A P P E N D I X

APPENDIX 1	Summary of core boring in Kasseb project area. Geological log of drill hole.
APPENDIX 2	Permeability test in drill hole
APPENDIX 3	Log of test pit

APPENDIX 1

CONTENTS

Table App 1 - 1 Summary of Core Boring in Kasseb Project Area

Hole name	Co-ordinates X	Co-ordinates Y	Elevation	Bearing	Dip	Length	Over-burden	Core recovery	Pumped-in test	Commenced	Completed	Advance
			m		°	m	m	%	sect.			m/day
SB 10	87,047.44	78,644.03		N	45	50.0	3.4	76.9	7	17, Oct. 79	20, Dec. 79	0.78
SB 11	87,157.47	78,638.77		S	45	55.0	11.0	46.2	3	23, Oct. 79	07, Dec. 79	0.98
SB 12				-	90	30.6	3.1	67.2	-	16, Jul. 79	14, Aug. 79	1.02
SB 12 bis	87,246.77	78,641.06		-	90	30.0	2.9	70.2	3	19, Aug. 79	26, Sep. 79	0.77
SB 13	86,613.08	78,480.04		-	90	35.0	0.2	82.4	2	04, May. 79	30, May. 79	1.40
SB 14	87,692.10	77,872.81		-	90	35.0	2.2	97.2	4	08, Jun. 79	08, Jul. 79	1.13
SI 2	86,947.01	78,490.58		-	90	150.0	5.0	47.0	11	13, Jun. 79	14, Dec. 79	0.81
SU 11				-	90	70.0	3.0	50.4	6		23, Feb. 80	
			Total;	8 holes		455.6 meters		59.8 % in average				

Remarks

1/ Location; Damsite - - - SB 10, SB 11, SB 12 and SB 12 bis.
South saddle in upper reservoir area - - - SB 13.
North saddle in upper reservoir area - - - SB 14.
Intake site - - - SI 2. Outlet site - - - SU 11.

2/ Size of bore hole was mostly NX.

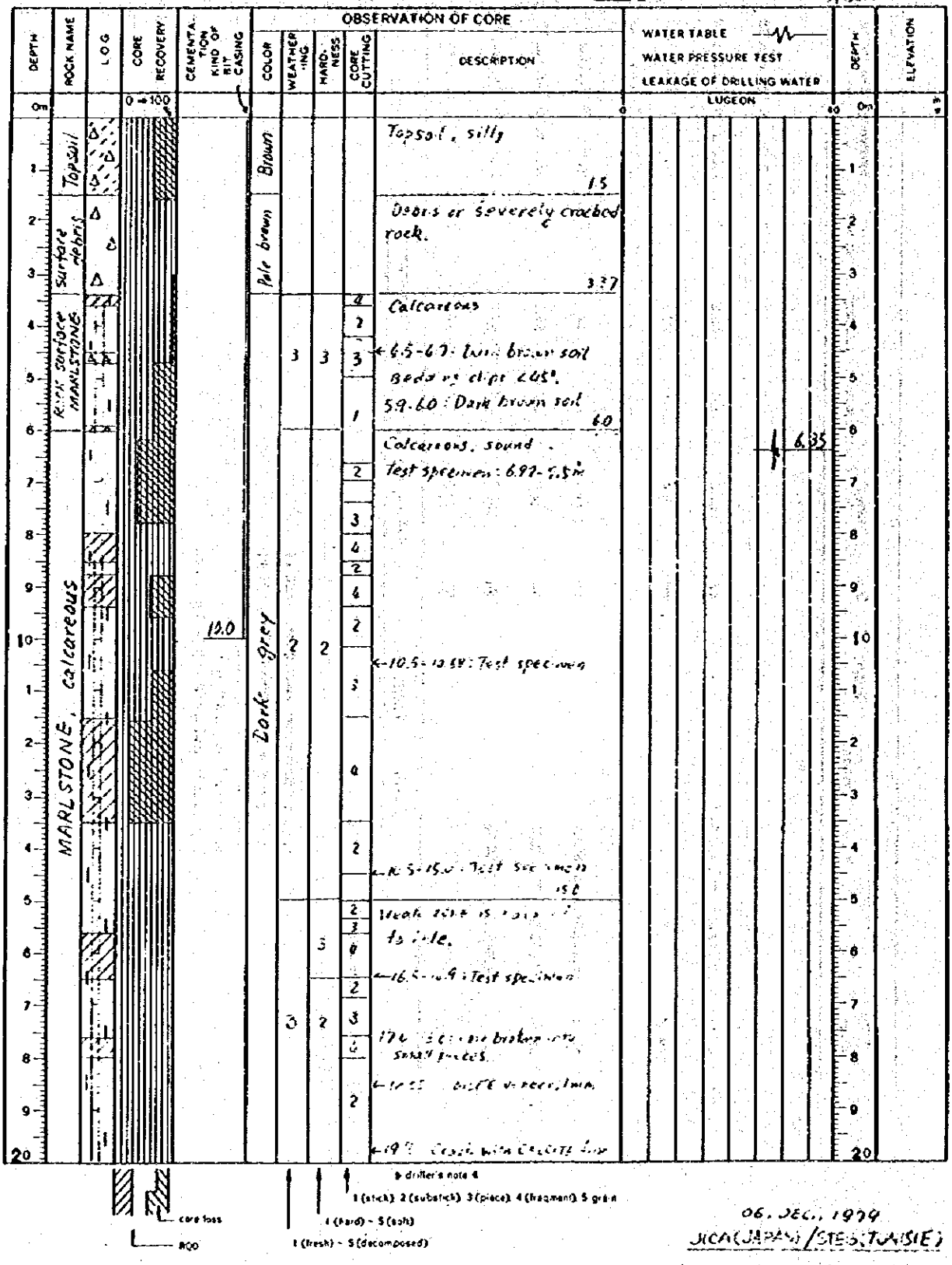
3/ Each elevation indicates that of the top of hole.

4/ Machines used in the boring works are shown below.
Model - - - Diamant Boart BELGIUM D.B. 250, Moscow Regional Economy Coun. L. USSR and Long year IHBO 246, U.S.A.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No. SB 10 (SHEET 1 OF 3)

LOCATION	Left river side	DEPTH OF HOLE	50.0 m	COMMENCED	17-Oct-'79
ELEVATION	m	DEPTH OF OVERBURDEN	3.4 m	COMPLETED	20-Dec.-'79
COORDINATE	X 87,027.49 Y 28,644.03	LENGTH OF ROCK DRILLING	46.6 m	DRILLED BY	STEG / EGTH
ANGLE FROM HORIZONTAL	45°	TOTAL LENGTH OF CORE	m	LOGGED BY	Hellal
BEARING OF ANGLE HOLE	N	CORE RECOVERY	%		

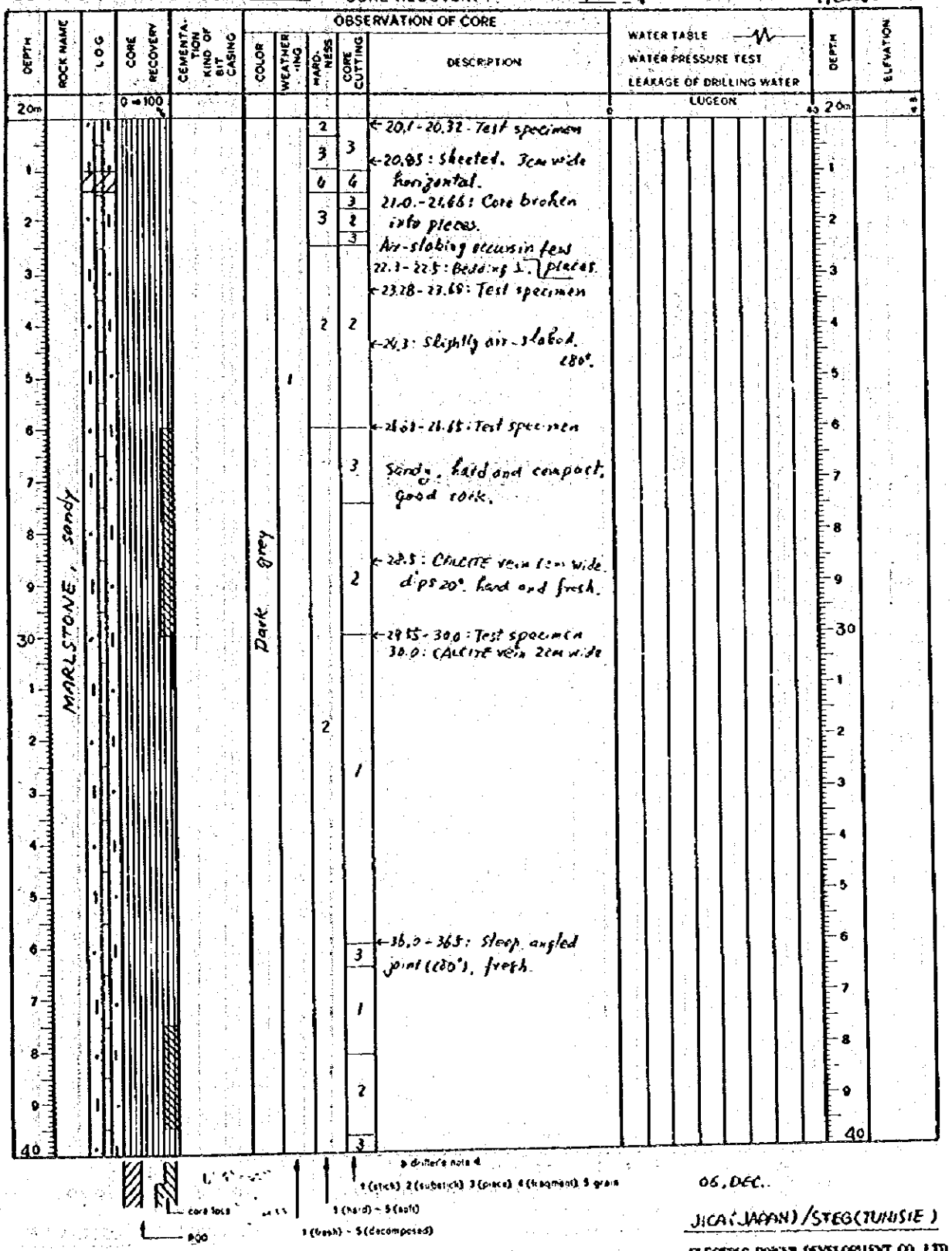


06. DEC., 1979
JICA (JAPAN) / STEG (TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No. SB 10 (SHEET 2 OF 3)

LOCATION	Left river side	DEPTH OF HOLE	50.0 m	COMMENCED	17-Oct-'79
ELEVATION	m	DEPTH OF OVERBURDEN	3.4 m	COMPLETED	20-Dec-'79
COORDINATE	X 87.027.46 Y 78.664.03	LENGTH OF ROCK DRILLING	46.6 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	45°	TOTAL LENGTH OF CORE	m	LOGGED BY	M. Sueto/Mr. Helal
BEARING OF ANGLE HOLE	N	CORE RECOVERY	%		



GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No. SB 10 (SHEET 3 OF 3)

LOCATION	Left river side	DEPTH OF HOLE	50.0 m	COMMENCED	17-Oct.-'79
ELEVATION	m	DEPTH OF OVERBURDEN	3.4 m	COMPLETED	20-Dec.-'79
COORDINATE	X 87,047.43 Y 76,[illegible].03	LENGTH OF ROCK DRILLING	46.6 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	45°	TOTAL LENGTH OF CORE	m	LOGGED BY	[illegible]
BEARING OF ANGLE HOLE	N	CORE RECOVERY	%		

Column headings: DEPTH | ROCK NAME | LOG | CORE RECOVERY (0 → 100) | CEMENTATION, KIND OF BIT, CASING | OBSERVATION OF CORE: COLOR, WEATHERING, HARDNESS, CORE CUTTING, DESCRIPTION | WATER TABLE, WATER PRESSURE TEST, LEAKAGE OF DRILLING WATER (LUGEON) | DEPTH | ELEVATION

Depth 40 m – 50 m:

- Rock name: MARLSTONE, somewhat sandy
- Color: Dark grey to grey
- Weathering: 2
- Hardness: 2
- Core cutting: 2, 4, 2, 5, 2, 1, 3
- Description:
  - 42.3 – 42.7: Sandy and clayey.
  - 46.7: Crushed, 1cm wide, ∠70°
  - 46.98–47.05: Two joints with clay film

Bottom of hole, 50.0 m

Legend: core loss; RQD; driller's note; 1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain; 1 (hard) ~ 5 (soft); 1 (fresh) ~ 5 (decomposed)

16 and Dec., 1979

JICA (JAPAN) / STEG (TUNISIA)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No. SB 11 (SHEET 1 OF 3)

LOCATION Right river side	DEPTH OF HOLE 55.0 m	COMMENCED 23-Oct.-'79
ELEVATION m	DEPTH OF OVERBURDEN 11.0 m	COMPLETED 07-Dec.-'79
COORDINATE X 87,157.47 Y 78,638.77	LENGTH OF ROCK DRILLING 44.0 m	DRILLED BY STEG/EGTH
ANGLE FROM HORIZONTAL 45°	TOTAL LENGTH OF CORE m	LOGGED BY H. Suetomi
BEARING OF ANGLE HOLE S	CORE RECOVERY %	

DEPTH	ROCK NAME	LOG	CORE RECOVERY (0 → 100)	CEMENTATION, KIND OF BIT, CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER (LUGEON)	DEPTH	ELEVATION
0–3.0	CLAY				brown - dark brown				Clay, cohesive, damp			
3.0–3.3									LIMESTONE (fragment)			
3.3–11.0					Brown				Clay, cohesive, damp 3.2–9.2: may be consists of LIMESTONE brecciated debris in general			
11.0–15.0	MARLSTONE, calcareous				Grey				Highly weathered, disturbed, very soft, plastic (Test specimen: 11.0–11.36) Containing few account of tiny particles which are white and completely weathered.			
15.0–19.50									Disturbed rock, with steeply dipped foliation. Fault zone ? 19.–			
19.50–20									Becoming slightly contact.			

Legend: core loss; RQD; 1 (fresh) ~ 5 (decomposed); 1 (hard) ~ 5 (soft); 1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain; driller's note

05. Dec., 1979

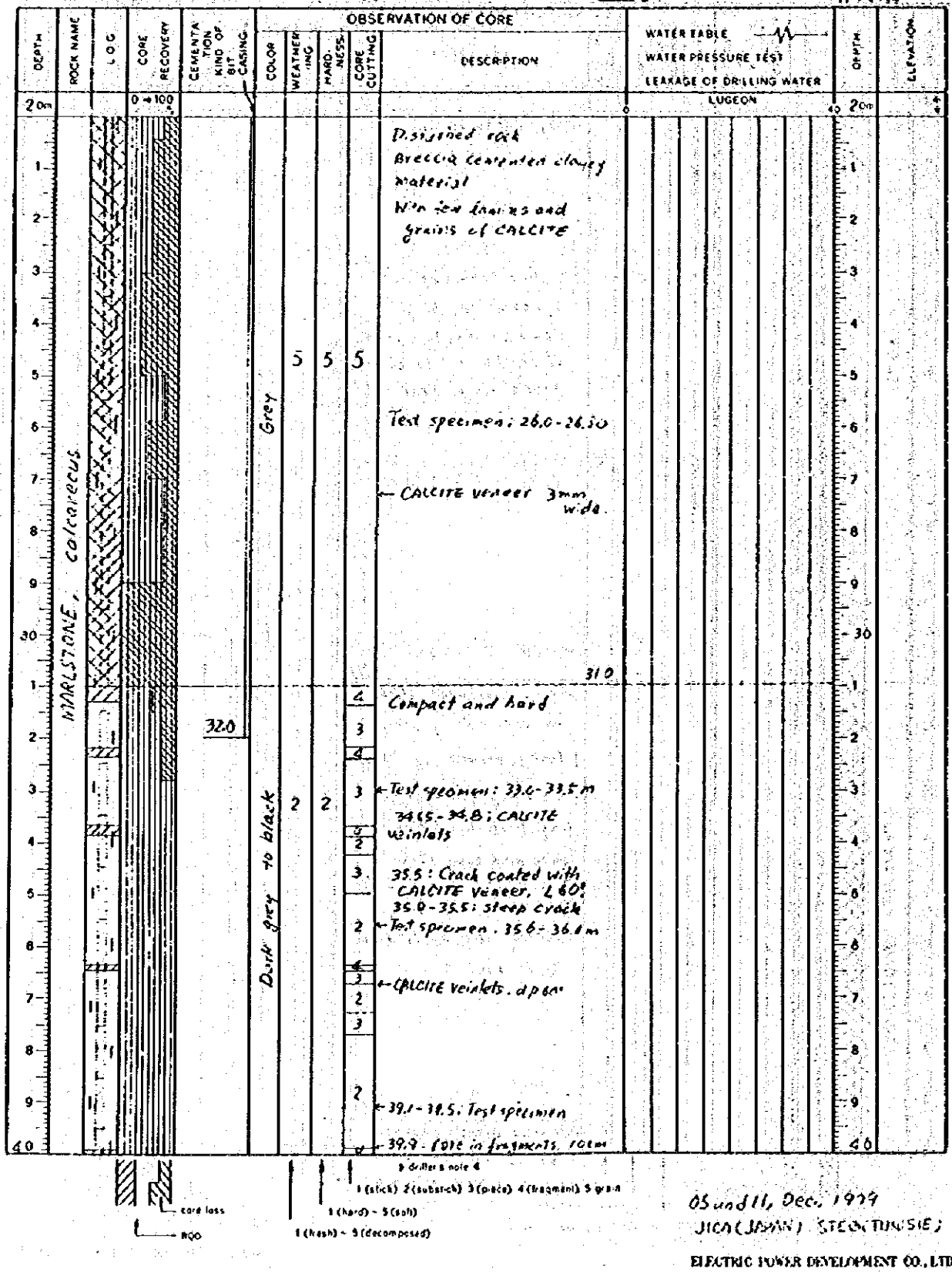
JICA, JAPAN; STEG (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No SB 1 (SHEET 2 OF 3)

LOCATION	Right river side	DEPTH OF HOLE	55.0 m	COMMENCED	23-Oct-'79
ELEVATION	m	DEPTH OF OVERBURDEN	11.0 m	COMPLETED	07-Dec-'79
COORDINATE	X 82,137.41 Y 78,238.22	LENGTH OF ROCK DRILLING	44.0 m	DRILLED BY	STEQ/EGTH
ANGLE FROM HORIZONTAL	45°	TOTAL LENGTH OF CORE	m	LOGGED BY	M. Guetame H. Hilali
BEARING OF ANGLE HOLE	S	CORE RECOVERY	%		



OS and II, Dec. 1979
JICA (JAPAN) STEQ (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No SB 11 (SHEET 3 OF 3)

LOCATION Right river side
ELEVATION ____ m
COORDINATE X 87,757.47 Y 78,138.72
ANGLE FROM HORIZONTAL 45°
BEARING OF ANGLE HOLE S

DEPTH OF HOLE 55.0 m
DEPTH OF OVERBURDEN 11.0 m
LENGTH OF ROCK DRILLING 44.0 m
TOTAL LENGTH OF CORE ____ m
CORE RECOVERY ____ %

COMMENCED 23-Oct-'79
COMPLETED 07-Dec-'79
DRILLED BY STEG/EGTH
LOGGED BY [illegible]

