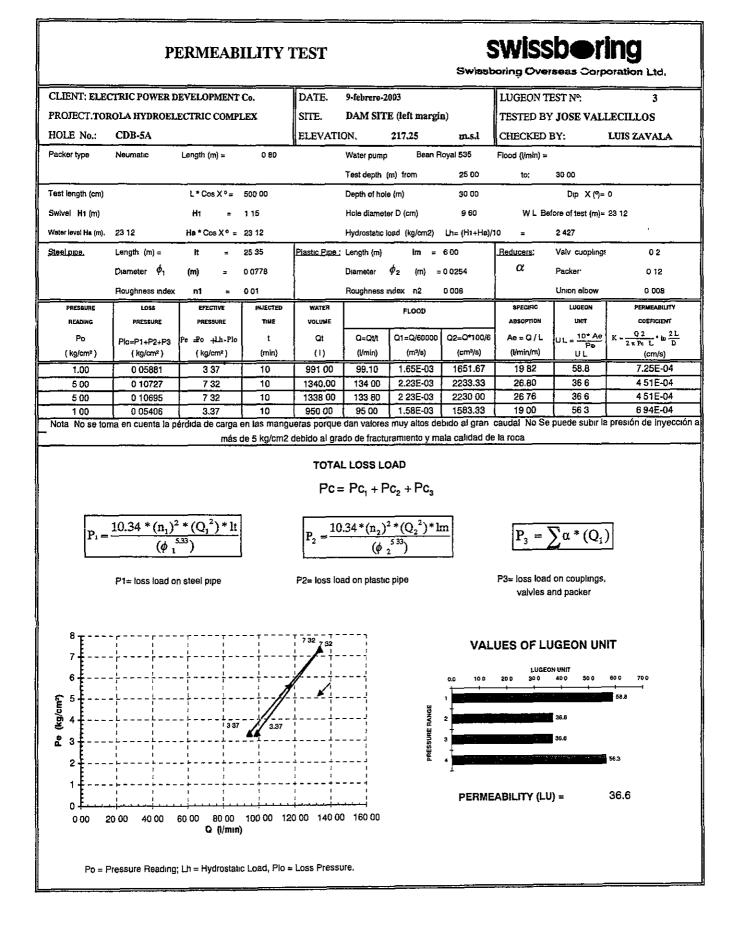
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| | | ····· | ************************************** | | | | SWISSE | ering Ove | iseas Corp | oration Ltd. |
|-------------------------|--------------------------------------|------------------------------|--|------------------|----------------|---|--------------------|----------------------------|-----------------------------|---|
| 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 | | 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 ϕ_1 | (m) = | 0 0603 | | Diameter | φ ₂ (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 ²) | (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 | |
| P ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1^5)}$ | $(Q_1^2) * lt$ | | | , | $Pc_{2} + Pc_{3}$ $\frac{2^{2} * (Q_{2}^{2}) * ls}{2^{5}}$ | m | $P_3 = 2$ | $\sum \alpha * (Q_1)$ |) |
| | P1= loss load on | | | P2= loss loa | | | | P3= loss load valvies a | on couplings, and packer | |
| ¹⁶ 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 | ++- - | + 4 B10 I | · 4 | | | | ц з с | | | 98 |
| £ 6 | 1 | ₽+ I | _ | <i>-</i> | | | | | | 94 |
| 4 | | | · | | | ł | 5 5 | | 8.1 | |
| 2 | | , . | | [¦] | | | - | | | |
| 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 | | | | | |