OBSERVATION OF CORE

DEPTH	ROCK NAME	L.O.G	CORE RECOVERY 0→100 %	CEMENTATION KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
40m									
1	MARLSTONE, calcareous				Dark grey	2	3	6	Short bar core is lifted in part
2							2	2	22: Joint coated with CALCITE film, ∠75°
3									42.8: Irregular crack, steepy inclined.
4							3	4	43.0–45.0: Core recovery is very poor. Core broken into fragments with clay. 45.0
5	MARLSTONE, foliated				Dull grey	5	5	5	Fault zone. Mostly clayey materials with rock fragments and particles in various places due to foliation. Some fragmental cores have pitted CALCITE small patches. 51.0-52.0: Sheared and foliated core, ∠60°. CALCITE veinlets in some places. 55.0
6									Bottom of hole, 55.0m
7									
8									
9									
50									
1									
2									
3									
4									
5									
6									
7									
8									
9									
0									

WATER TABLE
WATER PRESSURE TEST
LEAKAGE OF DRILLING WATER
LUGEON 0 — 40

DEPTH: 40m
ELEVATION: m

core loss
RQD
※ driller's note ④
1 (slick) 2 (subslick) 3 (piece) 4 (fragment) 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

05, Dec, 1979
JICA (JAPAN) / STEG (TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No. SB 12 (SHEET 1 OF 2)

LOCATION	Right river side	DEPTH OF HOLE	30.6 m	COMMENCED	16 - Jul - '79
ELEVATION	m	DEPTH OF OVERBURDEN	3.1 m	COMPLETED	14 - Aug - '79
COORDINATE		LENGTH OF ROCK DRILLING	27.5 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	[illegible]
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

OBSERVATION OF CORE

DEPTH (m)	ROCK NAME	LOG	CORE RECOVERY (0 → 100)	CEMENTATION KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER (LUGEON)	DEPTH (m)	ELEVATION (m)
0			0 → 100							0 → 4.5		
1	Topsoil				Dark Brown				1.3 Brown with white spots 1.5 Dried from MARLSTONE.		1	
2	Weathered Zone										2	
3									3.1		3	
4	MARLSTONE					4			←3.35-3.53: Test specimen. 3.35: Slip plane. ∠70°. Cracky due to disturbing and clayey.		4	
5											5	
6									←5.8-6.1: Test specimen. 5.8m: Vertically foliated.		6	
7						5	5		6.7 Rock changes to clayey marl/crais.		7	
8						5					8	
9											9	
10					Dark grey				10.1		10	
1						2	2	4	13.5: Crack, steeply inclined. Not calcareous.		1	
2									←12.0: Clay, 5cm wide. 12.4		2	
3									Disturbed and clayey. Completely CALCITE veinlets in part		3	
4						4	5	5			4	
5											5	
6						3	3	4	←15.6-15.8: Rock fragments. (Not calcareous)		6	
7						4	5	5	←16.8-17.0: Rock fragments.		7	
8						3	3	4	←18.35-18.55: Rock fragments calcareous		8	
9						4	5	5			9	
20											20	

core loss

RQD

▶ driller's note ◀

1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

12. Dec., 1979

JICA(JAPAN)/STEG(TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT: Damsite HOLE No. SB 12 (SHEET 2 OF 2)

LOCATION: Right river side	DEPTH OF HOLE: 30.6 m	COMMENCED: 16-Jul-'79
ELEVATION: ____ m	DEPTH OF OVERBURDEN: 3.1 m	COMPLETED: 14-Aug-'79
COORDINATE: X ____ Y ____	LENGTH OF ROCK DRILLING: 27.5 m	DRILLED BY: STEG/EGTH
ANGLE FROM HORIZONTAL: 90°	TOTAL LENGTH OF CORE: ____ m	LOGGED BY: Mr. Suetomi
BEARING OF ANGLE HOLE: ____	CORE RECOVERY: ____ %	Mr. Ellis

OBSERVATION OF CORE

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION, KIND OF BIT, CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
0			0 100						
1							3	3	Grey Calcareous 23.5
2							5	5	21.5
3						4	4	5	Core brittled and clayey. 23.2
4							3	4	23.2-23.4: Air-slaked shaly. Clacky but undisturbed rock.
5					Dark grey		4		24.75-24.9: Clayey. 25.2: Slickensides. 25-25.3: Core into small pieces
6									
7						2	3	3	
8								4	27.5: Joint, fresh, ∠80° 27.9
9								3	Shaly and air-slaked along foliation.
30	LIMESTONE shaly					2	4	5	Foliation; 0.5 to 2mm wide and dip of 80°.
30.6									Clay 30.4 30.6
									Bottom of hole: 30.6m.

WATER TABLE
WATER PRESSURE TEST
LEAKAGE OF DRILLING WATER
LUGEON

DEPTH | ELEVATION

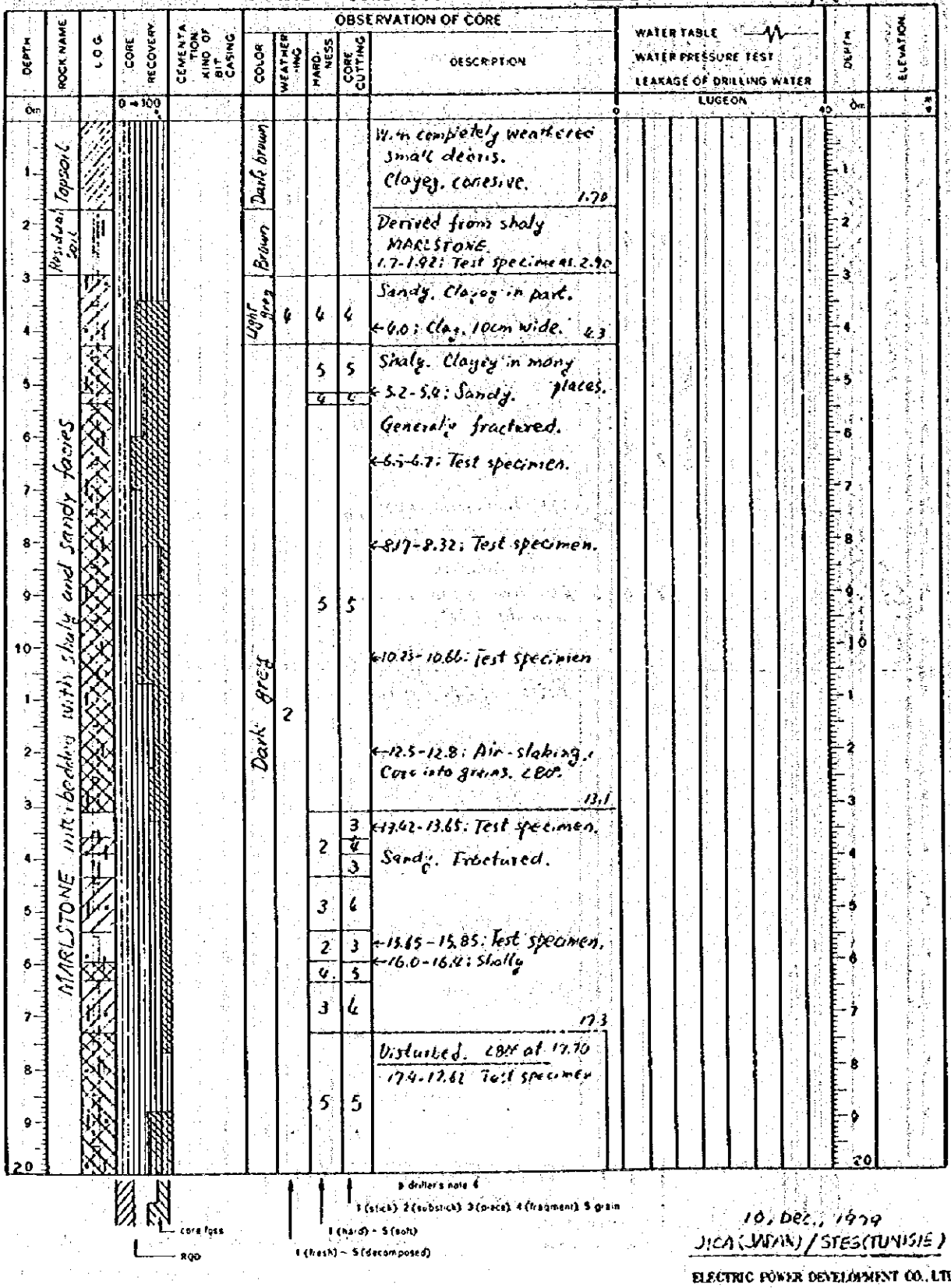
core loss
RQD
b driller's note 4
1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

12, Dec. 1979
JICA (JAPAN) / STEG (TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Dam site HOLE No. SB-2 bis (SHEET 1 OF 2)

LOCATION	Right bank	DEPTH OF HOLE	32.0 m	COMMENCED	19-Aug-'79
ELEVATION	289.366.77 m	DEPTH OF OVERBURDEN	2.9 m	COMPLETED	26-Sept-'79
COORDINATE	289.461.86	LENGTH OF ROCK DRILLING	29.1 m	DRILLED BY	STES/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	Mustapha Hellab
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

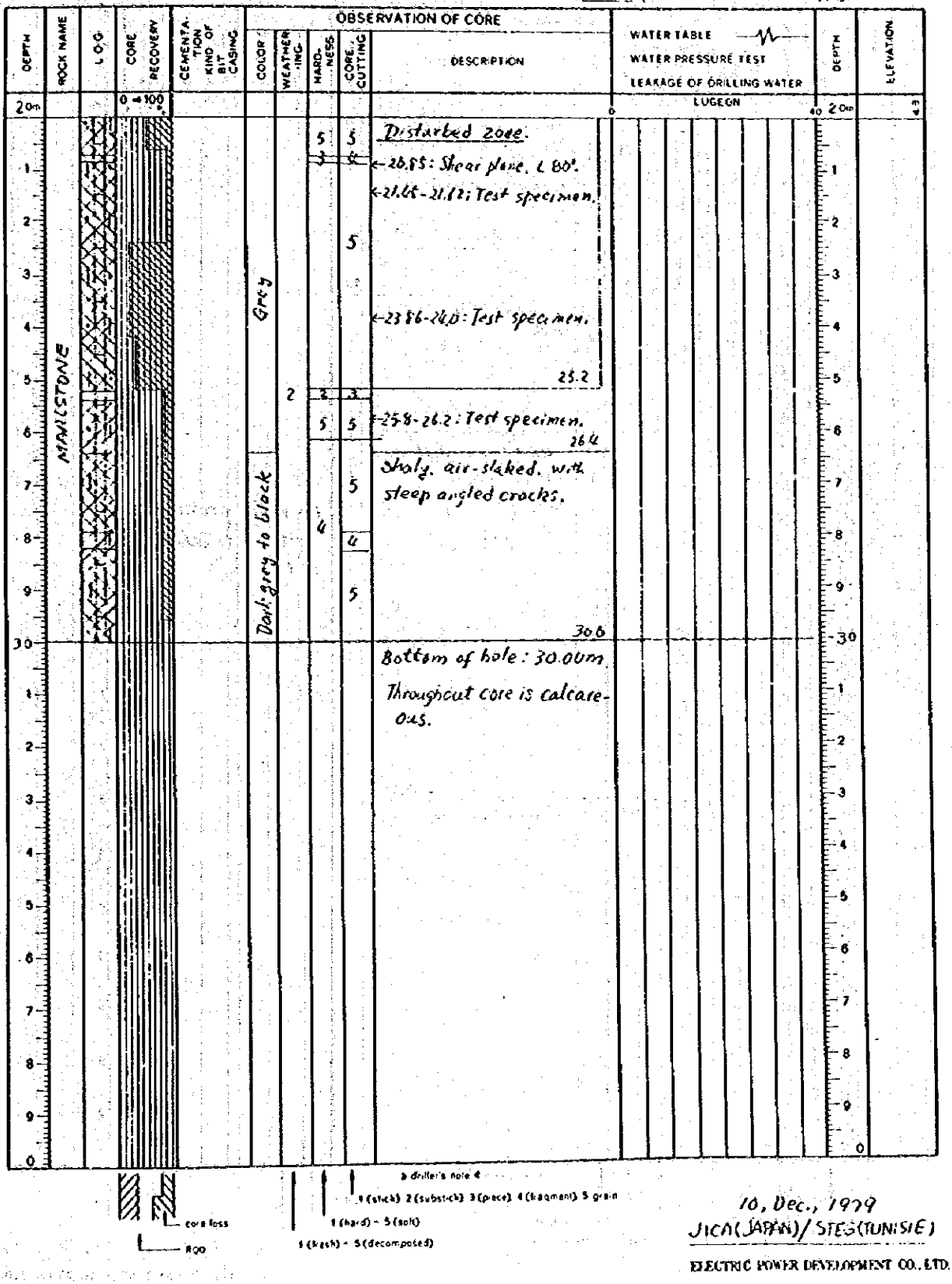


10, Dec., 1979
JICA (JAPAN) / STES (TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Damsite HOLE No. SB12 bis (SHEET 2 OF 2)

LOCATION	Right bank	DEPTH OF HOLE	30.0 m	COMMENCED	19-Aug-'79
ELEVATION	m	DEPTH OF OVERBURDEN	2.9 m	COMPLETED	26-Sept-'79
COORDINATE	X 87.246.77 Y 78.441.06	LENGTH OF ROCK DRILLING	27.1 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	I. Tsutomi H. Ali
BEARING OF ANGLE HOLE		CORE RECOVERY	%		



10, Dec., 1979
JICA(JAPAN)/STEG(TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

NASSEB PROJECT Reservoir area HOLE No. SB 13 (SHEET 1 OF 2)

LOCATION	Sanin saddle	DEPTH OF HOLE	35.7 m	COMMENCED	4-May-'79
ELEVATION	m	DEPTH OF OVERBURDEN	0.2 m	COMPLETED	30-May-'79
COORDINATE	X 85,613.08 Y 28,480.09	LENGTH OF ROCK DRILLING	35.5 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	K. Sekiguchi H. Ishida
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

OBSERVATION OF CORE

DEPTH	ROCK NAME	L.O.G.	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
0m			0→100 %						
1					Dark brown	2	3	4	Brecciated rock fragments. Iron stain spots. Core is stained. 1.3
2					Dull grey	4	4	4	Weathered, clayey 2.0
3								5	Clayey forming to soil 2.5
4								4	Disturbed and shattered rock 3.6
5									
6									6.0
7	MARLSTONE, Calcareous				Dark grey		5	5	Sheared and disturbed zone. Fault. Clayey.
8									
9									
10									
1									
2									
3						2	2	4	←13.0-13.3 : MARLSTONE, Shaly fragments.
4									
5									
6							5	5	
7									
8									
9									
20									

WATER TABLE
WATER PRESSURE TEST
LEAKAGE OF DRILLING WATER
LUGEON

No water pressure test due to collapse of hole wall.

DEPTH: 0m, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 1, 2, 3, 4, 5, 6, 7, 8, 9, 20

ELEVATION: m

core loss
RQD

9 driller's note 4
1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain
1 (hard) - 5 (soft)
1 (fresh) - 5 (decomposed)

JICA (JAPAN)/STEG (EGYPT)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Reservoir area HOLE No. SB 13 (SHEET 2 OF 2)

LOCATION	South saddle	DEPTH OF HOLE	35.0 m	COMMENCED	4-May-'79
ELEVATION	X 66,613.68 m	DEPTH OF OVERBURDEN	0.2 m	COMPLETED	30-May-'79
COORDINATE	Y 28,492.04	LENGTH OF ROCK DRILLING	34.5 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	Nakamura
BEARING OF ANGLE HOLE		CORE RECOVERY	%		Hirich

OBSERVATION OF CORE

DEPTH	ROCK NAME	LOG	CORE RECOVERY 0→100 %	CEMENTATION KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
20m										LUGEON 0 40	20m	
1	MARLSTONE, Calcareous			21.0	Pale grey	2	5	5	Fault zone. 21.5	No water pressure test due to collapse of hole wall.	1	
2							5	4	←22.6-22.9: Test specimen. Very steeply foliated 22.9 With Slickensides.		2	
3							3	3			3	
4							C	C	←23.7-24.0: Cracked & clayey		4	
5							3	4	←24.65-24.9 steepy cracks. 25.7		5	
6							4	5	Friable rock. foliated. ←26.65-26.8: Test specimen 27.0		6	
7							4	5	27.10-27.2: Clayey but not disturbed. bedding and		7	
8								4	Contact dips 65°.		8	
9								3	←28.72-28.97: Test specimen 29.0		9	
30							3	3	Most of core in pieces. Irregular shaped. Clayey.		30	
1							5	3			1	
2							4	4			2	
3							5	5	Clayey.		3	
4								3	←32.1-32.26: Test specimen. ←32.5-32.6 ' ' ←32.9: Clayey 10cm wide. Crazing rock.		4	
5							3	4	←34.2: Slickensides. Not clayey 35.0		5	
6									Bottom of hole. 35.00m		6	
7											7	
8											8	
9											9	
0											0	

core loss
RQD
1 (fresh) - 5 (decomposed)
1 (hard) - 5 (soft)
driller's note 1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain

JICA (JAPAN) / STEG (TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Reservoir area HOLE No SB 14 (SHEET 1 OF 2)

LOCATION	North Sadine	DEPTH OF HOLE	35.0 m	COMMENCED	09 - Jul. - '77
ELEVATION	m	DEPTH OF OVERBURDEN	2.2 m	COMPLETED	08 - Jul. - '77
COORDINATE	X 87,672.10 Y 77,822.81	LENGTH OF ROCK DRILLING	32.8 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	[illegible]
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
0m			0 ◀ 100 %						
		△			Brn				Topsoil with roots. 0.5
1	MARLSTONE, calcareous				Dull yellow		5	4	Completely decomposed to clayey slate. Residual soil. 2.2
2									
3								3	Severely weathered very soft 4.0
4						4	4		
5								4	Severely brittled and clayey
6									
7									7.25
									Somewhat sheared 7.7
8					Dark grey	2	3	3	Slightly compact but soft 9.6
9						4	4	4	Clayey. Core into pieces 9.7
10						4	5	5	Very clayey slime. 10.2
						2	3	3	10.2-11.0 : Core into short bars and some pieces. 11.5
1						2	4	4	11.9
2						2	3	3	Core into short bars 12.3
3						2	4	4	Core broken into pieces and clayey particles 14.0
									Somewhat sandy, Grey 14.6
4						2	3	5	Disturbed Ac-Rt. 14.75
5	MARLSTONE, sandy				Grey	2	3	3	Phyllitic. Dips 45°. 15.6
6								4	Calcareous, and somewhat sandy.
7						2	2	3	
8								4	Somewhat clayey
								3	
9								4	
								2	18.8 - 19.1 : Core in thin slices. Dip near horizontal.
20								3	

WATER TABLE
WATER PRESSURE TEST
LEAKAGE OF DRILLING WATER
LUGEON

core loss
RQD

9 driller's note 8
1 (stick) 2 (subslick) 3 (piece) 4 (fragment) 5 grain
1 (hard) - 5 (soft)
1 (fresh) - 5 (decomposed)

JICA (JAPAN), STEG (TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Reservoir area HOLE No. SB 14 (SHEET 2 OF 2)

LOCATION	North Saddle	DEPTH OF HOLE	35.0 m	COMMENCED	03 - Jun. - '77
ELEVATION	m	DEPTH OF OVERBURDEN	2.2 m	COMPLETED	08 - Jul. - '77
COORDINATE	X 87,892.70 Y 72,972.81	LENGTH OF ROCK DRILLING	32.8 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	[illegible]
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
20m			0 → 100 %						LUGEON 0 ↔ 20m			
1	MARLSTONE sandy				Light grey	2	2	2	Sandy and compact. Somewhat phyllitic, but very compact. 21.70-21.95: Slightly shaken. 21.95			
2								2	Sandy, massive, hard and compact.			
3								4				
4								2	23.5: Crushed 1cm wide, dips 65°. 23.8			
5						1	1	3	Silty MARLSTONE Somewhat softer than Sandy facies 25.0			
6								1	Sandy massive, and very hard. Good rock.			
7									←27.05-27.1. Shaly, dark grey somewhat soft. 27.7			
8						3	3	3	Core broken and clayey 28.1			
9						1	2	2	Sandy, hard and compact massive. 28.8 and 28.9: Cobbing dips 60° and 70°.			
30								4	←29.9-30.0: Core in fragments 30.5			
1						4	5	5	Disturbed rock. clayey Core recovery is very poor 31.85			
2							2	2	Sandy, compact. ←32.5. clayey band 5cm wide. ←32.7-33.1. Steep crack not stained. 33.3			
3	MARLSTONE calcareous					2	4	4	Foliated. Core parts into small grains due to air-slaking, at dip of 45°. But compact in natural. 35.8			
35							5	5	Bottom of hole: 35.00m			
6												
7												
8												
9												
0												

core loss

R00

▶ driller's note ◀

1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain

1 (hard) - 5 (soft)

1 (fresh) - 5 (decomposed)

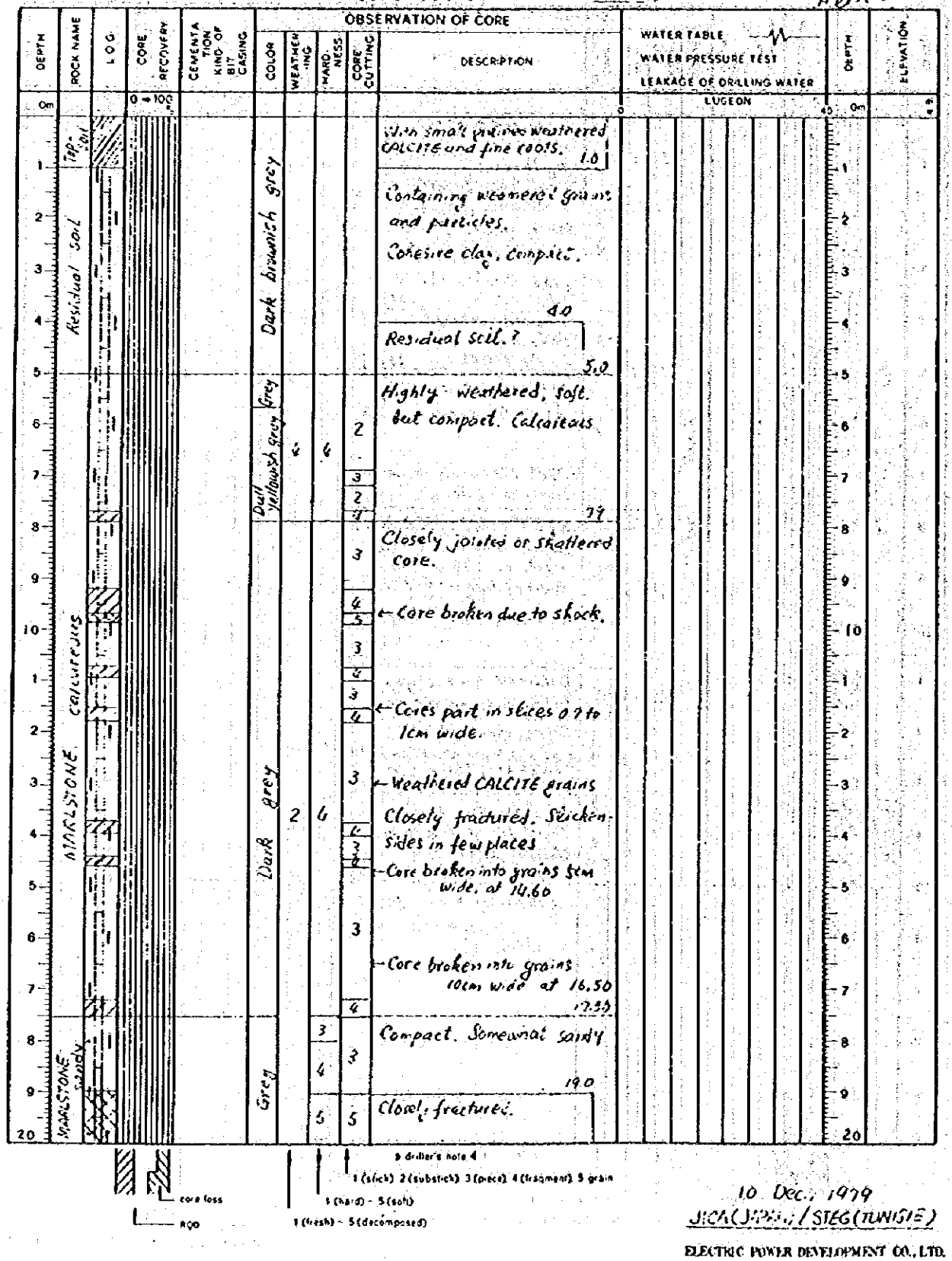
[illegible] / STEG (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Upper reservoir area HOLE No. S1 2 (SHEET 1 OF 8)

LOCATION	Intake site	DEPTH OF HOLE	150.0 m	COMMENCED	13 - Jul - '79
ELEVATION	m	DEPTH OF OVERBURDEN	5.0 m	COMPLETED	14 - Dec - '79
COORDINATE	X 85,967.01 Y 78,490.38	LENGTH OF ROCK DRILLING	145.0 m	DRILLED BY	STEG/EGTI
ANGLE FROM HORIZONTAL	40°	TOTAL LENGTH OF CORE	m	LOGGED BY	[illegible] Hefni
BEARING OF ANGLE HOLE		CORE RECOVERY	%		



10 Dec., 1979
JICA (JAPAN) / STEG (TUNISIE)
ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Upper reservoir area HOLE No. SI 2 (SHEET 2 OF 8)

LOCATION	Intake site	DEPTH OF HOLE	150.0 m	COMMENCED	13 - Jul - '79
ELEVATION	m	DEPTH OF OVERBURDEN	5.0 m	COMPLETED	16 - Dec - '79
COORDINATE		LENGTH OF ROCK DRILLING	145.0 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	Hellal
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

OBSERVATION OF CORE

WATER TABLE
WATER PRESSURE TEST
LEAKAGE OF DRILLING WATER
LUGEON

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
20m			0 → 100						
1	MARLSTONE, Sandy				Grey		4	5	
							3	2	Joints dip 70°.
2							5	5	22.0
							5	5	Shell-like. Dip 70° 22.4
							5	3	Sandy, grey 22.7
3					Dark grey		4	5	Foliated. Core in thin slices and pieces. With few CALCITE veneers. Shear zone ? 24.9
4							3	3	Stonewhat sandy. At 25.0 and 25.3: clay 2cm wide.
5								4	Slickensides in parts. 26.0
6								3	
7	MARSTONE, Sandy				Light grey	2	2	4	Generally hard and compact but cracky in most part.
8								2	
9								2	
30								4	← Core into slices 1 to 3cm wide. dips 70°. Planes with striae.
1								3	31.1
2	MARSTONE Shaly				Dark grey		4	6	← Contact with CALCITE veneer, dips 70° Core in very thin slices. with thin CALCITE veneers in some places.
3							5	5	33.3
4	MARSTONE, Sandy				Light grey		2	3	Sound and compact.
5								4	
6								3	← 35.7: Slickensides, ∠70°
7								3	← 37.15: Core into pieces.
8								4	← 37.9: Slickensides, ∠65°
9								3	Core into very thin slices and pieces. Fine-grained 39.0 ∠45°. Shaly. Dark grey 39.5
40							4	5	
							2	3	

core loss
RQD

9 driller's note 4
1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

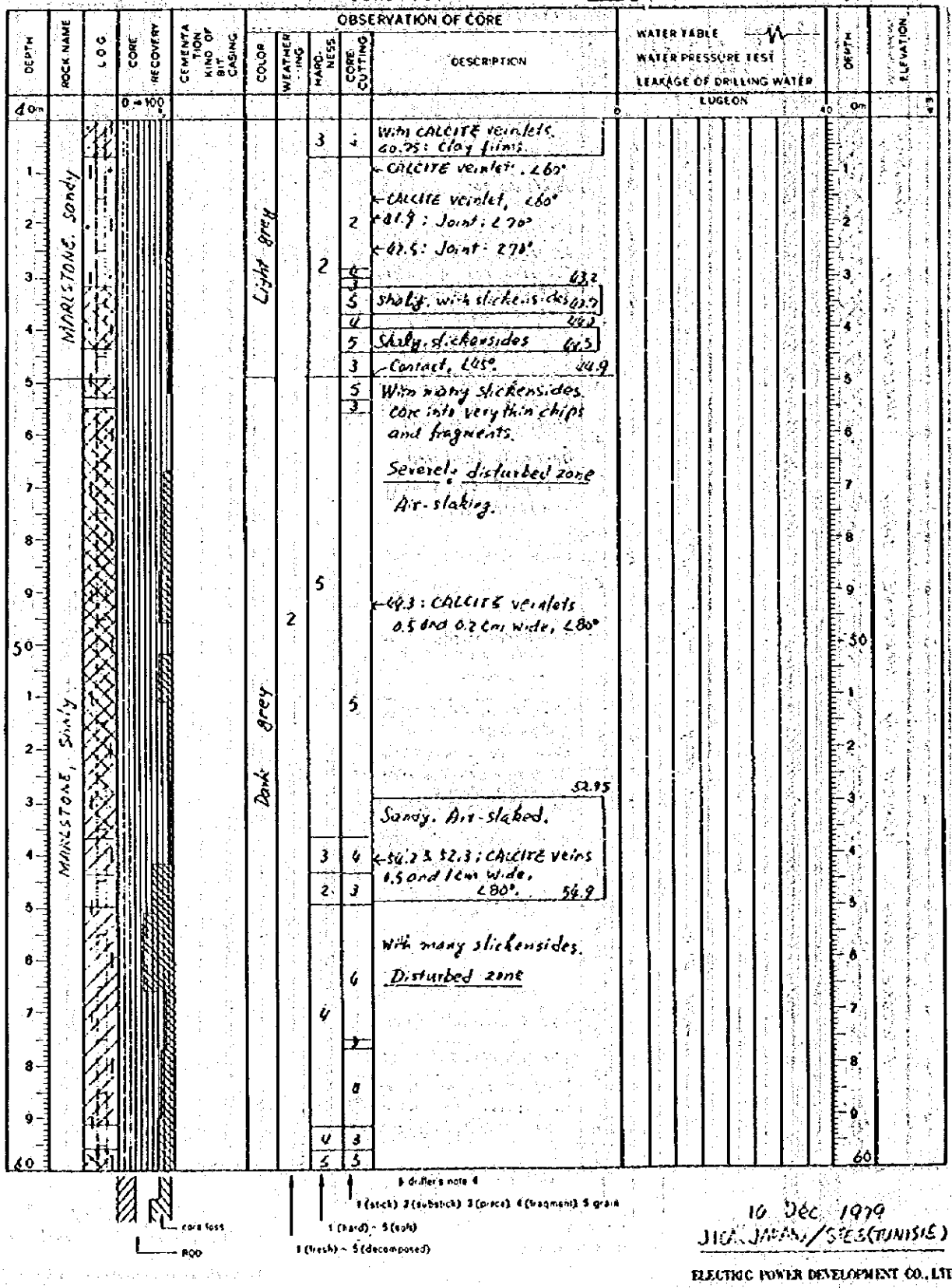
10 Dec, 1979
JICA (JAPAN), STEG (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Upper reservoir area HOLE No. S1 2 (SHEET 3 OF 9)

LOCATION	Intake site	DEPTH OF HOLE	150.3 m	COMMENCED	
ELEVATION	m	DEPTH OF OVERBURDEN	5.0 m	COMPLETED	
COORDINATE		LENGTH OF ROCK DRILLING	145.0 m	DRILLED BY	STEG/EQTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	M. Suetomi / HEGO
BEARING OF ANGLE HOLE		CORE RECOVERY	%		



10 Dec. 1979
JICA JAPAN / STEG (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Upper reservoir area HOLE No. S1 2 (SHEET 4 OF 9)

LOCATION	Intake site	DEPTH OF HOLE	150.0 m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	5.0 m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	145.0 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	Kisutomi Hellali
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER	DEPTH	ELEVATION
60m			0 ● 100						LUGEON 0 ○ 60m		60m	
60	MARLSTONE, shaly				Dark grey	2	5	5	60.0-63.5: sandy		60	
1									61.3: CALCITE vein, 1cm wide		1	
2							5	5	Air-slaked		2	
3							4	3	Sandy. Joints, ∠ 70° 63.3		3	
4											4	
5									Clayey. 66.5		5	
6									Vertically foliated with many slickensides. Easily crush with fingers.		6	
7							5	5			7	
8											8	
9									70.2		9	
70											70	
1											1	
2											2	
3											3	
4											4	
5								4			5	
6									76.1 Clayey 76.6		6	
7								5			7	
8											8	
9									Slickensides 79.0		9	
80									Clayey		80	

▶ driller's note ◀

core loss

POO

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain

10 Dec. 1973

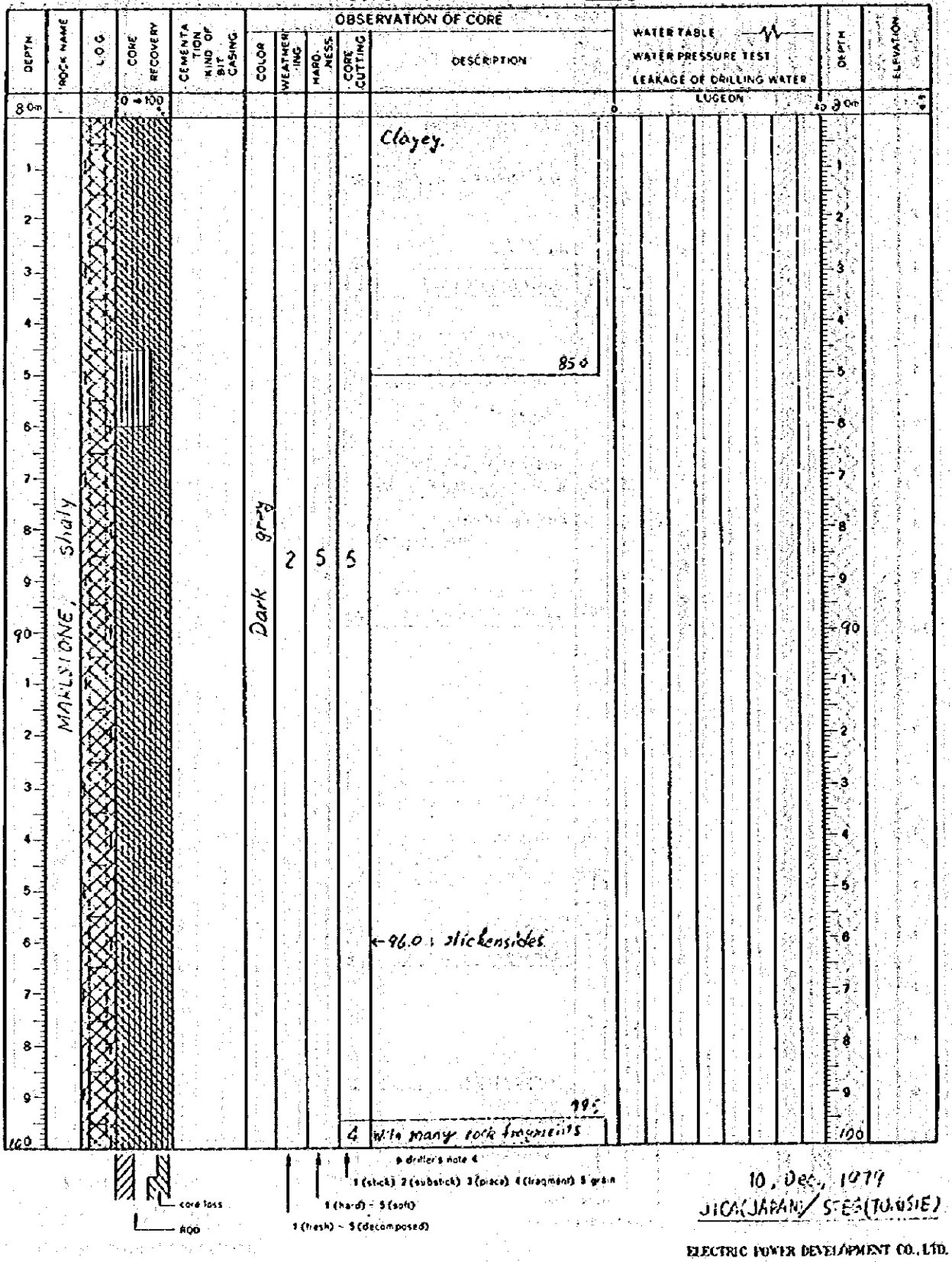
JICA (JAPAN) / STEG (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Upper reservoir area HOLE No. S: 2 (SHEET 5 OF 8)

LOCATION	Intake site	DEPTH OF HOLE	160.0 m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	5.0 m	COMPLETED	
COORDINATE		LENGTH OF ROCK DRILLING	145.0 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	Hidactomi. Heliab
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

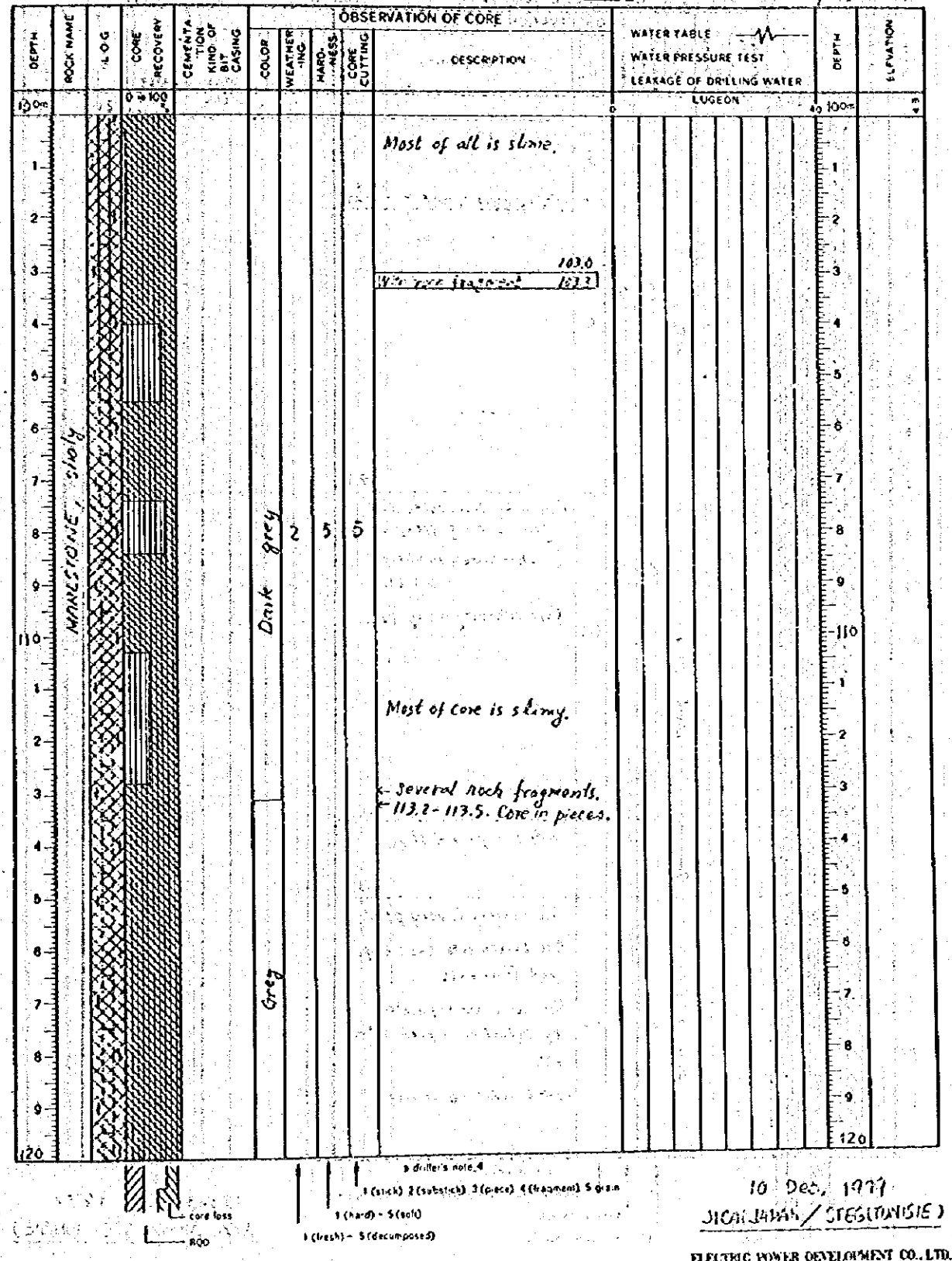


ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KAESEB PROJECT Upper reservoir area HOLE No. SI 2 (SHEET 6 OF 8)