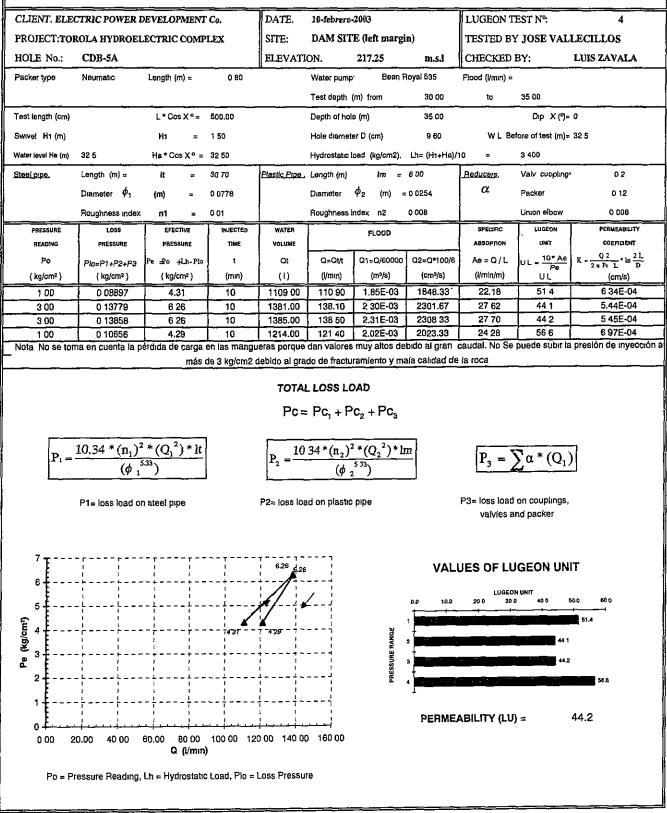


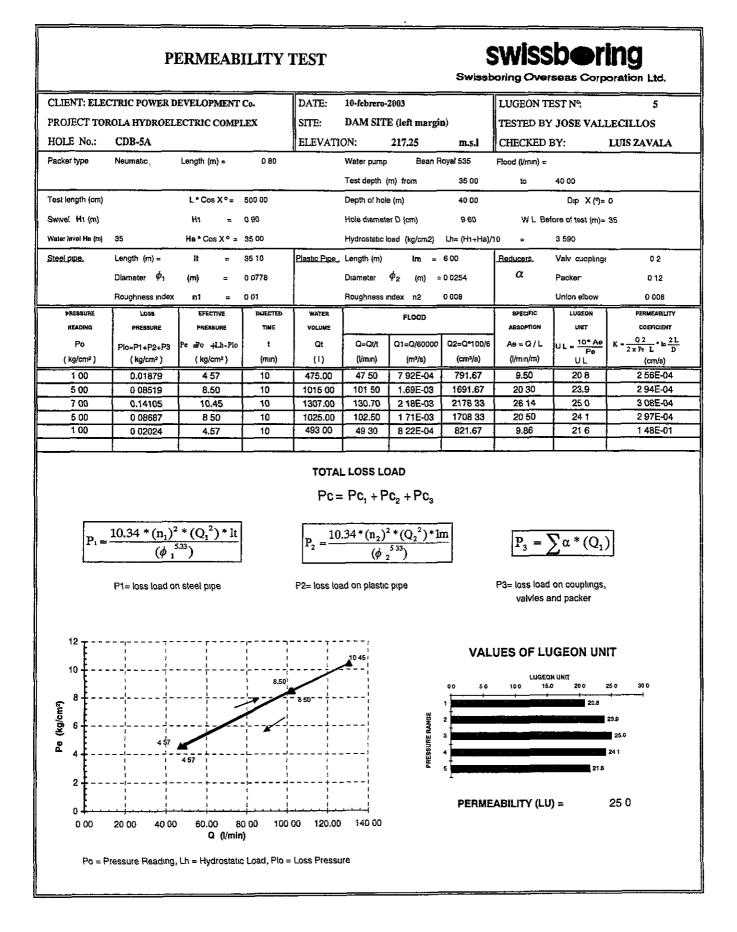
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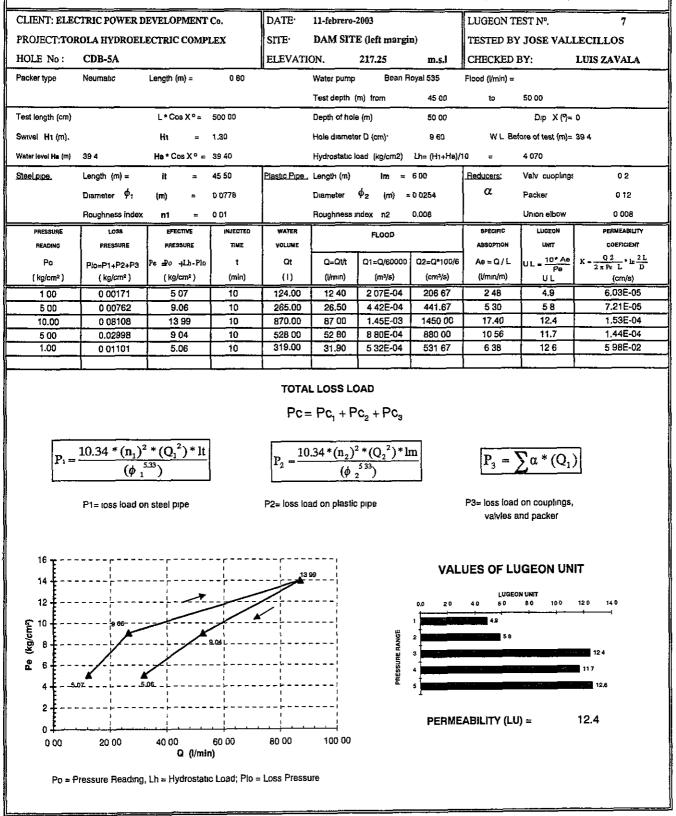


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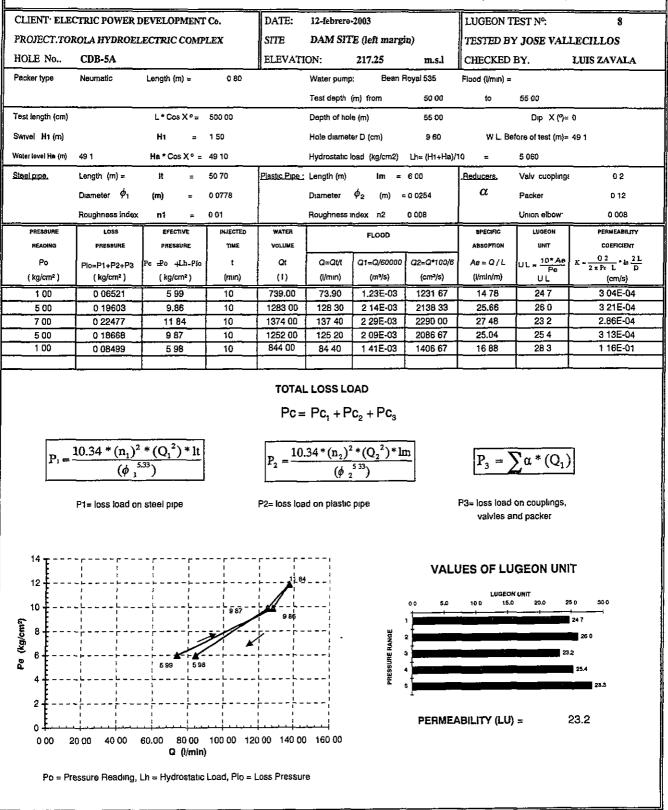
| Packer type. Neumatic Length (m) = 0 B0 Water pump Bean Royal 535 Flood (//min) = Test length (cm) L* Cos X ° = 500 00 Depth of hole (m) 40 00 to 45 00 Test length (cm) L* Cos X ° = 500 00 Depth of hole (m) 45 00 Dip X (°)= 0 Swivel H1 (m) H1 = 1 70 Hole diameter D (cm) 9 60 W L Before of test (m)= 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 ϕ_1 (m) = 0 0778 Diameter ϕ_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 ϕ_1 (m) = 0 0778 Diameter ϕ_2 (m) = 0 254 α 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 ± 0.4 3.56 ± 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 | |
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| PERMEABILITY (LU) = 27.9 | |
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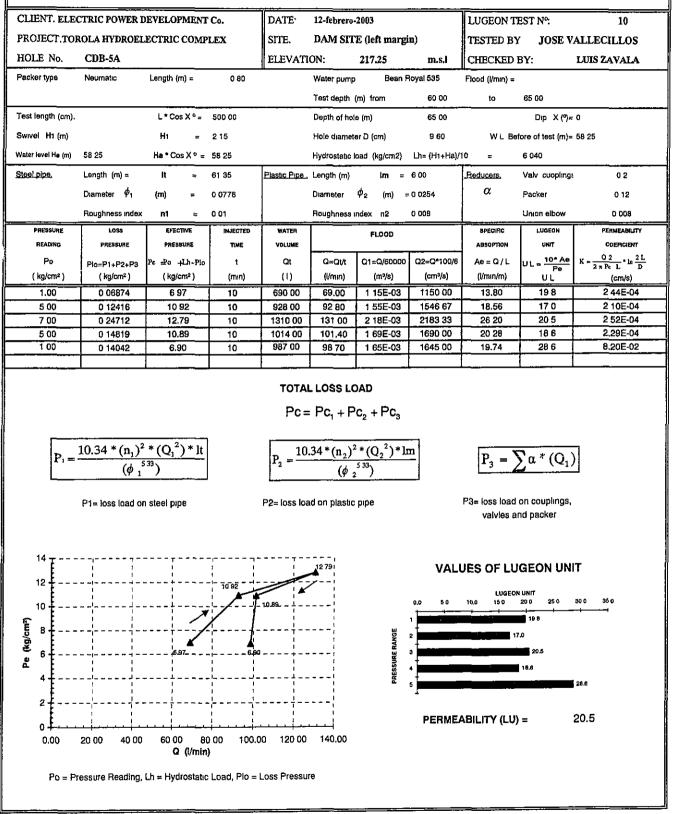


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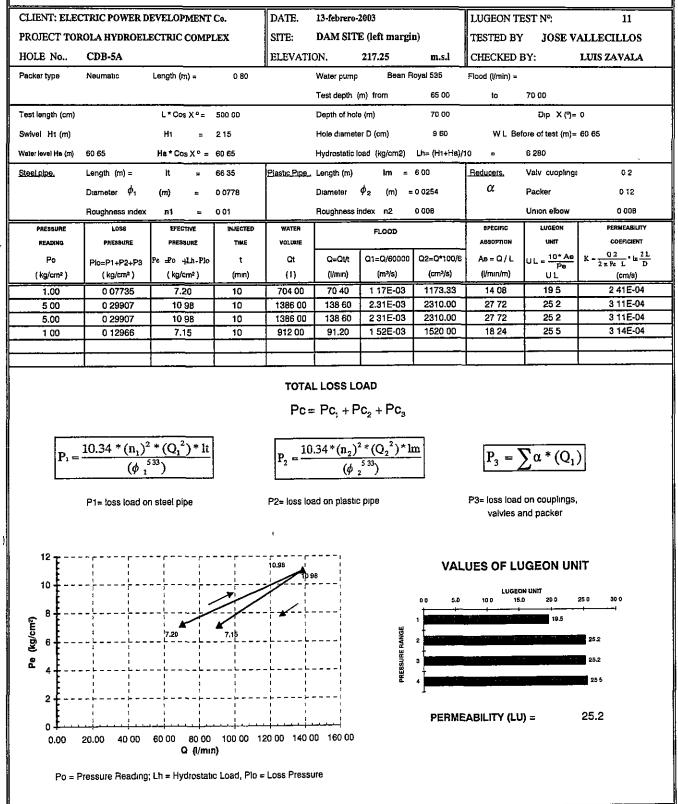


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|--|--|--------------------------------|---------------------------|----------------------|---|---------------------------------|--------------------|----------------------------|--|--|
| CLIENT: F | ELECTRIC POWER D | DEVELOPMENT | Co. | DATE: | 12-febrero- | | | 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 ϕ_1 | (m) = | 0 0778 | | Diameter | φ ₂ (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 ₂) ² (\$\$ | $\frac{(Q_2^2)^* h}{(Q_2^2)^*}$ | <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 | |
| | | | | | | | | | | |
| ¹⁴ E | | - | | | 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 | IT 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 ²) 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 ²) 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 ²) 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 |

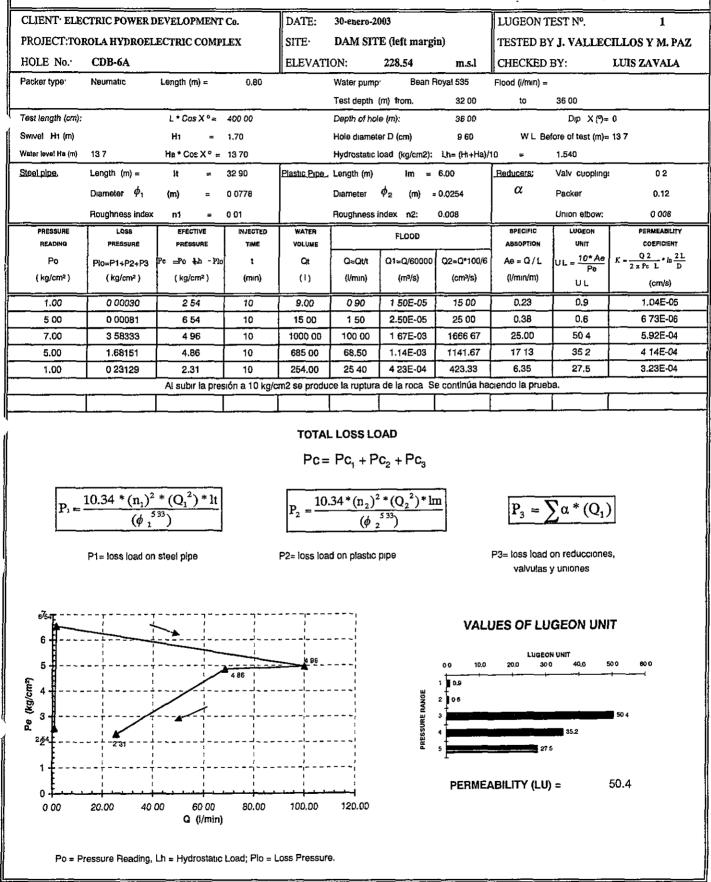
swissboring



swissbering



swissbering



SWISSDORING Swissboring Overseas Corporation Ltd.