LOCATION	Intake site	DEPTH OF HOLE	150.0 m	COMMENCED	- - -
ELEVATION	m	DEPTH OF OVERBURDEN	5.5 m	COMPLETED	- - -
COORDINATE		LENGTH OF ROCK DRILLING	145.2 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	72°	TOTAL LENGTH OF CORE	m	LOGGED BY	H. Kustomi
BEARING OF ANGLE HOLE		CORE RECOVERY	%		H. Hotaki



10 Dec. 1977
JICA (JAPAN) / STEG (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Upper reservoir area HOLE No.S1 (SHEET 7 OF 8)

LOCATION	Intake site	DEPTH OF HOLE	150.0m	COMMENCED	
ELEVATION	m	DEPTH OF OVERBURDEN	5.0 m	COMPLETED	
COORDINATE		LENGTH OF ROCK DRILLING	145.0m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	H.Sakuramoto
BEARING OF ANGLE HOLE		CORE RECOVERY	%		H.Ochi

DEPTH	ROCK NAME	L.O.G.	CORE RECOVERY 0→100	CEMENTATION OF BIT CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER: LUGEON
120m									0	
1	MARLSTONE, shaly				Grey	5	5	5	121.5 Core, 60° 121.7	
2										
3										
4										
5										
6										
7									127.2	
8					Dark grey	2	5	5-4	Core into thin plates and cross sections, steep cracks. Slickensides in various places. Core recovery very poor.	
130										
1										
2										
3									133.5	
4					Grey				Sandy fine grained slate. 133.0	
5									Core recovery is very poor. Core broken into small chips and fragments. Some cores are separated by foliation dipped 70°to 80°. -138.9 · calcite veinles	
6										
7					Dark grey	2	3	5-4		
8										
9										
140										

DEPTH	ELEVATION
120m	
130	
140	

core loss

RQD

9 driller's note 4

1 (rock) 2 (substock) 3 (piece) 4 (fragment) 5 grain

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

10 and 11 Dec, 1977

JICA, JAPAN / STEG (TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Upper reservoir area HOLE No. S1 2 (SHEET 9 OF 8)

LOCATION Intake site
ELEVATION ____ m
COORDINATE ____
ANGLE FROM HORIZONTAL 90°
BEARING OF ANGLE HOLE ____

DEPTH OF HOLE 150.0m
DEPTH OF OVERBURDEN 5.0 m
LENGTH OF ROCK DRILLING 145.0m
TOTAL LENGTH OF CORE ____ m
CORE RECOVERY ____ %

COMMENCED ____
COMPLETED ____
DRILLED BY STEG/EGTH
LOGGED BY M. Guetoni
Helic.

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER: LUGEON	DEPTH	ELEVATION
14.0m			0 4 100 %							0 45.16		
1–6	MARL STONE				Dark grey	2	3	3-4	Core recovery is very poor. Core broken into small chips and fragments. Some cores are separated by foliation dipped 70° to 80°. 165.0		1–6	
6–9	MARLS ONE, STONE, PARTLY				Grey	5	5	5	Sandy slime. 169.0		6–9	
9	MARL STONE				Dark Brown	2	3	4	Core recovery is very poor. Joint. dips 45°. 150.0		9	
150									Bottom of hole. 150.0m		150	

core loss
100
※ driller's note ※
1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

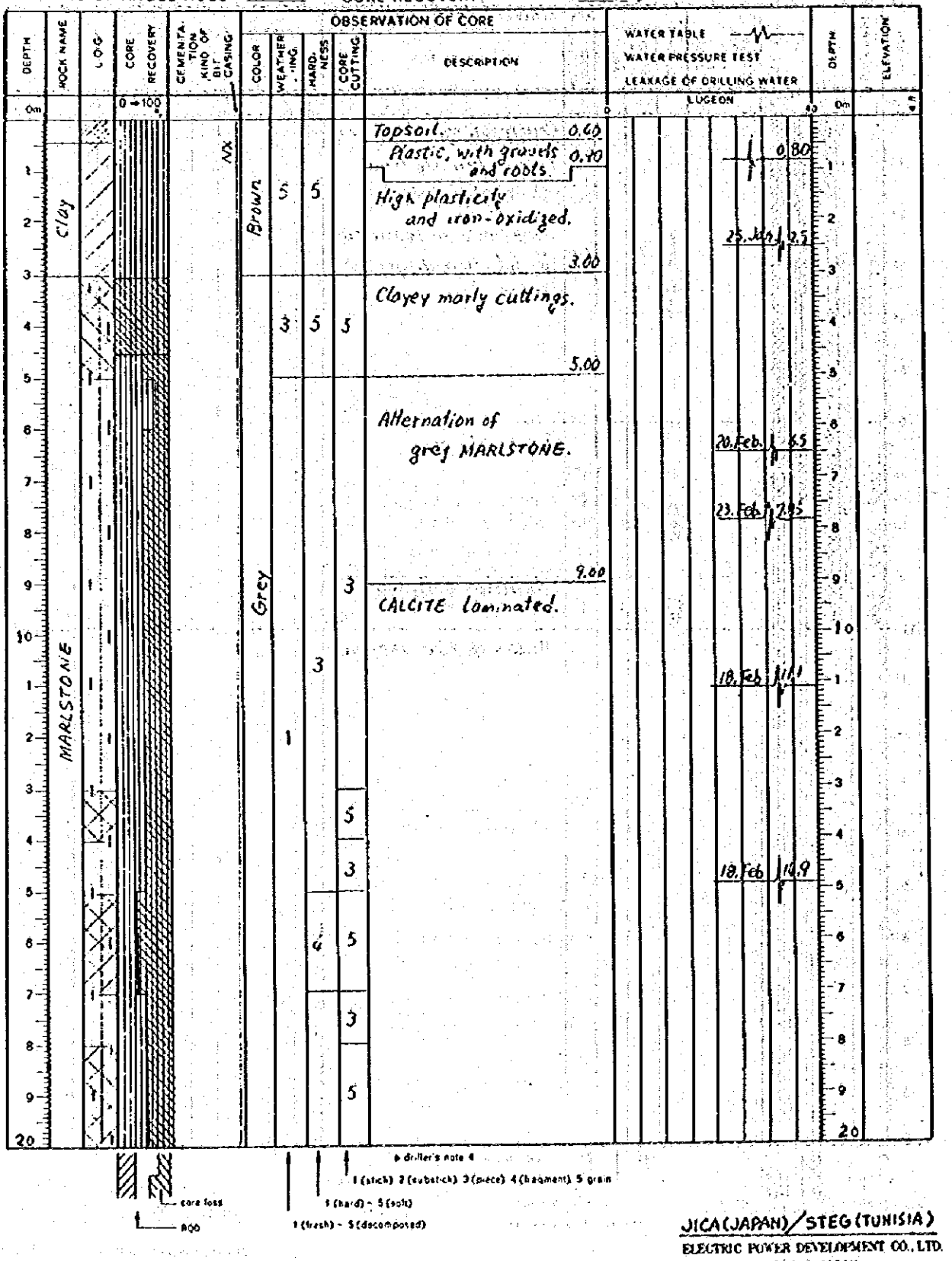
11, Dec., 1979
JICA/SHAPAN/STEG(TUNISIE)

ELECTRIC POWER DEVELOPMENT CO., LTD.

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Outlet site HOLE No. SU 11 (SHEET 1 OF 4)

LOCATION		DEPTH OF HOLE	70.0 m	COMMENCED	-
ELEVATION	m	DEPTH OF OVERBURDEN	3.0 m	COMPLETED	23-Feb.-'80
COORDINATE	X: 79.632 Y: 85.680 (planning)	LENGTH OF ROCK DRILLING	67.0 m	DRILLED BY	STEG/EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	33.8 m	LOGGED BY	HELLALI
BEARING OF ANGLE HOLE		CORE RECOVERY	50.4 %		

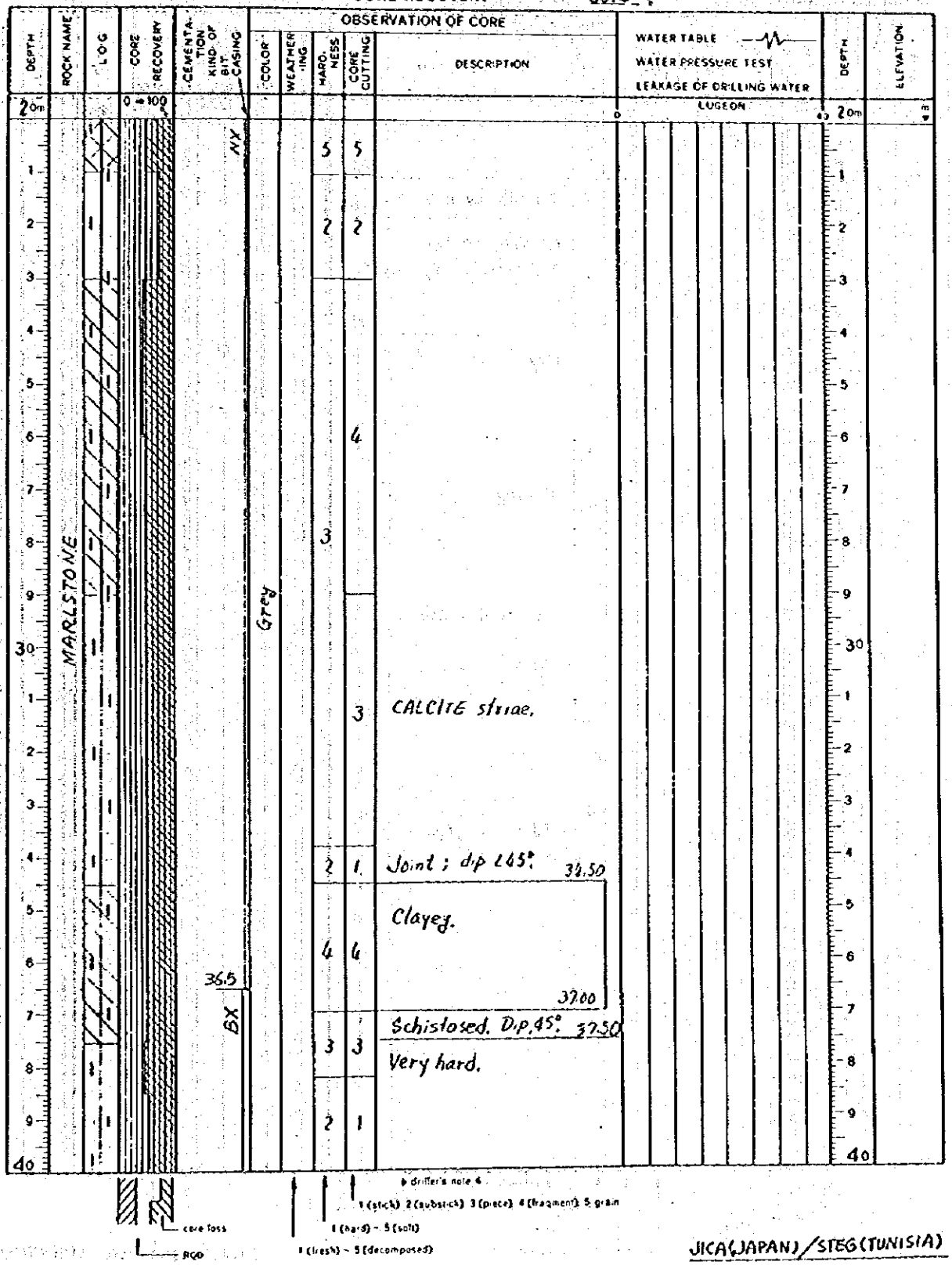


JICA (JAPAN) / STEG (TUNISIA)
ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT : Outlet site HOLE No. SU 11 (SHEET 2 OF 4)

LOCATION		DEPTH OF HOLE	70.0 m	COMMENCED	- - -
ELEVATION	m	DEPTH OF OVERBURDEN	3.0 m	COMPLETED	23 - Feb - '80
COORDINATE		LENGTH OF ROCK DRILLING	67.0 m	DRILLED BY	STEG / EGTH
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	33.8 m	LOGGED BY	HELLALI
BEARING OF ANGLE HOLE		CORE RECOVERY	50.4 %		



JICA (JAPAN) / STEG (TUNISIA)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO JAPAN

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT Outlet site HOLE No. SU11 (SHEET 3 OF 4)

LOCATION		DEPTH OF HOLE	70.0 m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	3.0 m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	67.0 m	DRILLED BY	STEG/EGTH
ANGLE FROM HO. IZONTAL	90°	TOTAL LENGTH OF CORE	33.8 m	LOGGED BY	HELLALI
BEARING OF ANGLE HOLE		CORE RECOVERY	50.4 %		

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
4m			0 ~ 100 %						OBSERVATION OF CORE
0	MARLSTONE			BX			2	1	41.0
							4	4	CALCITE veined. 41.8
							3	2	CALCITE veined Schistosity dips 45° 46.0
							4	5	Very hard.
							3	3	
								4	Clayey.
							2	2	Joints dip 60°.
50								3	
							4	3	← 53.5 : Clayey.
60									

WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER: LUGEON

b driller's note 4

1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

core loss

RQD

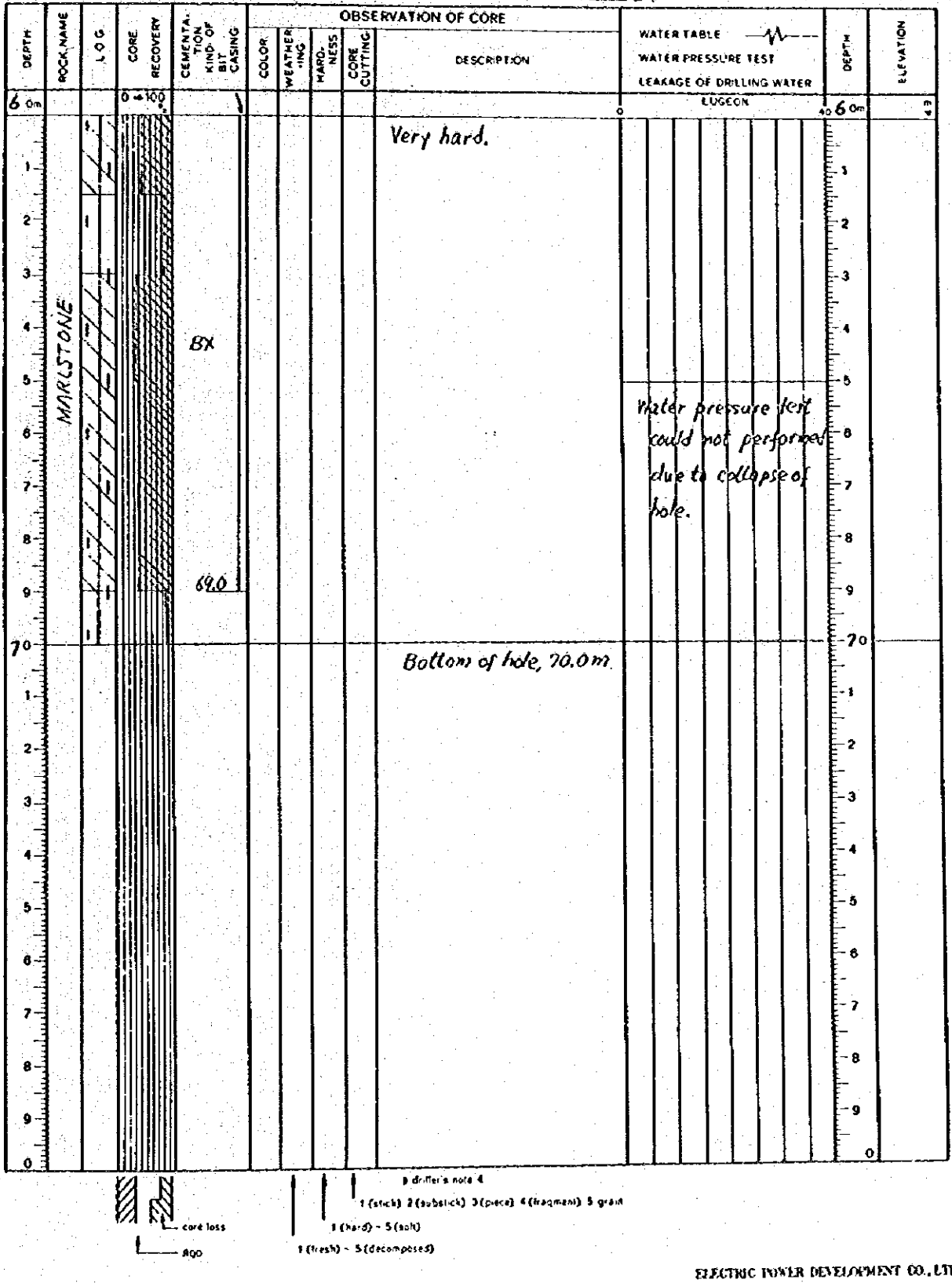
JICA (JAPAN) / STEG (TUNISIA)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

KASSEB PROJECT *Outlet site* HOLE No. SU11 (SHEET 4 OF 4)

LOCATION		DEPTH OF HOLE	70.0 m	COMMENCED	- - -
ELEVATION	m	DEPTH OF OVERBURDEN	3.0 m	COMPLETED	23-Feb.-'80
COORDINATE		LENGTH OF ROCK DRILLING	67.0 m	DRILLED BY	STEG/EGTH
ANGLE FROM HOLIZONTAL	90°	TOTAL LENGTH OF CORE	33.8 m	LOGGED BY	HELLALI
BEARING OF ANGLE HOLE		CORE RECOVERY	50.4 %		



ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

APPENDIX 2

CONTENTS

JICA(JAPAN) / STEC(TUNISIA)

PERMEABILITY TEST IN DRILL HOLE (SHEET 1 OF 4)