| CLI | ENT: | ELECT | RIC POWER D | EVELOPMENT | Г С 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. · (| CDB-6A | | | ELEVATI | ON: | 228.54 | m.s.l | CHECKED | | LUIS ZAVALA |
| Packe | er type |) P | Veumatic | Length (m) = | 0 80 | _H | Water pump |) Bean F | loyal 535 | Flood (I/min) = | | |
| | | | | | | | Test depth | (m) from | 36 00 | to [.] | 41 00 | |
| Test l | ength | (cm). | · | L * Cos X ° ≖ | 500 00 | | Depth of ho | le (m) [.] | 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 ϕ_1 | (m) = | 0 0778 | | Diameter | ϕ_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 | | ² *(Q ₂ ²)*h ⁵³³) pipe | _ | P3≂ loss load | $\sum_{n} \alpha * (Q_1)$ | |
| | ¹⁶ Ŧ | | | | | | | | VAL | UES OF LU | | IT |
| | ¹⁴ E | | | | - ! | 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 | | | | | | | auss | 4 | | | 0.2 |
| | 4 Ę | 4 52 | 4 52 | | | | | 284 | 5 | 0.0 | | |
| | , E | - 12 | 4 44 | | | | | | 1 | | | |
| | 2 f | | | | | | | | PERME | ABILITY (LU |) = | 0.1 |
| | | | ···· | + · · · · · · · · · · · · · · · · · · · | <u></u> | | ┵╍┙ | | , L . 100 . | | ,- | |
| | ٥Ļ | | | | | 1 00 | 1 20 | | | | | |
| | ب 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 ϕ_1 ϕ_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) (cm³/s) υĽ (kg/cm² (kg/cm²) {kg/cm²} (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 $Pc = Pc_1 + Pc_2 + Pc_3$ $10.34 * (n_1)^2 * (Q_1^2) * lt$ $10.34*(n_2)^2*(Q_2^2)*lm$ $P_3 = \sum \alpha * (Q_1)$ $\mathbf{P}_1 =$ (ϕ_{2}^{533}) (**φ**₁ 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/cm²) 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

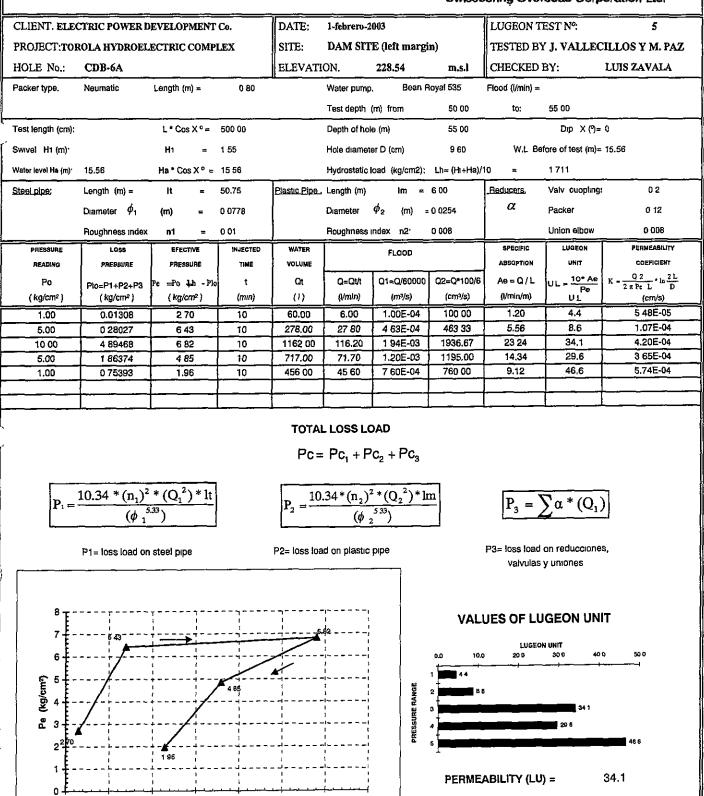
Po = Pressure Reading; Lh = Hydrostatic Load; Plo = Loss Pressure.

Q (i/min)

| (m) == 00 ex n1 == 00 | ELE ³ 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 ₁ + 1 | (m) from. le (m). ter D (cm) load (kg/cm2) im = ϕ_2 (m) = index n2 FLOOD Q1=Q/60000 (m ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC ₂ + PC ₃ | 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 ²) 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 ϕ_2 (m) Im Index n2 FLOOD Q1=Q/60000 (m ³ /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 ²) 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 ₁ + I | (m) from. le (m). ter D (cm) load (kg/cm2) im = ϕ_2 (m) = index n2 FLOOD Q1=Q/60000 (m ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC ₂ + PC ₃ | 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 ²) 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 ₁ + 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 ²) 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 ₁ + l | ter D (cm) totad (kg/cm2) im = ϕ_2 (m) = index n2 FLOOD Q1=Q/60000 (m ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.22E-04 6.67E-05 OAD PC ₂ + PC ₃ | 9 60 Lh= (H+Ha)/1 6.00 0 0254 0 008 C2=Q*100/6 (cm ³ /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 ₁ + 1 | $\frac{\log d}{(kg/cm2)}$ im = $\frac{\phi_2}{m}$ index n2 FLOOD Q1=Q/60000 (m ³ /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 ₁ + l | $im = \phi_2$ (m) = index n2 FLOOD Q1=Q/60000 (m ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC ₂ + PC ₃ | 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 ²) 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 ₁ + 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 ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6.67E-05 OAD PC ₂ + PC ₃ | 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 ²) 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 ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD PC ₂ + PC ₃ | 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 ²) 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 ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD PC ₂ + PC ₃ | (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 ²) 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 ²) 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 ₁ + l | (m ³ /s) 8.17E-05 3.42E-04 1.02E-03 3.25E-04 6 67E-05 OAD PC ₂ + PC ₃ | (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 ₂ + PC ₃ | 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 ₂ + PC ₃ | 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 ₁ + I | 3.25E-04 6 67E-05 OAD PC ₂ + PC ₃ | 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 ₂ + PC ₃ | | | · · · · · · · · · · · · · · · · · · · | |
| | 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 ₁ + I | Pc ₂ + Pc ₃ | · · · · · · · · · | | <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 |
| | - | 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 |

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

60 00 80. G (l/mìn)

80.00

120.00

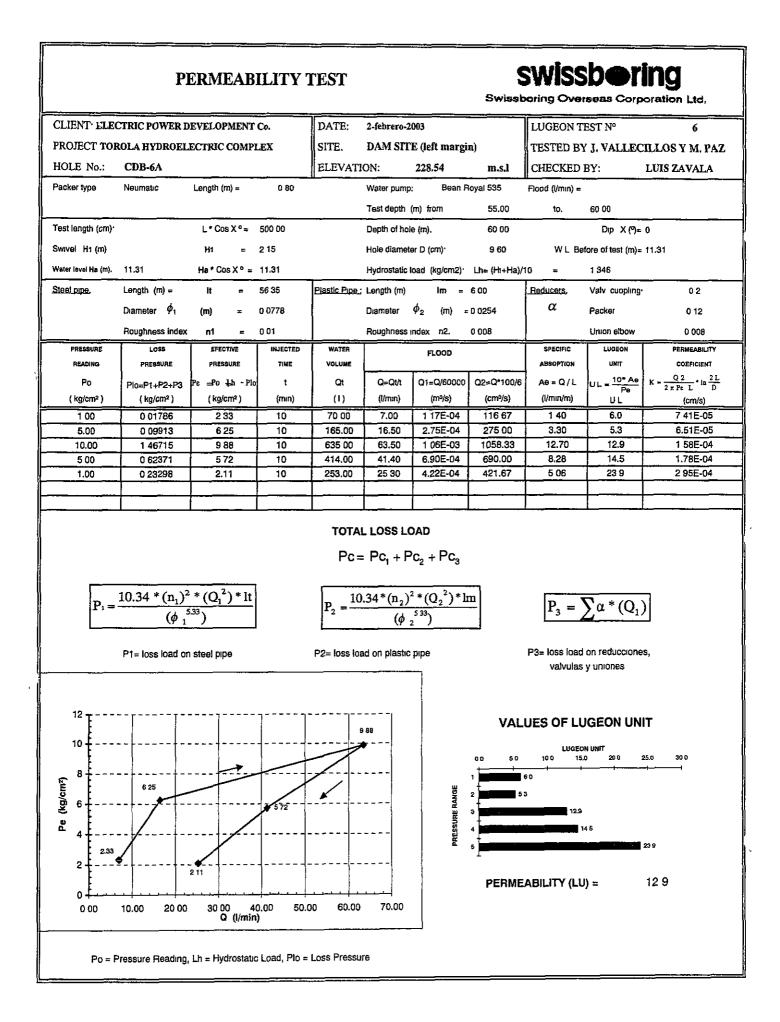
100 00

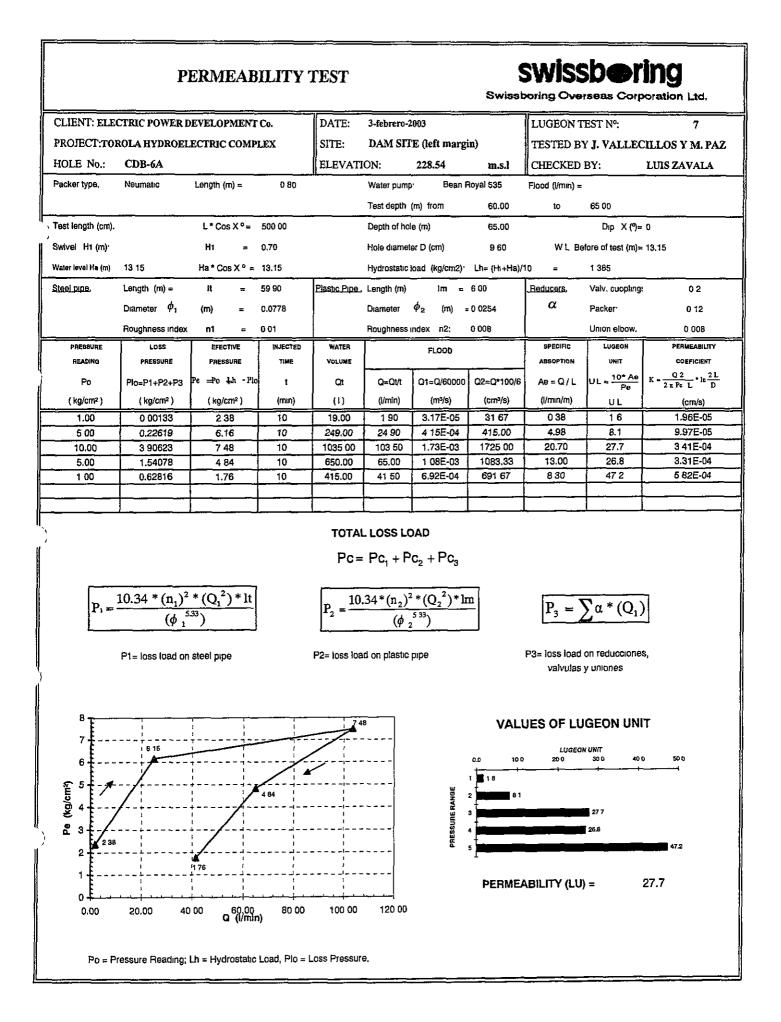
140 00

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) [.] | 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 ϕ_1 | (m) = | 0 0778 | | Diameter | ϕ_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 ²) | (kg/cm²) | (kg/cm ²) | (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 |
| |] | | | | | | | | . | |