KASSEB PROJECT Damsite HOLE No. SB 10

LOCATION _____ DEPTH OF HOLE 50.0 m TEST DATE _____

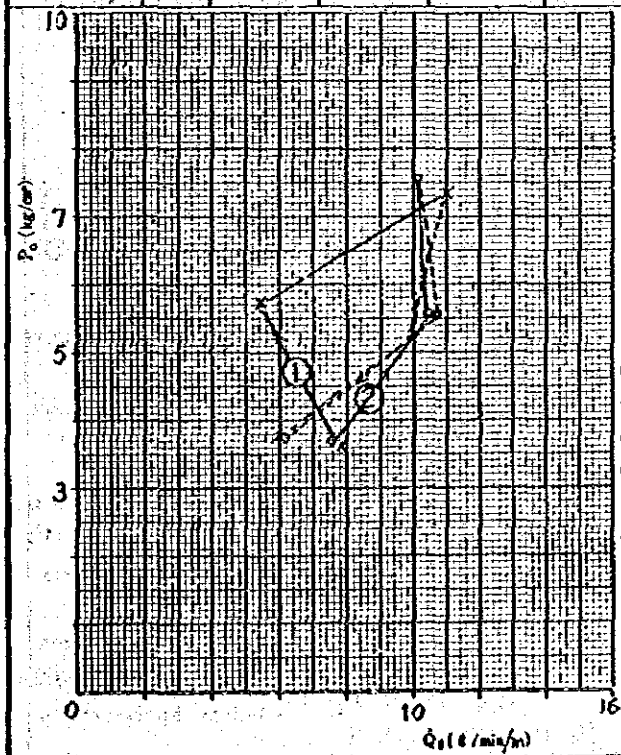
ELEVATION _____ m DIAMETER OF HOLE NX cm TESTED BY _____

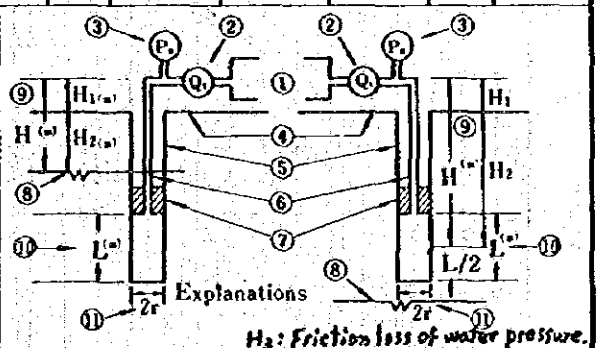
COORDINATE X 87.027.28 Y 28.498.03 DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 45° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE N BEFORE.T. ① 8.2 ② 8.4 m AFTER.T. 9.6 9.8 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
① 10.0	15.0	5.0	0.3	8.50	3	3.70	10	380	7.6	20.5	1.85	
		〃	〃	〃	5	5.53	〃	520	10.4	18.8	3.46	
		〃	〃	〃	7	7.55	〃	505	10.1	13.4	3.26	
		〃	〃	〃	5	5.51	〃	535	10.7	19.4	3.45	
		〃	〃	〃	3	3.76	〃	310	6.2	16.5	1.23	
② 15.0	20.0	5.0	0.3	8.50	3	3.61	10	390	7.8	21.6	2.71	
		〃	〃	〃	5	5.95	〃	270	5.4	9.4	1.39	
		〃	〃	〃	7	7.34	〃	550	11.0	15.0	3.59	
		〃	〃	〃	5	5.44	〃	500	10.0	18.4	4.[illegible]	
		〃	〃	〃	3	3.72	〃	300	6.0	15.[illegible]	1.60	





H_3 : Friction loss of water pressure.

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H^{(m)}/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
L_u : Lugeon value in ℓ/min/m/10 kg/cm²
K : Coefficient of permeability

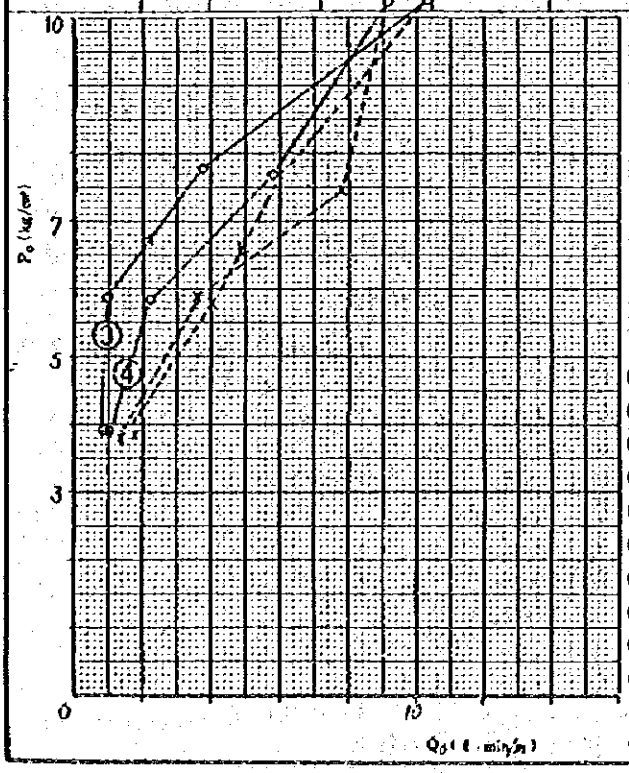
ELECTRIC POWER DEVELOPMENT CO LTD TOKYO JAPAN

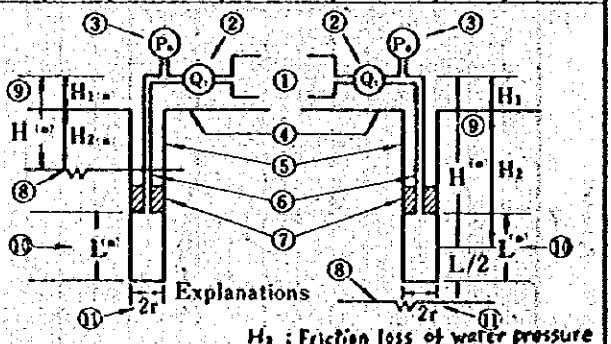
PERMEABILITY TEST IN DRILL HOLE (SHEET 2 OF 4)

KASSEB PROJECT Upper reservoir dam site HOLE No. SB 10

LOCATION		DEPTH OF HOLE	56.0 m	TEST DATE	
ELEVATION	m	DIAMETER OF HOLE	NX cm	TESTED BY	
COORDINATE		DRILLED DEPTH	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	LEVEL OF WATER TABLE		CHECKED BY	
BEARING OF ANGLE HOLE		BEFORE T. 8.5 m	AFTER T. 8.5 m		

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
③ 20.5	25.5	5.0	0.3	8.60	3	3.89	10	40	0.8	2.06	0.04	
		〃	〃	〃	5	5.88	〃	53	1.0	1.70	0.06	
		〃	〃	〃	7	7.81	〃	195	3.8	4.87	0.82	
		〃	〃	〃	10	10.27	〃	520	10.4	10.13	4.17	
		〃	〃	〃	7	7.69	〃	300	6.0	7.80	2.05	
		〃	〃	〃	5	5.80	〃	203	4.0	6.90	0.91	
		〃	〃	〃	3	3.78	〃	70	1.4	3.70	1.12	
③ 25.5	30.5	5.0	0.3	8.60	3	3.88	10	50	1.0	2.58	0.07	
		〃	〃	〃	5	5.86	〃	110	2.2	3.95	0.34	
		〃	〃	〃	7	7.66	〃	290	5.8	7.57	2.54	
		〃	〃	〃	10	10.30	〃	463	9.2	8.93	5.83	
		〃	〃	〃	7	7.47	〃	390	7.8	10.44	4.23	
		〃	〃	〃	5	5.8	〃	185	3.6	6.21	0.90	
		〃	〃	〃	3	3.86	〃	90	1.8	4.66	0.26	





Explanations

- ① : Pump
- ② : Flow meter
- ③ : Pressure gauge
- ④ : Ground surface
- ⑤ : Drill hole
- ⑥ : Injection pipe
- ⑦ : Packer
- ⑧ : Water table
- ⑨ : Hydrostatic head
- ⑩ : Length of test section
- ⑪ : Diamater of hole

H_3 : Friction loss of water pressure
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 3 OF 4)

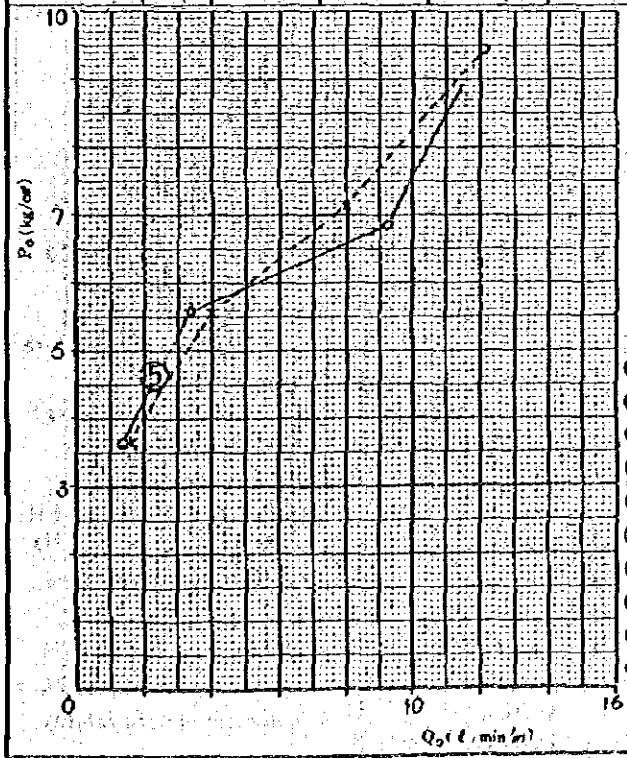
KASSEB PROJECT Upper reservoir damsite HOLE No. SP 3

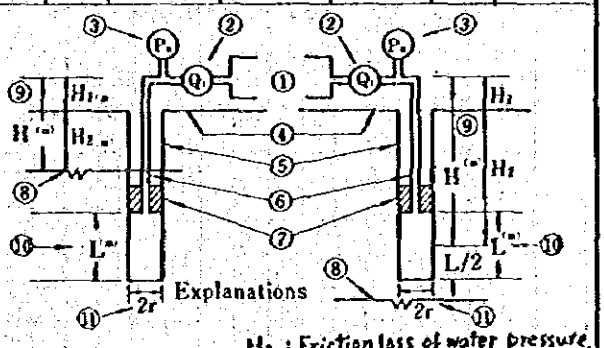
LOCATION
ELEVATION m
COORDINATE
ANGLE FROM HORIZONTAL °
BEARING OF ANGLE HOLE

DEPTH OF HOLE 50.0 m
DIAMETER OF HOLE NX cm
DRILLED DEPTH m
LEVEL OF WATER TABLE
BEFORE T. ③ 6.5 ② 6.25 m AFTER T. 6.5 6.25 m

TEST DATE
TESTED BY
DRILLED BY
CHECKED BY

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
⑤ 30.0	35.0	5.0	0.3	6.55	3	3.66	10	70	1.4	3.83	0.18	
		"	"	"	5	5.59	"	170	3.4	6.08	0.95	
		"	"	"	7	6.85	"	460	9.2	13.43	6.92	
		"	"	"	10	9.42	"	620	12.1	12.84	12.61	
		"	"	"	7	7.16	"	403	8.0	11.17	5.25	
		"	"	"	5	5.55	"	200	4.0	7.21	1.31	
		"	"	"	3	3.66	"	80	1.6	4.37	0.21	
⑤ 35.0	40.0	5.0	0.3	6.25	3	3.64	10	80	1.6	4.40	0.24	
		"	"	"	5	5.48	"	220	4.4	8.03	1.83	
		"	"	"	7	6.64	"	520	10.4	15.66	10.22	
		"	"	"	5	5.27	"	320	6.4	12.14	3.87	
		"	"	"	3	3.61	"	110	2.2	6.09	0.66	





Explanations

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H'/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 4 OF 4)

KASSEB PROJECT Upper reservoir dam site HOLE No. SB 10

LOCATION _____ DEPTH OF HOLE _____ m TEST DATE _____

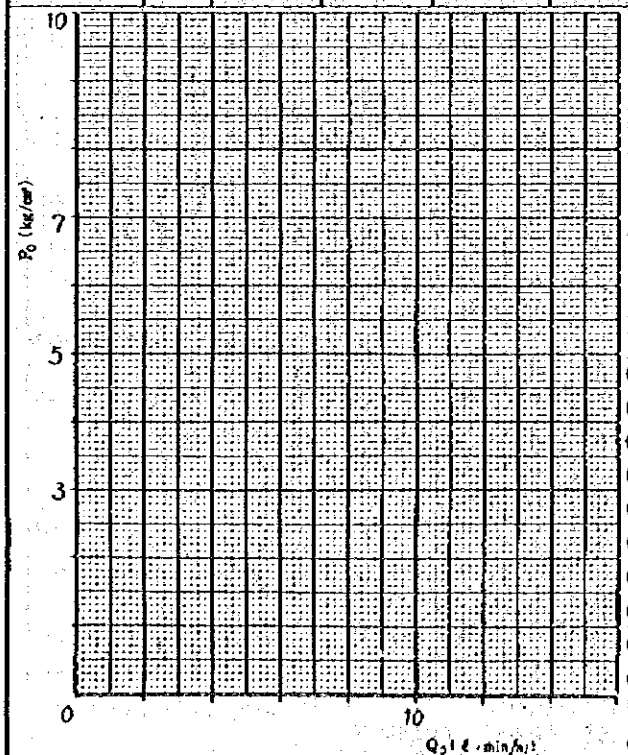
ELEVATION _____ m DIAMETER OF HOLE _____ cm TESTED BY _____

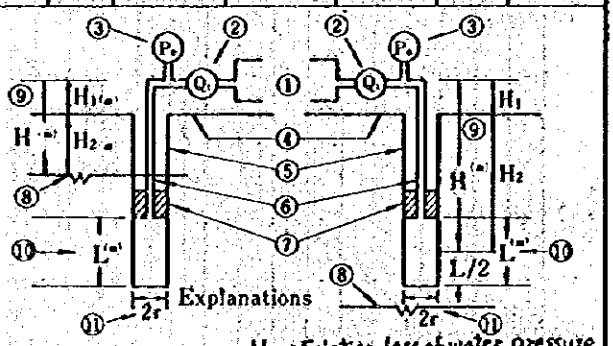
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL _____ ° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. ⑦ _____ m AFTER T. _____ m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_i (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
⑦ 40.0	45.0	5.0	0.3	6.25	3	3.56	10	150	3.0	8.43	0.96	
		〃	〃	〃	5	5.50	〃	140	3.8	6.91	1.55	
		〃	〃	〃	7	7.24	〃	310	6.2	8.56	4.11	
		〃	〃	〃	10	10.00	〃	390	7.8	7.8	6.51	
		〃	〃	〃	7	7.32	〃	280	5.6	7.65	3.36	
		〃	〃	〃	5	5.53	〃	170	3.4	6.15	1.24	
		〃	〃	〃	3	3.59	〃	120	2.4	6.69	0.62	
⑧												





① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure.
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H - H_3/10$, $H = H_1 + H_2$
t : injected time
Q_i : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 1 OF 2)

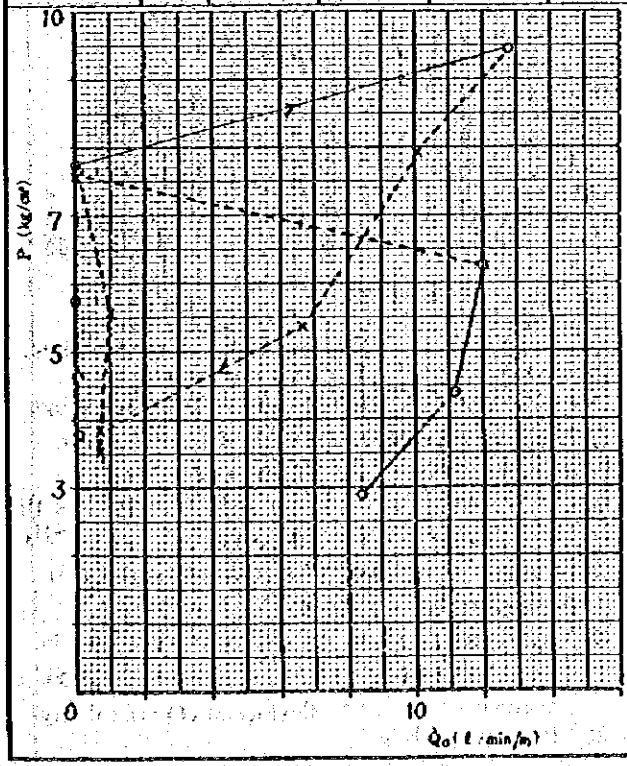
KASSER PROJECT Upper reservoir dimsite HOLE No. SB 11

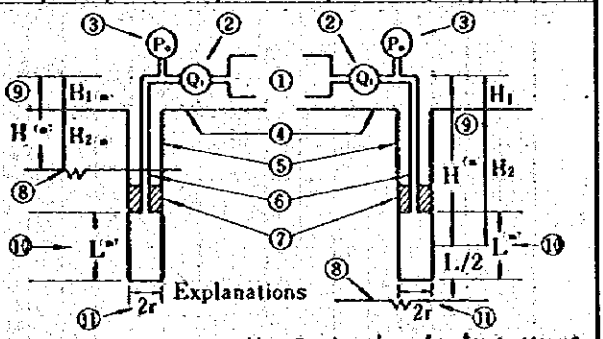
LOCATION Dimsite
ELEVATION ____ m
COORDINATE X 59. 129. 47 / Y 29. 638. 79
ANGLE FROM HORIZONTAL 65°
BEARING OF ANGLE HOLE S

DEPTH OF HOLE 55.0 m
DIAMETER OF HOLE NX cm
DRILLED DEPTH ____ m
LEVEL OF WATER TABLE
BEFORE.T. ① 8.2 ② 3.0 m AFTER.T. 6.6 / 8.2 m

TEST DATE ____
TESTED BY ____
DRILLED BY ____
CHECKED BY ____

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
① 33.0	35.0	5.0	0.3	7.4	3	3.77	10		0.02	0.05	–	
		〃	〃	〃	5	5.77	〃	0	0	0	0	
		〃	〃	〃	7	7.77	〃	0	0	0	0	
		〃	〃	〃	10	9.43	〃	640	12.8	13.58	13.83	
		〃	〃	〃	7	6.93	〃	505	10.1	14.57	8.36	
		〃	〃	〃	5	5.36	〃	330	6.6	12.31	3.57	
		〃	〃	〃	3	3.77	〃	38	0.76	2.02	0.05	
② 35.0	63.0	5.0	0.3	5.6	3	2.92	10	420	8.4	28.77	6.67	
		〃	〃	〃	5	4.40	〃	560	11.2	25.45	11.86	
		〃	〃	〃	7	6.23	〃	600	12.0	19.26	13.61	
		〃	〃	〃	10	Water pressure did not rise up to 10 kg/cm².						
		〃	〃	〃	7	7.59	10	1	0.02	0.63	–	
		〃	〃	〃	5	5.58	〃	50	1	1.79	0.09	
		〃	〃	〃	3	3.58	〃	35	0.7	1.96	0.05	





① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure.
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H'/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO. LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 2 OF 2)