$$Pc = Pc_1 + Pc_2 + Pc_3$$

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

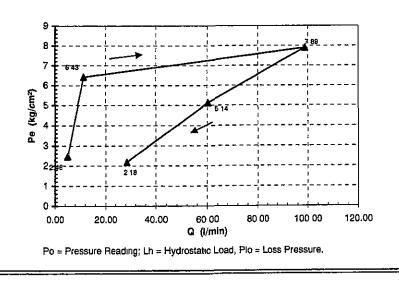
P1= loss load on steel pipe

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

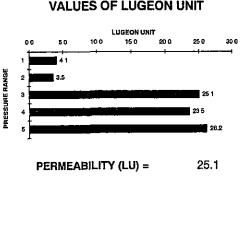
P2= loss load on plastic pipe

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

P3= loss load on reducciones, valvulas y uniones

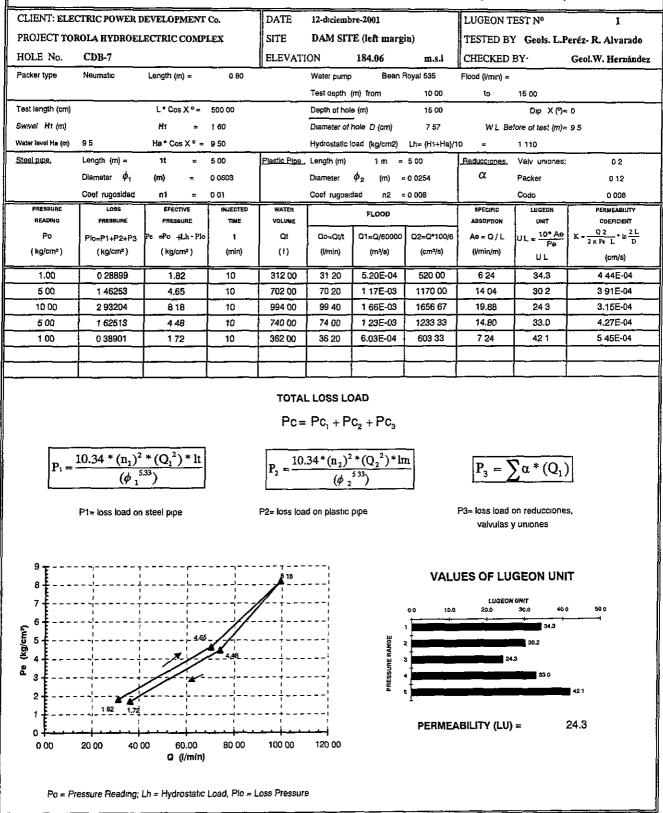


VALUES OF LUGEON UNIT



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| 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 ϕ_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 | | | . | 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 ₁ + P | c ₂ + Pc ₃ | | <u> </u> | <u>I</u> | |
| P. = | $\frac{10.34 * (n_1)^2}{(\phi_1)^2}$ | $\frac{(Q_1^2) * lt}{(33)}$ | | Pc= | : Pc ₁ + P | c ₂ + Pc ₃ | <u>m</u> | $P_3 = $ | $\sum \alpha * (Q_1)$ |) |
| P ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1^2)^2}$ | | | Pc= | $Pc_1 + P$.34*(n ₂) ² (ϕ | $c_2 + Pc_3$ $\frac{2^{2} (Q_2^{2}) + h}{2^{5}}$ | <u>m</u> | P3= loss load | $\sum \alpha * (Q_1)$ | |
| P ₁ = | | | | $Pc = \frac{10}{P_2} = \frac{10}{2}$ | $= Pc_1 + P$ $\frac{.34 * (n_2)^2}{(\phi_2)^2}$ 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 ₂) ² (ϕ | $c_2 + Pc_3$ $\frac{2^{2} \cdot (Q_2^{2}) \cdot h}{2^{533}}$ | | P3= loss load valvulas | on reduccione y uniones JGEON UN | s, |
| 12 - 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 ₂ + PC ₃ | 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 ₂ + PC ₃ | 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 ₂ + PC ₃ | 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 ₂ + PC ₃ | 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 ₂ + PC ₃ | 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> (ϕ ad on plastic | C ₂ + PC ₃ | 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> (ϕ ad on plastic | C ₂ + PC ₃ | 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> (ϕ ad on plastic | C ₂ + PC ₃ | 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 ϕ_1 | (m) = | 0 0603 | ł | Diameter | ϕ_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 ₂ ²)*lr ^{5 33}) | | $P_3 =$ P3= loss load | $\sum \alpha * (Q_1)$ | _J |
| 12 | | , _ . . | | | , | | | | y uniones | _ |
| 10 | 1 1 1 | 1 I 1 I 1 I |) | | ا تر 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 ⁸ | | | <u> </u> | | ! | | 1 00 | | ~+ + | 1 |
| ка стан | 6 12 | | | b | , ł | ANGE | | 6.0 | | |
| ÷ | 1/ | 611 | 4 1 | 1 | | PRESSURE RANGE | | | 1. | 9 |
| * 4 | | | | - - + - I | ; | RESS | | | 1.6 | |
| 2 | · | , . | | , | 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) |) = | |