KASSEB PROJECT Upper reservoir damsite HOLE No. SB 11

LOCATION _____ DEPTH OF HOLE 55.0 m TEST DATE _____

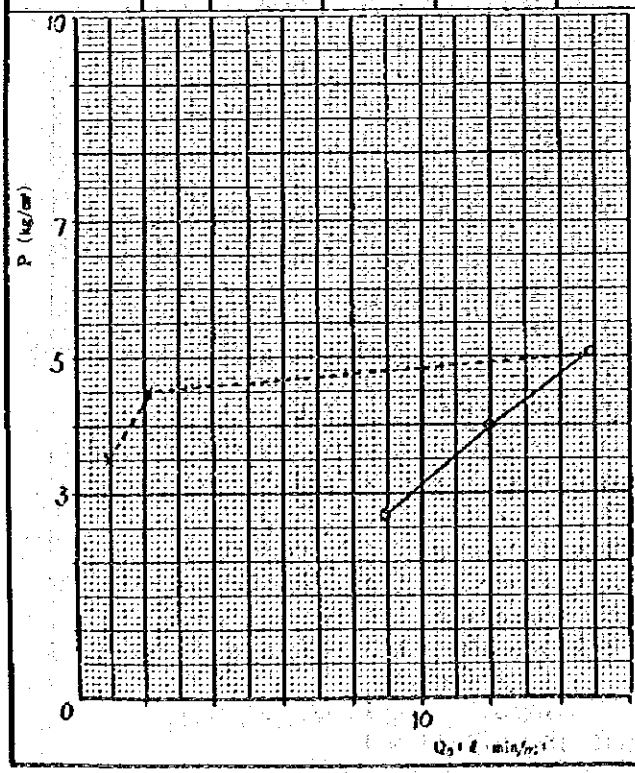
ELEVATION _____ m DIAMETER OF HOLE NX cm TESTED BY _____

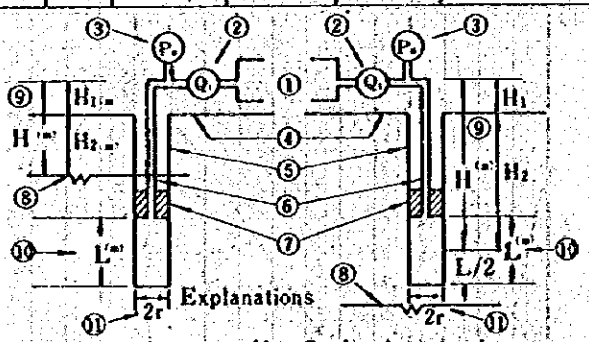
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL _____ ° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. 3.22 m AFTER T. _____ m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
③ 40.0	45.0	5.0	0.3	5.0	3	2.69	10	442	8.84	32.86	8.36	
		〃	〃	〃	5	3.98	〃	601	12.02	30.20	15.46	
		〃	〃	〃	7	5.15	〃	745	14.9	28.93	23.76	
		〃	〃	〃	10	Water pressure did not rise up to 10 kg/cm².						
		〃	〃	〃	7							
		〃	〃	〃	5	5.68	10	105	2.1	3.83	0.47	
		〃	〃	〃	3	3.52	〃	48	0.96	2.73	0.10	





Explanations

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure.
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO. LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 1 OF 2)

KASSEB PROJECT Upper reservoir damsite HOLE No. SF 2 bis

LOCATION _____ DEPTH OF HOLE 30.0 m TEST DATE _____

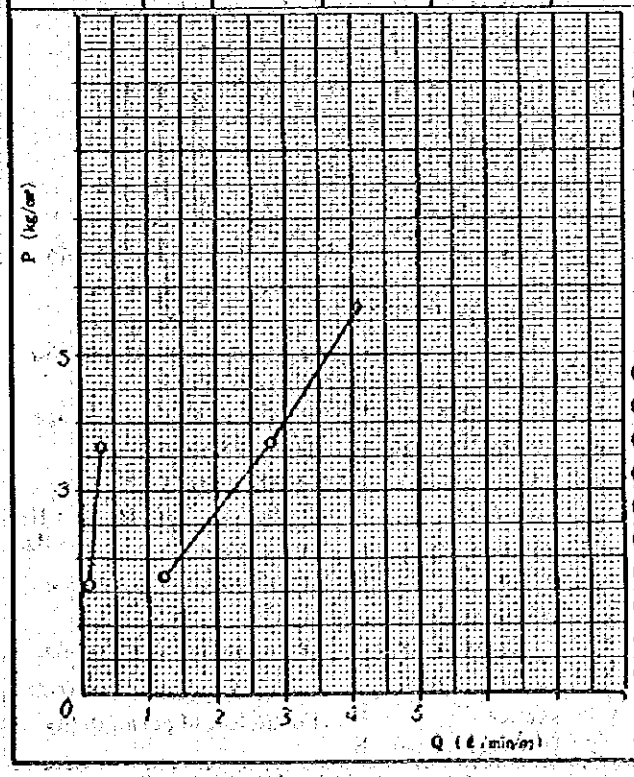
ELEVATION _____ m DIAMETER OF HOLE NX cm TESTED BY _____

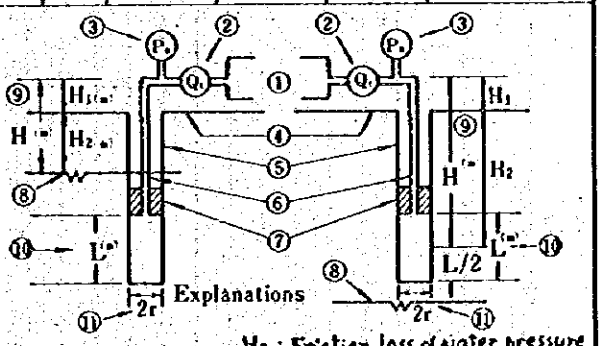
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE -- BEFORE T. 24.7 m AFTER T. 23 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
① 10.0	15.0	5.0	0.3	7.0	1	1.73	10	61	1.22	7.05	0.05	
		〃	〃	〃	3	3.71	〃	140	2.8	7.55	0.25	
		〃	〃	〃	5	5.68	〃	205	4.1	7.22	0.54	
		Water table is at 7m deep in this hole.										
② 20.0	25.0	5.0	0.3	6.0	1	1.63	10	5	0.1	0.61	–	
		〃	〃	〃	3	3.63	〃	15	0.3	0.83	–	





H_3 : Friction loss of water pressure

① : Pump — P_o : Gauge pressure

② : Flow meter — H_1 : Height of Pressure gauge

③ : Pressure gauge — H_2 : Depth of Ground water

④ : Ground surface — P : Effective pressure

⑤ : Drill hole — $P = P_o + H'''/10$, $H = H_1 + H_2 - H_3$

⑥ : Injection pipe — t : Injected time

⑦ : Packer — Q_t : Water volume during time in "t"

⑧ : Water table — Q_o : Water volume per one min.

⑨ : Hydrostatic head — L_u : Lugeon value in ℓ/min/m/10 kg/cm²

⑩ : Length of test section — K : Coefficient of permeability

⑪ : Diamater of hole

ELECTRIC POWER DEVELOPMENT CO. LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 2 OF 2)

KASSEP PROJECT Upper reservoir damsite HOLE No. SB 1 bis

LOCATION ____ DEPTH OF HOLE 32.0 m TEST DATE ____

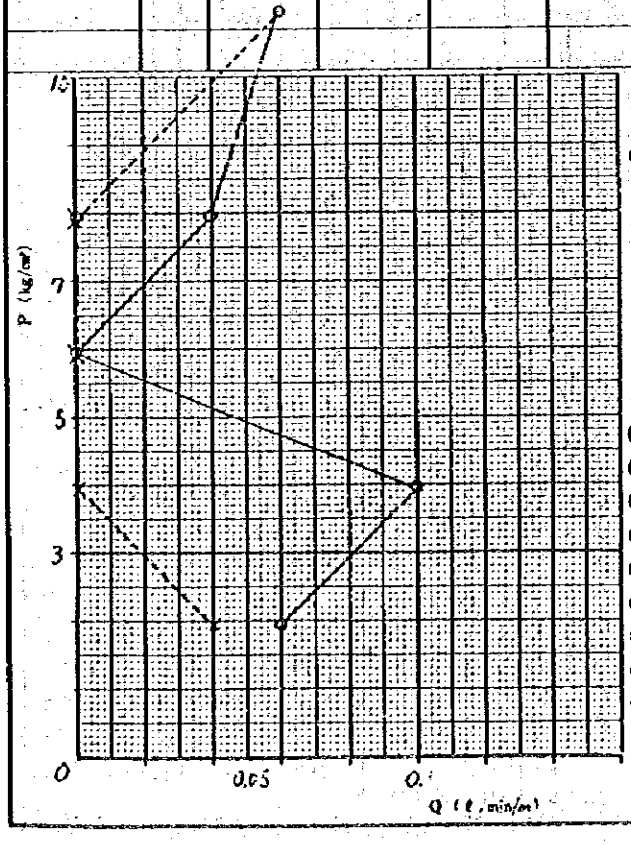
ELEVATION ____ m DIAMETER OF HOLE NX cm TESTED BY ____

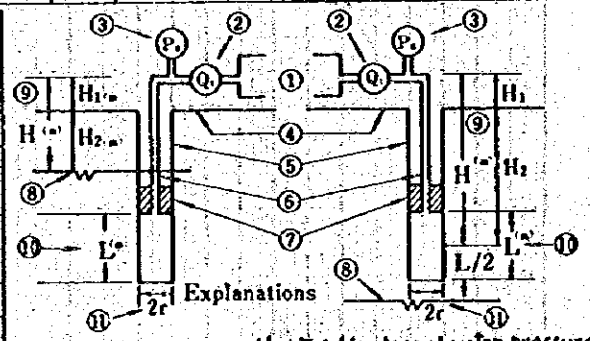
COORDINATE ____ DRILLED DEPTH ____ m DRILLED BY ____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY ____

BEARING OF ANGLE HOLE ____ BEFORE T. ③ m AFTER T. 90 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
③ 25.0	32.0	5.0	0.3	9.0	1	1.93	10	3	0.06	0.31	–	
		〃	〃	〃	3	3.93	〃	5	0.1	0.25	–	
		〃	〃	〃	5	5.93	〃	0	0	0	0	
		〃	〃	〃	7	7.93	〃	2	0.04	0.05	–	
		〃	〃	〃	10	10.93	〃	3	0.06	0.05	–	
		〃	〃	〃	7	7.93	〃	0	0	0	0	
		〃	〃	〃	5	5.93	〃	0	0	0	0	
		〃	〃	〃	3	3.93	〃	0	0	0	0	
		〃	〃	〃	1	1.93	〃	2	0.04	0.21	–	





Explanations

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H(m)/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10⁶g/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO. LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 1 OF 1)

KASSEB PROJECT: Upper reservoir dam site HOLE No. SB 13

LOCATION _____ DEPTH OF HOLE 35.9 m TEST DATE _____

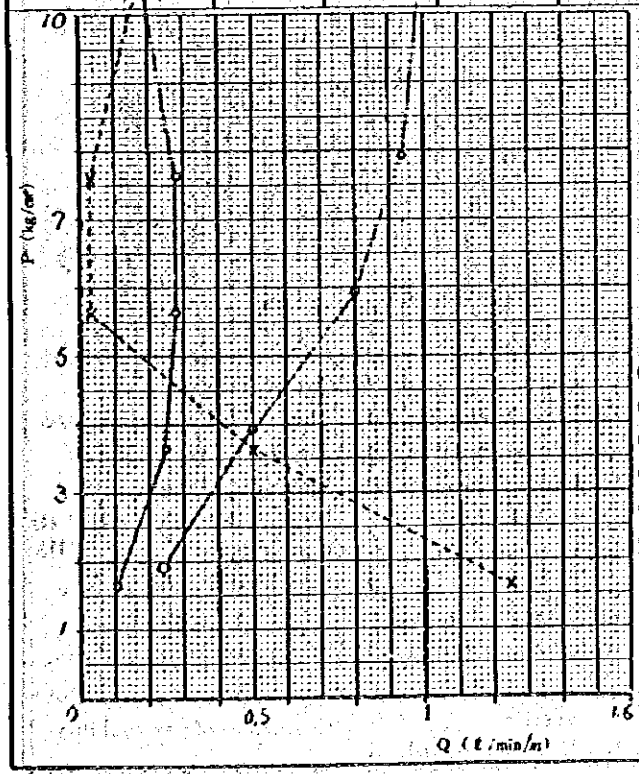
ELEVATION _____ m DIAMETER OF HOLE NX cm TESTED BY _____

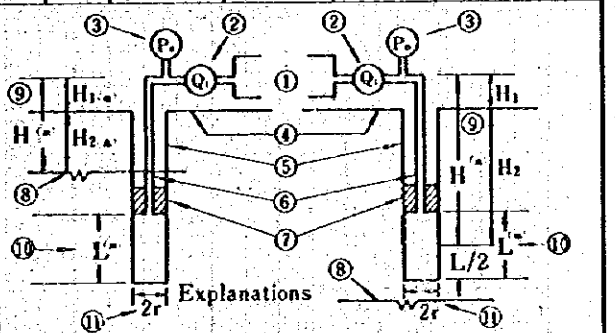
COORDINATE X 65,273.05 / Y 78,393.03 DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE ① 6.0 / 10.0 CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. ② 6.2 m AFTER T. 5.5 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
① 24.0	29.0	5.0	0.3	9.0	1	1.93	10	12	0.24	1.24	–	
		〃	〃	〃	3	3.93	10	25	0.5	1.27	0.02	
		〃	〃	〃	5	5.93	10	40	0.8	1.35	0.04	
		〃	〃	〃	7	7.92	10	47	0.94	1.19	0.06	
		〃	〃	〃	10	10.92	7	50	1	0.92	0.07	
② 29.0	33.0	4.0	0.3	6.25	1	1.66	10	4	0.1	0.60	–	
		〃	〃	〃	3	3.66	10	10	0.25	0.68	–	
		〃	〃	〃	5	5.66	10	11	0.28	0.69	–	
		〃	〃	〃	7	7.66	10	11	0.28	0.37	–	
		〃	〃	〃	10	10.66	10	7	0.18	0.17	–	
		〃	〃	〃	7	7.66	10	1	0.03	0.04	–	
		〃	〃	〃	5	5.66	10	1	0.03	0.05	–	
		〃	〃	〃	3	3.65	10	20	0.5	1.37	0.01	
		〃	〃	〃	1	1.65	10	50	1.25	7.58	0.08	





H_3 : Friction loss of water pressure

① : Pump — P_o : Gauge pressure

② : Flow meter — H_1 : Height of Pressure gauge

③ : Pressure gauge — H_2 : Depth of Ground water

④ : Ground surface — P : Effective pressure

⑤ : Drill hole — $P = P_o + H'/10$, $H = H_1 + H_2 - H_3$

⑥ : Injection pipe — t : Injected time

⑦ : Packer — Q_t : Water volume during time in "t"

⑧ : Water table — Q_o : Water volume per one min.

⑨ : Hydrostatic head — L_u : Lugeon value in ℓ/min/m/10 kg/cm

⑩ : Length of test section — K : Coefficient of permeability

⑪ : Diamater of hole

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 1 OF 2)

KASSEB PROJECT Upper reservoir damsite HOLE No. SP 1

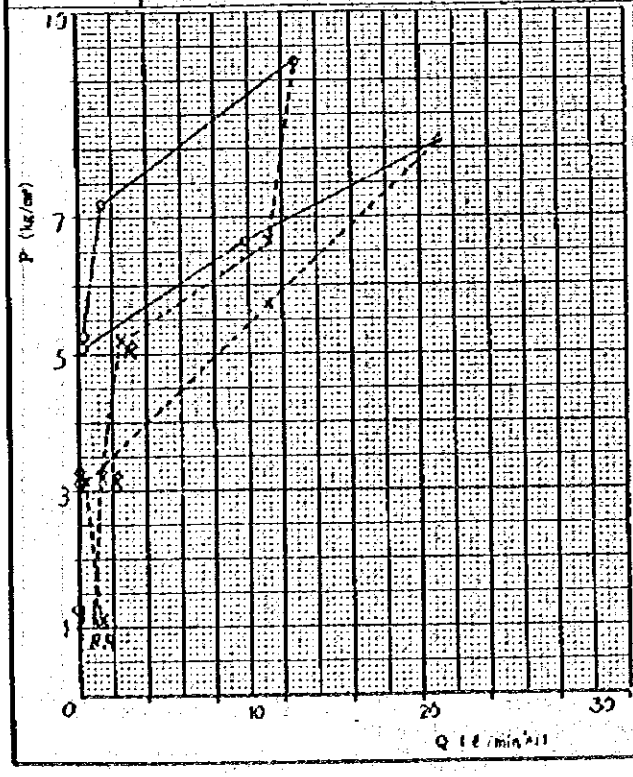
LOCATION
ELEVATION m
COORDINATE X 97,673.10 Y 77,973.81
ANGLE FROM HORIZONTAL 90°
BEARING OF ANGLE HOLE

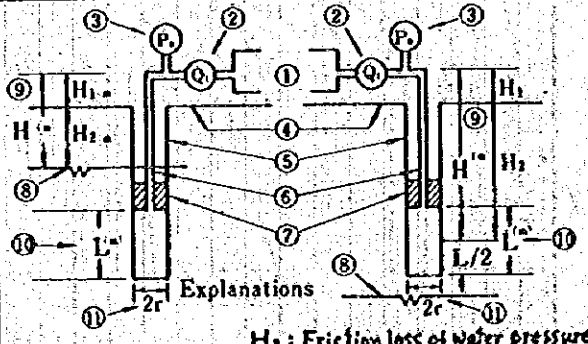
DEPTH OF HOLE 35 m
DIAMETER OF HOLE NX cm
DRILLED DEPTH m
LEVEL OF WATER TABLE
BEFORE T. 0.0 1.6 m AFTER T. 1.5 2.9 m

TEST DATE
TESTED BY
DRILLED BY
CHECKED BY

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
① 15.0	20.0	5.0	0.3	3.75	1	1.11	10	1	0.02	0.18	–	
		〃	〃	〃	3	3.11	〃	1	0.02	0.06	–	
		〃	〃	〃	5	5.11	〃	3	0.06	0.12	–	
		〃	〃	〃	7	6.67	〃	495	9.9	14.84	6.36	
		〃	〃	〃	10	8.11	〃	1,060	21.2	26.14	20.03	
		〃	〃	〃	7	5.73	〃	880	17.6	30.72	13.78	
		〃	〃	〃	5	4.55	〃	560	11.2	24.62	5.58	
		〃	〃	〃	3	3.11	〃	10.	0.2	0.64	–	R
		〃	〃	〃	1	1.10	〃	70.	1.4.	12.73	0.09	R
② 20.0	25.0	5.0	0.3	2.0	1	1.23	10	0	0	0	–	
		〃	〃	〃	3	3.23	〃	1	0.02	0.06	–	
		〃	〃	〃	5	5.23	〃	15	0.3	0.57	0.01	
		〃	〃	〃	7	7.22	〃	77	1.54	2.13	0.14	
		〃	〃	〃	10	9.30	〃	640	12.8	13.76	7.34	
		〃	〃	〃	7	6.71	〃	480	9.6	14.31	5.25	
		〃	〃	〃	5	5.19	〃	130	2.6	5.01	0.37	R
		〃	〃	〃	3	3.22	〃	73	1.46	4.53	0.12	R
		〃	〃	〃	1	1.22	〃	52	1.04	8.52	0.06	R

Remarks. R ; Pumped-in water flew out from top of hole.





Explanations

H_3 : Friction loss of water pressure.