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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 [.] | 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 ϕ_1 (m) - 0 0003 Diameter ϕ_2 (m) 1 m 6 00 Code Diameter ϕ_2 (m) - 215 Teacher O code Diameter ϕ_1 movement Numbers Water Diameter ϕ_2 (m) 0 0054 α Diameter ϕ_2 α | • • • | | | | | | • | | | | |
| $\begin{aligned} \underbrace{\text{Sitest}_{pope}}{\text{Diameter}} \underbrace{\text{A}}_{q} (m) = 0.0003 \\ \hline \text{Diameter} \underbrace{\text{A}}_{q} (m) = 0.0003 \\ \hline \text{Cost}_{pope}(m) \text{Im} = 6.00 \\ \hline \text{Diameter} \underbrace{\text{A}}_{q} (m) = 0.0003 \\ \hline \text{Cost}_{pope}(m) = 0.0254 \\ \hline \text{Cost}_{pope}(m) \text{Cost}_{pope}(m) \text{Im} = 6.00 \\ \hline \text{Cost}_{pope}(m) \text{Cost}_{pope}(m) \text{Cost}_{pope}(m) \\ \hline \text{FLOOD} \text{Second} \text{Diameter} \underbrace{\text{A}}_{q} = 0.008 \\ \hline \text{Cost}_{pope}(m) \text{Cost}_{q} = 0.008 \\ \hline \text{Cost}_{q$ | | | | | | | | | | , , | 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 | | | 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 ϕ_1 | (m) = | 0 0603 | | Diameter | ϕ_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 |
| $Pc = Pc_{1} + Pc_{2} + Pc_{3}$ $\boxed{P_{1} = \frac{10.34 * (n_{1})^{2} * (Q_{1}^{2}) * lt}{(\phi_{1}^{5.33})}}$ $\boxed{P_{2} = \frac{10.34 * (n_{2})^{2} * (Q_{2}^{2}) * lm}{(\phi_{2}^{5.33})}}$ $\boxed{P_{2} = loss load on plastic pipe}$ $P_{2} = loss load on plastic pipe$ $P_{3} = loss load on reducciones, valvulas y uniones$ $VALUES OF LUGEON UNIT$ $\underbrace{Uaeon UniT}_{100$ | . | | | | 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 ₂) ² (ϕ_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