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H'' / 10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO. LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 2 OF 3)

KASSEB PROJECT Upper reservoir dam site HOLE No. SB 14

LOCATION _____ DEPTH OF HOLE 35 m TEST DATE _____

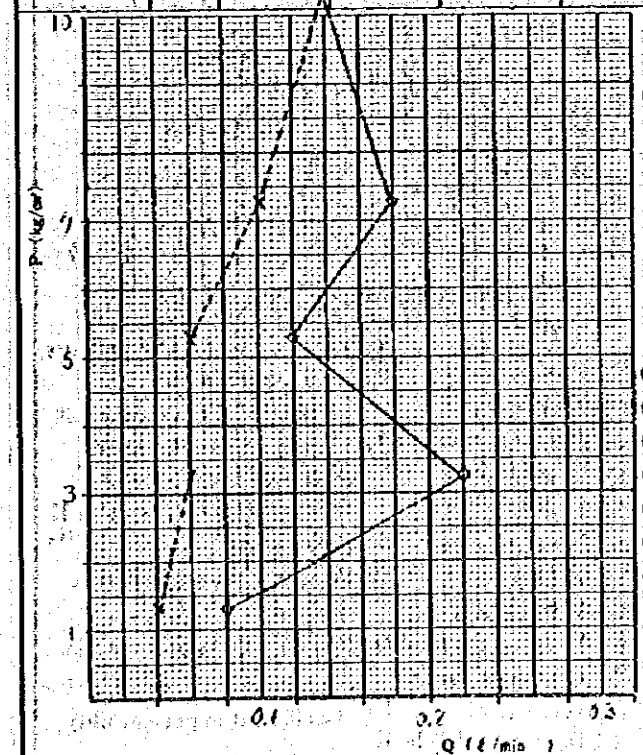
ELEVATION _____ m DIAMETER OF HOLE NX cm TESTED BY _____

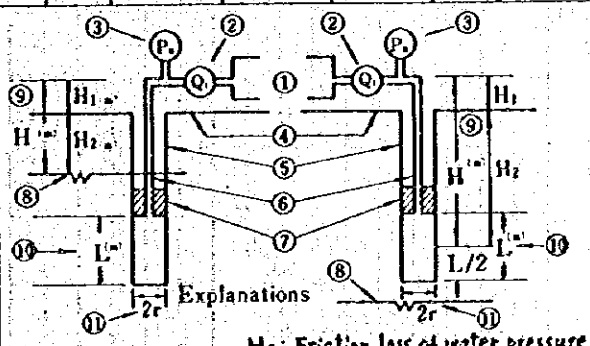
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL _____ ° LEVEL OF WATER TABLE CHECKED BY K. Sueto

BEARING OF ANGLE HOLE _____ BEFORE T. ② 4.8 m AFTER T. ④ 3.2 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
③ 25.0	30.0	5.0	0.3	2.5	1	1.28	10	4	0.08	0.63	–	
		〃	〃	〃	3	3.28	〃	11	0.22	0.69	–	
		〃	〃	〃	5	5.28	〃	5	0.1	0.19	–	
		〃	〃	〃	7	7.28	〃	8	0.16	0.22	–	
		〃	〃	〃	10	10.28	〃	7	0.14	0.14	–	
		〃	〃	〃	7	7.28	〃	5	0.1	1.37	–	
		〃	〃	〃	5	5.28	〃	3	0.06	0.11	–	
		〃	〃	〃	3	3.28	〃	3	0.06	0.18	–	
		〃	〃	〃	1	1.28	〃	2	0.04	0.31	–	
④ 30.0	35.0	5.0	0.3		1	1.2	10	1	0.02	0.17	–	
		〃	〃		3	3.2	〃	15	0.3	0.93	0.01	
		〃	〃		5	5.2	〃	4	0.08	0.15	–	
		〃	〃		7	7.2	〃	1	0.02	0.03	–	
		〃	〃		10	10.2	〃	8	0.16	0.16	–	
		〃	〃		7	7.2	〃	0	0	0	–	
		〃	〃		5	5.2	〃	1	0.02	0.04	–	R
		〃	〃		3	3.2	〃	2	0.04	0.13	–	R
		〃	〃		1	1.2	〃	3	0.06	0.5	–	R





H_3: Friction loss of water pressure

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H'/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

PERMEABILITY TEST IN DRILL HOLE (SHEET 1 OF 6)

KASSES PROJECT Intake site HOLE No. S1 2

LOCATION _____ DEPTH OF HOLE 150.0 m TEST DATE _____

ELEVATION _____ m DIAMETER OF HOLE _____ cm TESTED BY _____

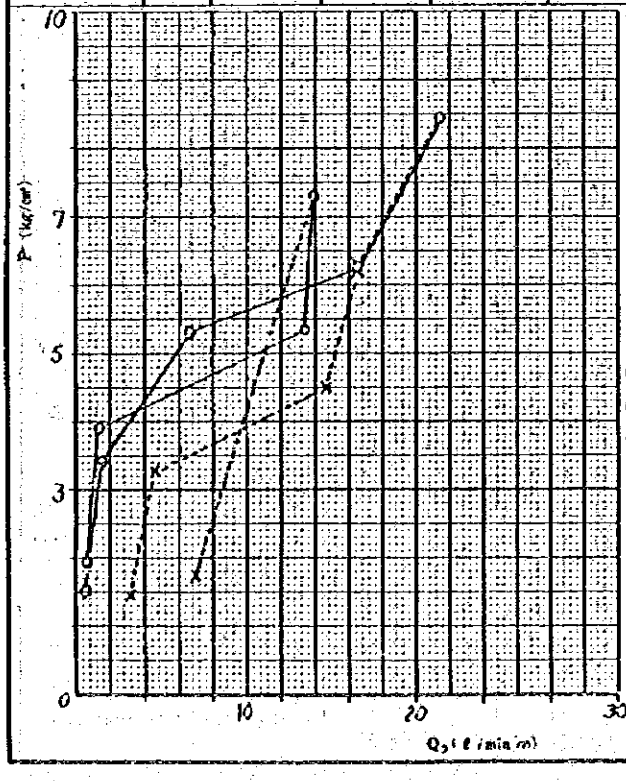
COORDINATE Y 81,737.01 DRILLED DEPTH _____ m DRILLED BY _____

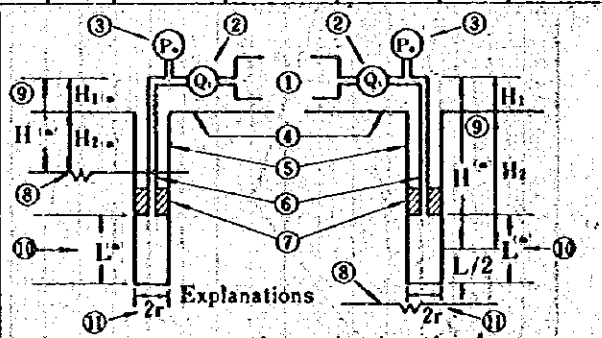
X 13,455.58

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. ① 3.5 m ② 5.3 m AFTER T. ① 14.5 m ② 5.0 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
① 10.0	5.0	5.0	0.3	9.0	1	1.93	10	33	0.66	3.42	0.01	
		〃	〃	〃	3	3.12	〃	67	1.34	3.42	0.05	
		〃	〃	〃	5	5.34	〃	678	13.56	25.37	5.88	
		〃	〃	〃	7	7.30	〃	700	14.0	19.18	6.27	
		〃	〃	〃	1	1.77	〃	355	7.1	60.11	1.61	
② 15.0	20.0	5.0	0.3	4.7	1	1.5	10	14	0.28	1.87	—	
		〃	〃	〃	3	3.9	〃	85	1.7	4.87	0.13	
		〃	〃	〃	5	5.3	〃	335	6.7	12.66	2.05	
		〃	〃	〃	7	6.27	〃	830	16.6	26.08	12.26	
		〃	〃	〃	10	8.47	〃	1080	21.6	25.65	20.76	
		〃	〃	〃	7	6.27	〃	830	16.6	26.48	12.26	
		〃	〃	〃	5	4.54	〃	735	14.7	32.38	9.62	
		〃	〃	〃	3	3.40	〃	236	4.72	13.88	0.99	
		〃	〃	〃	1	1.45	〃	168	3.32	22.90	0.49	





H_3 : Friction loss of water pressure

① : Pump — P_o : Gauge pressure

② : Flow meter — H_1 : Height of Pressure gauge

③ : Pressure gauge — H_2 : Depth of Ground water

④ : Ground surface — P : Effective pressure

⑤ : Drill hole — $P = P_o + H(m)/10$, $H = H_1 + H_2 + H_3$

⑥ : Injection pipe — t : Injected time

⑦ : Packer — Q_t : Water volume during time in "t"

⑧ : Water table — Q_o : Water volume per one min.

⑨ : Hydrostatic head — : Lugeon value in ℓ/min/m/10kg/cm²

⑩ : Length of test section — L_u : Coefficient of permeability

⑪ : Diamater of hole — K

PERMEABILITY TEST IN DRILL HOLE (SHEET 2 OF 6)

KAISER PROJECT Intake site HOLE No. S1 2

LOCATION _____ DEPTH OF HOLE 150.0 m TEST DATE _____

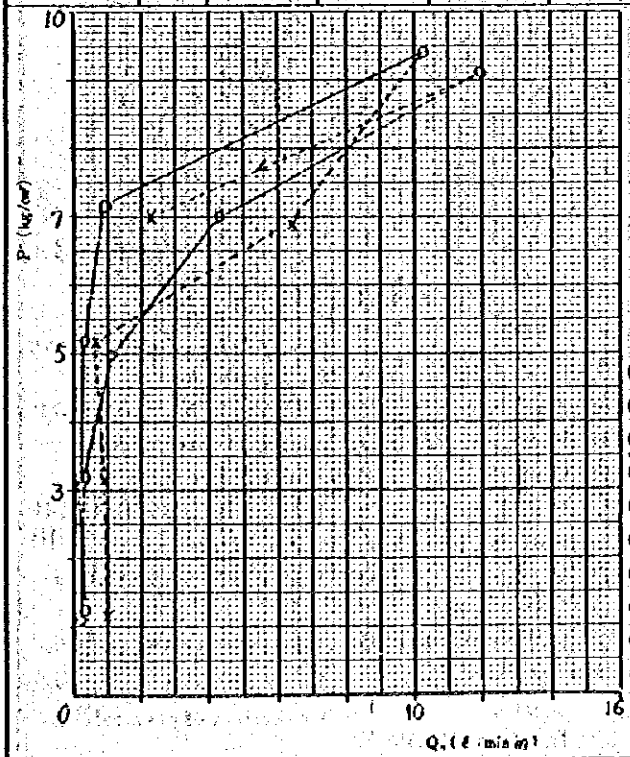
ELEVATION _____ m DIAMETER OF HOLE _____ cm TESTED BY _____

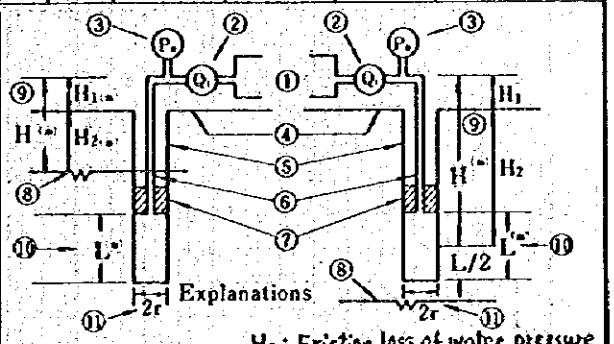
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE ③ 0.6 0.8 CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. 0 m AFTER T. 3.0 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min)	L_u (Lugeon)	H_3 (m)	Remarks
③ 20.0	25.0	5.0	0.3	0.7	1.	1.10	10	10	0.2	1.82	–	
		〃	〃	〃	3.	3.10	〃	14	0.28	0.90	–	
		〃	〃	〃	5	5.01	〃	58	1.16	2.32	0.03	
		〃	〃	〃	7	6.99	〃	219	4.38	6.27	1.09	
		〃	〃	〃	10	9.27	〃	602	12.04	12.99	8.26	
		〃	〃	〃	7	7.07	〃	112	2.24	3.17	0.29	
④ 25.0	30.0	5.0	0.3	1.5	1	1.18	10	16	0.32	2.71	–	
		〃	〃	〃	3	3.18	〃	9	0.18	0.57	–	
		〃	〃	〃	5	5.18	〃	15	0.3	0.58	–	
		〃	〃	〃	7	7.17	〃	47	0.94	1.03	0.06	
		〃	〃	〃	10	9.42	〃	524	10.48	11.13	7.63	
		〃	〃	〃	7	6.90	〃	320	6.4	9.28	2.85	
		〃	〃	〃	5	5.17	〃	66	1.32	2.55	0.12	
		〃	〃	〃	3	3.15	〃	98	1.96	6.22	0.27	
		〃	〃	〃	1	1.15	〃	104	2.08	18.09	0.33	





① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H(m)/10$. $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO. LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET 3 OF 6)

KASSEB PROJECT Intake site HOLE No. SI 2

LOCATION _____ DEPTH OF HOLE 150.0 m TEST DATE _____

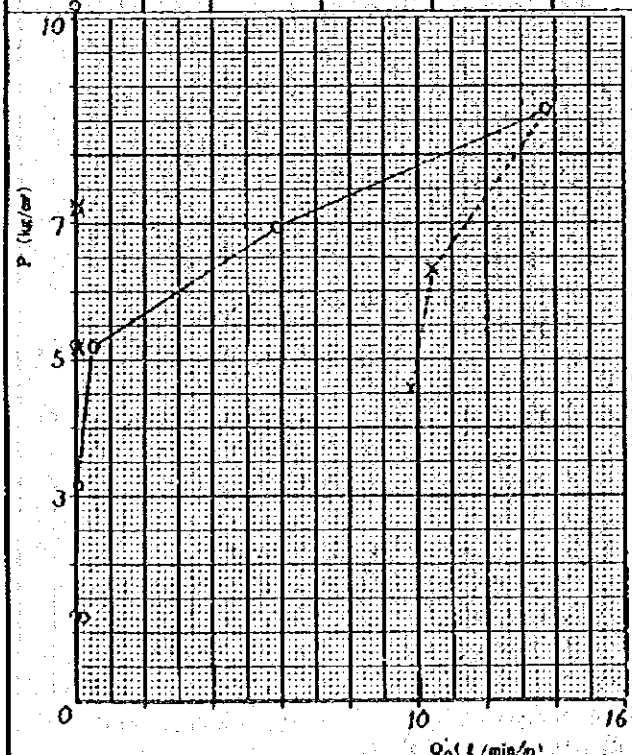
ELEVATION _____ m DIAMETER OF HOLE _____ cm TESTED BY _____

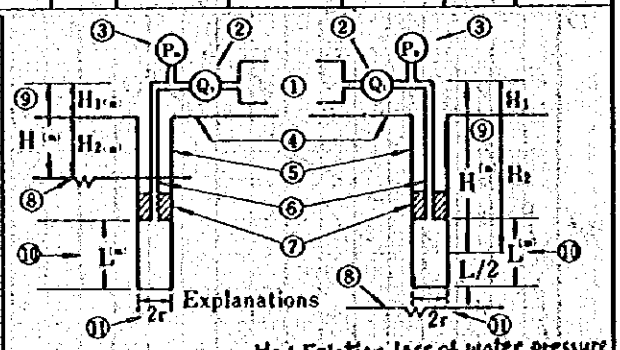
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. ⑤ 1.5 / ⑧ 1.3 m AFTER T. 2.6 / 2.2 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min)	L_u (Lugeon)	H_3 (m)	Remarks
③ 30.0	35.0	5.0	0.3	2.05	1	1.24	10	0	0	0	0	
		〃	〃	〃	3	3.24	〃	2	0.06	0.12	–	
		〃	〃	〃	5	5.22	〃	24	0.48	0.92	0.19	
		〃	〃	〃	7	6.95	〃	296	5.92	8.52	2.87	
		〃	〃	〃	10	8.66	〃	693	13.86	16.00	15.75	
		〃	〃	〃	7	6.35	〃	519	10.38	16.35	8.84	
		〃	〃	〃	5	4.45	〃	489	9.78	21.98	7.84	
⑤ 35.0	40.0	5.0	0.3	1.75	1	1.21	10	1	0.02	0.17	–	
		〃	〃	〃	3	3.21	〃	0	0	0	0	
		〃	〃	〃	5	5.21	〃	0	0	0	0	
		〃	〃	〃	7	7.21	〃	0	0	0	0	
		〃	〃	〃	10	10.21	〃	0	0	0	0	
		〃	〃	〃	7	7.21	〃	2	0.04	0.06	–	
		〃	〃	〃	5	5.21	〃	4	0.08	0.15	–	





H_3 : Friction loss of water pressure

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

PERMEABILITY TEST IN DRILL HOLE (SHEET 4 OF 6)

KASSEB PROJECT Intake site HOLE No. S1 2

LOCATION _____ DEPTH OF HOLE 150.0 m TEST DATE _____

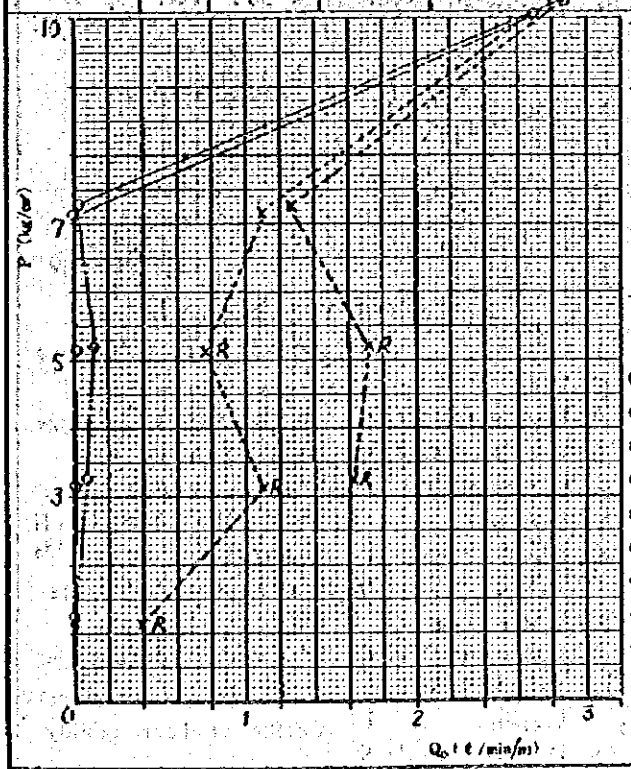
ELEVATION _____ m DIAMETER OF HOLE _____ cm TESTED BY _____

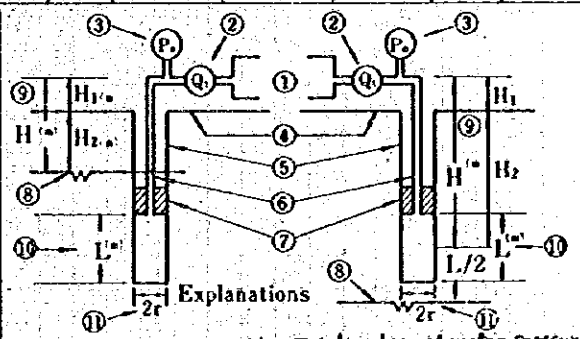
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. ⑦ 1.5 ⑧ 1.3 m AFTER T. 2.6 1.5 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min)	L_u (Lugeon)	H_3 (m)	Remarks
⑦ 40.0	45.0	5.0	0.3	2.05	1	1.24	10	0	0	0	0	
		〃	〃	〃	3	3.23	〃	4	0.08	0.25	0.37	
		〃	〃	〃	5	5.22	〃	6	0.12	0.23	0.15	
		〃	〃	〃	7	7.24	〃	1	0.02	0.03	–	
		〃	〃	〃	10	10.24	〃	143	2.86	2.79	0.88	
		〃	〃	〃	7	7.23	〃	46	0.92	1.27	0.09	
		〃	〃	〃	5	5.23	〃	45	0.9	1.72	0.09	R
		〃	〃	〃	3	3.23	〃	26	0.52	1.61	0.03	R
⑧ 53.0	58.0	5.0	0.3	1.4	1	1.17	10	0	0	0	0	
		〃	〃	〃	3	3.17	〃	0	0	0	0	
		〃	〃	〃	5	5.17	〃	1	0.02	0.04	–	
		〃	〃	〃	7	7.17	〃	0	0	0	0	
		〃	〃	〃	10	10.08	〃	139	2.78	2.76	0.92	
		〃	〃	〃	7	7.16	〃	56	1.12	1.56	0.15	
		〃	〃	〃	5	5.16	〃	39	0.78	1.51	0.07	R
		〃	〃	〃	3	3.16	〃	55	1.12	3.54	0.15	R
		〃	〃	〃	1	1.17	〃	20	0.4	3.42	0.02	R
		Remarks. R; Pumped-in water flew out from top of hole.										