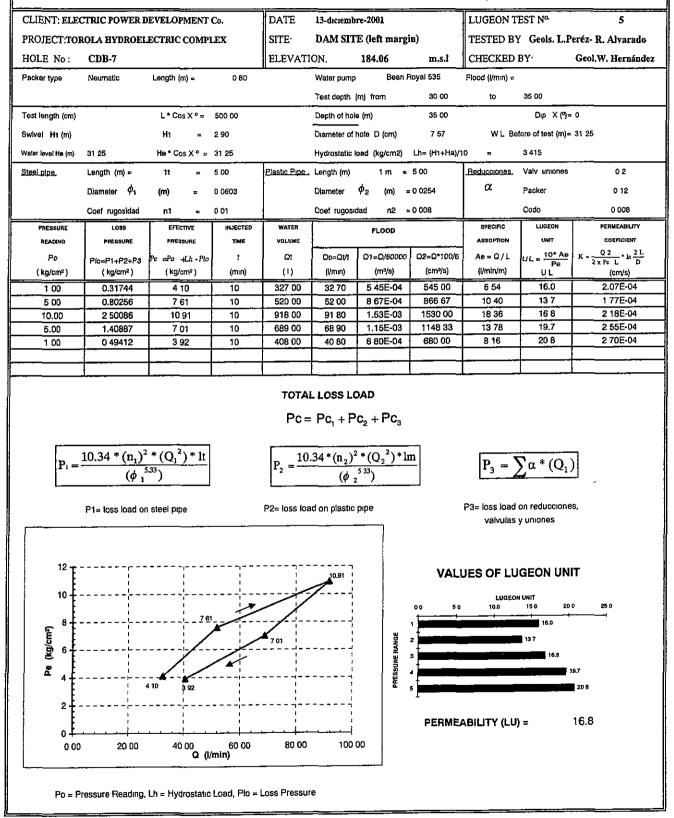
7-5-62

70 00

50 00 60 00

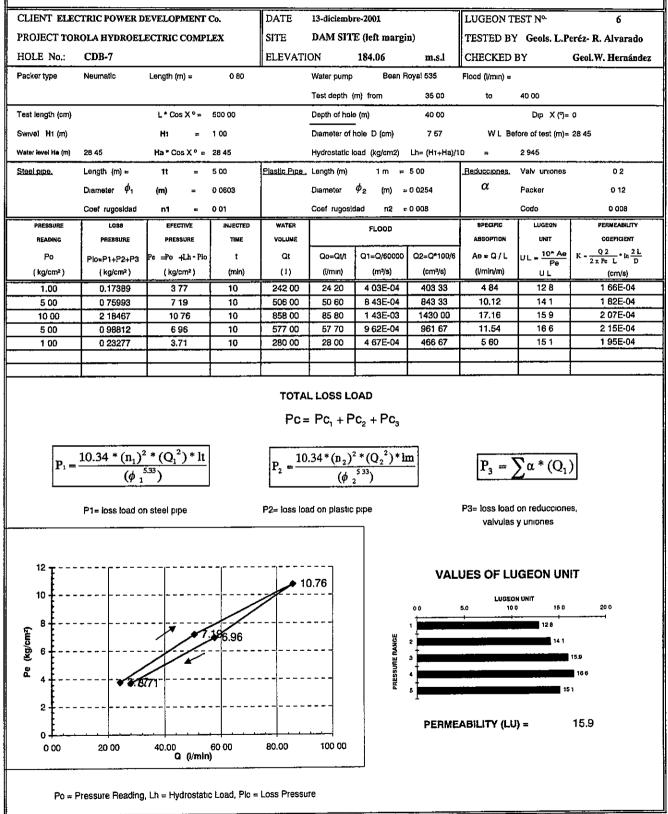
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| CLIENT FLEC | TRIC POWER D | EVEL OPMENT | <u> </u> | DATE | 13-diciemh | 2001 | | LUGEON T | TOT N10 | 7 |
|--|---|--|----------|--------------------------------------|--------------|--|----------------|----------------|--|---|
| | OLA HYDROEL | | | 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 ϕ_1 | (m) = | 0 0603 | | Diameter | φ _{2 (m)} = | = 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 ₂ ²)*ln 5 ³³) | | P3= loss load | $\sum_{n=1}^{\infty} \alpha^{*} (Q_{1})$ | _ _ |
| 14 | | | | 12 | 63 | | VAL (| | | |
| 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 | n) | 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 ϕ_1 | (m) = | 0 0603 | | Diameter | φ ₂ (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 ²) | (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 | |
| | $10.34 * (n.)^2$ | ² * (0, ²) * ¹ | | | , | $Pc_2 + Pc_3$ | m | | | 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 | $\sum \alpha * (Q_1)$ | - |
| 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 | - |
| | | | | $P_2 = \frac{10}{2}$ | $\frac{1.34*(n_2)}{(\phi_1)}$ | $\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$ | | P3= loss load | on reduccione y uniones | |
| ¹⁴ | | | | $P_2 = \frac{10}{2}$ | $.34*(n_2)$ (ϕ | $\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$ | VAL | P3= loss load valvulas UES OF LL | on reduccione y uniones JGEON UN | 95. IT |
| | | | | $P_2 = \frac{10}{1000}$ P2= loss los | $.34*(n_2)$ (ϕ | $\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$ | | P3= loss load valvulas UES OF LL | on reduccione y uniones JGEON UN | |
| ¹⁴ | | | | $P_2 = \frac{10}{1000}$ P2= loss los | $.34*(n_2)$ (ϕ | ² *(Q ₂ ²)*l ₁ ⁵³³) 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 | $.34*(n_2)$ (ϕ | ² *(Q ₂ ²)*l ₁ ⁵³³) 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 | $.34*(n_2)$ (ϕ | ² *(Q ₂ ²)*l ₁ ⁵³³) pipe | VAL | P3= loss load valvulas UES OF LL | on reduccione y uniones JGEON UN JGEON UNIT 2.0 25 | 25, 25, 21 T 30 55 |
| 14 12 10 | | n steel pipe | | $P_2 = \frac{10}{1000}$ P2= loss los | $.34*(n_2)$ (ϕ | $\frac{2^{2} * (Q_{2}^{2}) * h}{2^{5} 3^{3}}$ | 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 | $.34*(n_2)$ (ϕ | ² *(Q ₂ ²)*l ₁ ⁵³³) 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 | $.34*(n_2)$ (ϕ | ² *(Q ₂ ²)*l ₁ ⁵³³) pipe | VAL | P3= loss load valvulas UES OF LL | on reduccione y uniones JGEON UN 2.0 25 2.3 | |
| Le (kg/cm ²) 16 (kg/cm ²) 10 | P1= loss load or | n steel pipe | | $P_2 = \frac{10}{1000}$ P2= loss los | $.34*(n_2)$ (ϕ | ² *(Q ₂ ²)*l ₁ ⁵³³) 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 ₂) (φ ad on plastic | ² * (Q ₂ ²) * lu ⁵ ³³) 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 ₂) (φ ad on plastic | ² * (Q ₂ ²) * lu ⁵ ³³) 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 ϕ_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 ²) | (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] |
| | P1= loss load on | | | P2= loss loa | | | | P3= loss load valvies a | on couplings, nd packer | |
| 10 - 9 - | | | | | 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 | 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 | | | | ; - - | i | | PERME/ | ABILITY (LU) |) = | 17.2 |
| 0 F · · | 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 _i | 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 | n | 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 ϕ_1 | | 0 0603 | There are the set | • • • • | φ ₂ (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 ²) | (kg/cm ²) | (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 ₂ + Pc ₃ | m | , | | |
| P ₁ = | $\frac{10.34 * (n_1)^2}{(\phi_1^5)}$ | $(Q_1^2)^*$ lt | I | Pc= | = Pc, + P | | m | P ₃ =) | $\sum \alpha * (Q_1)$ |)] |
| 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 T | | | | $Pc =$ $P_2 = \frac{10}{2}$ | $= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi_1)}$ | $Pc_{2} + Pc_{3}$ $\frac{2*(Q_{2}^{2})*h}{2}$ | | P3= loss load valvies a | on couplings, | |
| 9 - | | | | $Pc =$ $P_2 = \frac{10}{2}$ | $= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ 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 - | | | | $Pc =$ $P_2 = \frac{10}{2}$ | $= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ 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 - | | | 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 - | | | | $Pc =$ $P_2 = \frac{10}{2}$ | $= Pc_1 + F$ $\frac{.34*(n_2)}{(\phi)}$ 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 ²) 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 | $Pc_2 + Pc_3$ $\frac{2*(Q_2^2)*h}{2}$ | VAL | P3= loss load valvies a UES OF LL 400 C0 22.9 22.6 | on couplings, and packer JGEON UN | IT |
| (kg/cm ²) 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 ²) 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 ²) 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 Francisco (Ka) 9 Francisco (Ka) 7 6 7 6 7 6 7 6 7 6 7 7 7 7 6 7 7 7 6 7 7 7 7 7777777777777 | | 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 ²) 9 Free (kg/cm ²) 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 = | $= Pc_1 + F$ $34*(n_2)$ (ϕ 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 | - | [| | r— | | Į | Į | _ | i — | 1 | [| [| | | [| — | |
|--------------|-----------|-------------|----------------|------------|------------|------------|-------------|-------------|-------------|-------------|------------|------------|------------|------------|------------|------------|------------|---|----------|--|
| | 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 | | | |
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LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

LECTURAS PIEZOMETRICAS

PROYECTO: El Chaparral, río Torola

POZO # CDB-2

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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 | | | |
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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 |
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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 |
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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 |
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LECTURAS PIEZOMETRICAS PROYECTO: El Chaparral, río Torola

POZO # CDB-8

| ELEV. TUBO | | | h de tubo 0.90 |
|-------------|-------|---------|--------------------------|
| 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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