Explanations

- ① : Pump
- ② : Flow meter
- ③ : Pressure gauge
- ④ : Ground surface
- ⑤ : Drill hole
- ⑥ : Injection pipe
- ⑦ : Packer
- ⑧ : Water table
- ⑨ : Hydrostatic head
- ⑩ : Length of test section
- ⑪ : Diamater of hole

H_3: Friction loss of water pressure.
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H(m)/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
K : Lugeon value in ℓ/min/m/10 kg/cm²
L_o : Coefficient of permeability

PERMEABILITY TEST IN DRILL HOLE (SHEET 5 OF 6)

KASSER PROJECT Intake site HOLE No. SI 2

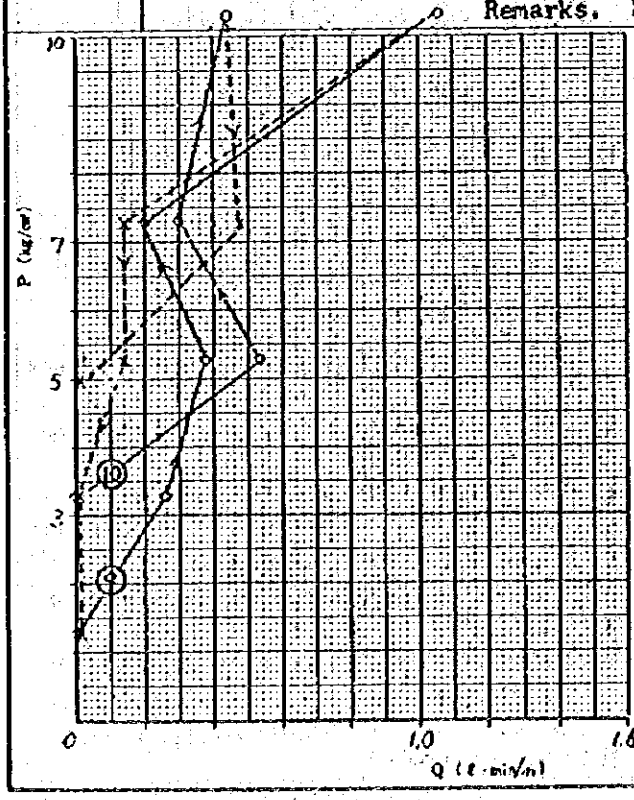
LOCATION
ELEVATION m
COORDINATE X 85.747.61 Y 23.876.12
ANGLE FROM HORIZONTAL 90°
BEARING OF ANGLE HOLE

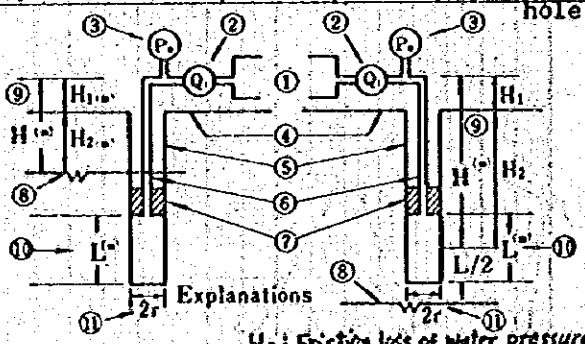
DEPTH OF HOLE 150.0 m
DIAMETER OF HOLE NX cm
DRILLED DEPTH m
LEVEL OF WATER TABLE
BEFORE T. 1.5 / 2.0 m AFTER T. 3.4 / 3.0 m

TEST DATE
TESTED BY
DRILLED BY
CHECKED BY

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
⑦ 50.0	55.0	5.0	0.3	2.5	1	1.28	10	0	0	0	0	
		〃	〃	〃	3	3.28	〃	13	0.26	0.19	–	
		〃	〃	〃	5	5.28	〃	19	0.38	0.72	0.02	
		〃	〃	〃	7	7.28	〃	10	0.2	0.27	–	
		〃	〃	〃	10	10.27	〃	53	1.06	1.03	0.15	
		〃	〃	〃	7	7.28	〃	7	0.14	0.19	–	R
		〃	〃	〃	5	5.28	〃	7	0.14	0.27	–	R
		〃	〃	〃	3	3.28	〃	3	0.06	0.18	–	R
		〃	〃	〃	1	1.28	〃	4	0.08	0.63	–	R
⑧ 55.0	60.0	5.0	0.3	2.5	1	1.28	10	0	0	0	0	
		〃	〃	〃	3	3.28	〃	0	0	0	0	
		〃	〃	〃	5	5.28	〃	14	0.28	0.53	0.01	
		〃	〃	〃	7	7.28	〃	11	0.22	0.30	–	
		〃	〃	〃	10	10.28	〃	22	0.44	0.43	0.03	
		〃	〃	〃	7	7.28	〃	24	0.48	0.65	0.03	
		〃	〃	〃	5	5.28	〃	3	0.06	0.11	–	
		〃	〃	〃	3	3.28	〃	0	0	0	0	
		〃	〃	〃	1	1.28	〃	0	0	0	0	

Remarks. R_j Pumped-in water flew out from top of hole.





H_3 : Friction loss of water pressure

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H(m)/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

PERMEABILITY TEST IN DRILL HOLE (SHEET 6 OF 6)

KASSEB PROJECT Intake site HOLE No. SI 2

LOCATION _____ DEPTH OF HOLE 150.0 m TEST DATE _____

ELEVATION _____ m DIAMETER OF HOLE NX cm TESTED BY _____

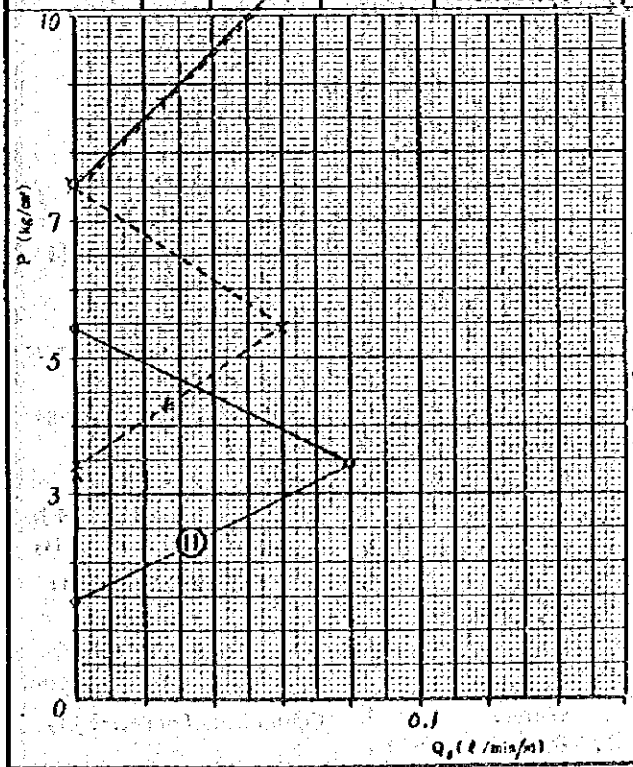
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

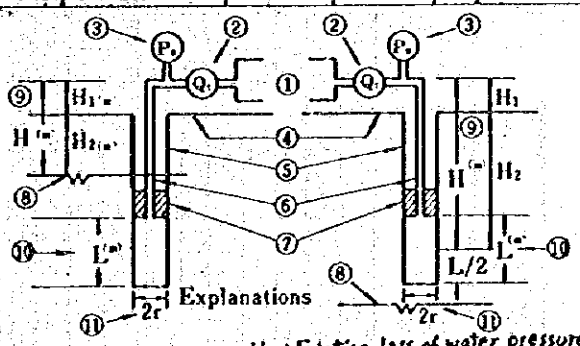
ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY _____

BEARING OF ANGLE HOLE _____ BEFORE T. ① 2.8 m AFTER T. 5.6 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min)	L_u (Lugeon)	H_3 (m)	Remarks
① 60.0	65.0	5	0.3	4.2	1	1.45	10	0	0	0	0	
		〃	〃	〃	3	3.45	〃	4	0.08	0.23	–	
		〃	〃	〃	5	5.45	〃	0	0	0	0	
		〃	〃	〃	7	7.45	〃	0	0	0	0	
		〃	〃	〃	10	10.45	〃	3	0.06	0.06	–	
		〃	〃	〃	7	7.45	〃	0	0	0	0	
		〃	〃	〃	5	5.45	〃	3	0.06	0.17	–	R
		〃	〃	〃	3	3.45	〃	0	0	0	0	
		〃	〃	〃	1	1.45	〃	0	0	0	0	

Remarks. R; Pumped-in water flew out from top of hole.





Explanations

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H'^m/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_o : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET NO. 1 OF 3)

KASSEB PROJECT Outlet site HOLE No. SU 11

LOCATION _____ DEPTH OF HOLE 70 m NR.0-46m TEST DATE _____

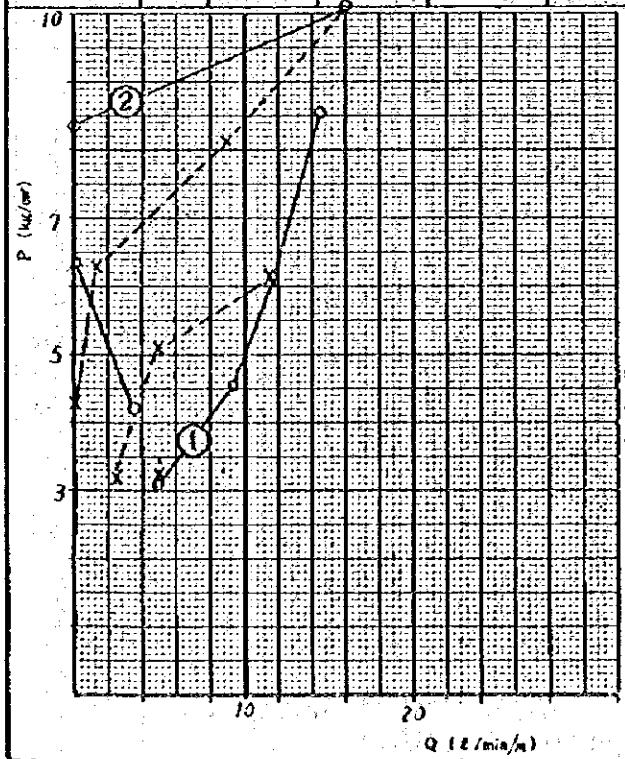
ELEVATION _____ m DIAMETER OF HOLE BX. 46- m TESTED BY _____

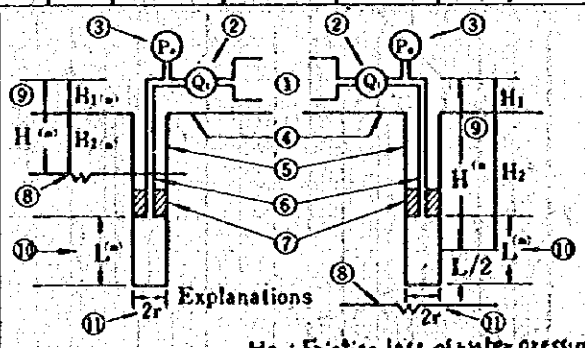
COORDINATE X 77.483 Y 93.193 (Planning) DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY HELALI

BEARING OF ANGLE HOLE _____ BEFORE T. ① 2.6 ② 11.1 m AFTER T. 2.5 18.9 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
① 33.0	35.0	5.0	0.3	2.5	3	3.09	15	240	4.5	15.53	1.87	
		"	"	"	5	4.56	"	470	9.4	20.62	7.13	
		"	"	"	7	6.15	"	590	11.8	19.19	11.31	
		"	"	"	10	8.35	"	730	14.6	17.08	17.32	
		"	"	"	7	6.21	"	575	11.5	18.52	10.75	
		"	"	"	5	5.03	"	247	4.94	9.72	1.98	
		"	"	"	3	3.23	"	128	2.56	7.93	0.53	
② 36.5	40.0	3.5	0.3	13.0	3	4.27	10	126	3.6	8.43	0.61	
		"	"	"	5	6.33	"	0	0	0		
		"	"	"	7	8.33	"	0	0	0		
		"	"	"	10	10.12	"	564	16.1	15.91	12.15	
		"	"	"	7	8.10	"	245	7.0	8.64	2.29	
		"	"	"	5	6.33	"	3	0.86	0.14		
		"	"	"	3	4.33	"	0	0	0		





Explanations

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure.
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H(m)/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET NO. 2 OF 3)

KASSER PROJECT Outlet site HOLE No. SII 11

LOCATION ____ DEPTH OF HOLE 70 m TEST DATE ____

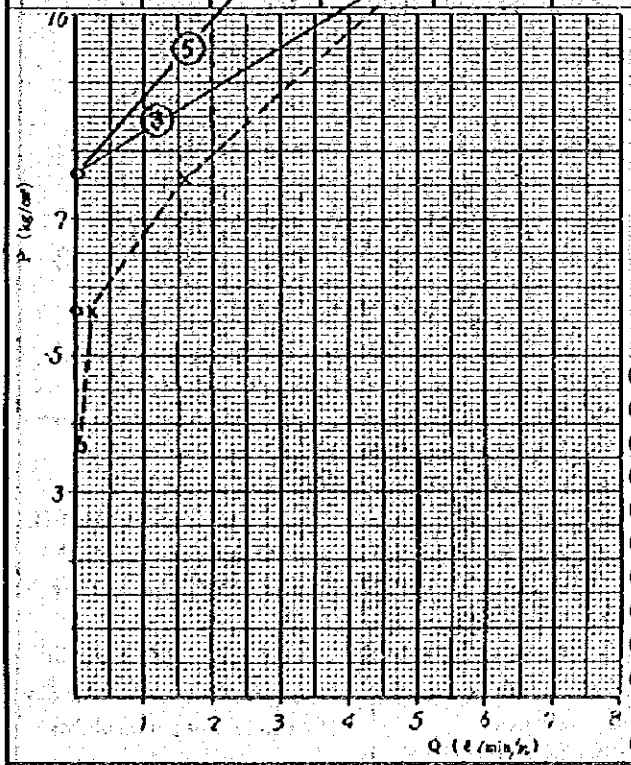
ELEVATION ____ m DIAMETER OF HOLE ____ cm TESTED BY ____

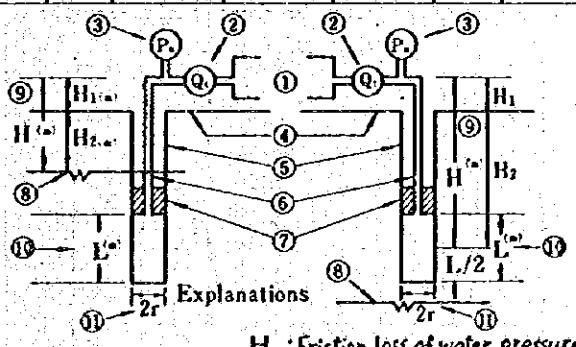
COORDINATE ____ DRILLED DEPTH ____ m DRILLED BY ____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY HELIALI

BEARING OF ANGLE HOLE ____ BEFORE.T. 11.1 m AFTER.T. 14.9 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
③ 40.0	45.0	5.0	0.3	13.0	3	4.33	10	7	0.04	0.09		
		〃	〃		5	6.33	〃	0	0	0		
		〃	〃		7	8.33	〃	0	0	0		
		〃	〃		10	11.02	〃	270	5.4	4.90	3.10	
		〃	〃		7	8.30	〃	85	1.6	1.93	0.27	
		〃	〃		5	6.32	〃	12	0.24	0.38	0.01	
		〃	〃		3	4.33	〃	0	0	0		
④ 45.0	50.0	This section wasn't tested due to the collapse of hole.										
⑤ 50.0	55.0	5.0	0.3	13.0	3	4.33	10	1	0.02	0.05	-	
		〃	〃	〃	5	6.33	〃	0	0	0	-	
		〃	〃	〃	7	8.33	〃	0	0	0	-	
		〃	〃	〃	10	11.31	〃	180	3.6	3.18	0.14	
		〃	〃	〃	7	8.33	〃	0	0	0	-	
		〃	〃	〃	5	6.33	〃	0	0	0	-	
		〃	〃	〃	3	4.33	〃	0	0	0	-	





Explanations

① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure.
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H^{(m)}/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10^{-6}kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN

PERMEABILITY TEST IN DRILL HOLE (SHEET NO.3 OF 3)

KASSEB PROJECT Outlet site HOLE No. SU 11

LOCATION _____ DEPTH OF HOLE 70.0 m TEST DATE _____

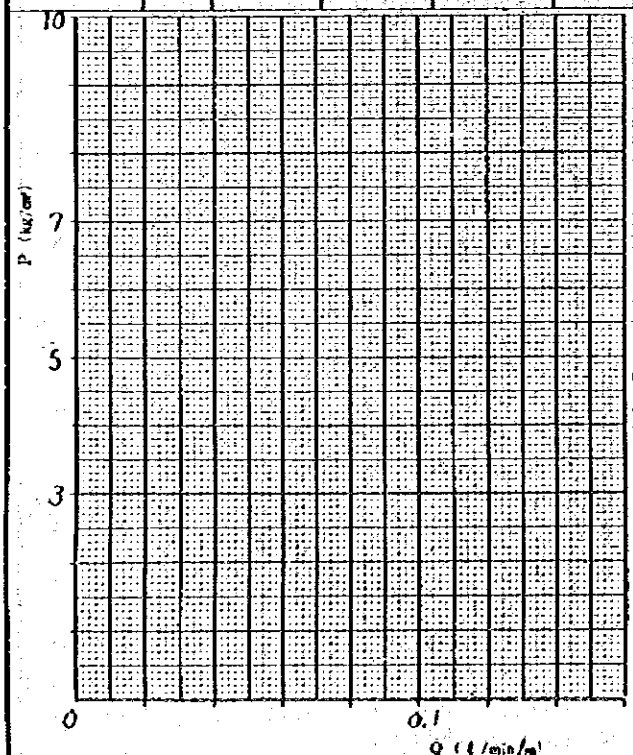
ELEVATION _____ m DIAMETER OF HOLE _____ cm TESTED BY _____

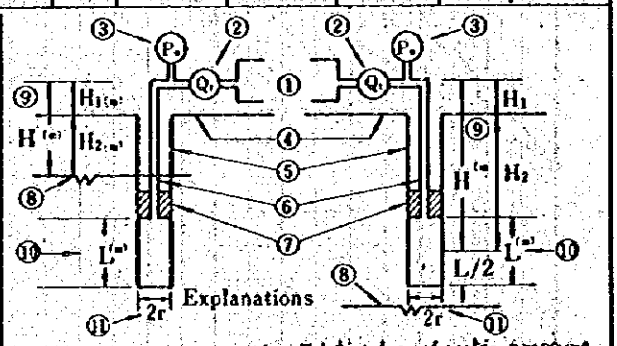
COORDINATE _____ DRILLED DEPTH _____ m DRILLED BY _____

ANGLE FROM HORIZONTAL 90° LEVEL OF WATER TABLE CHECKED BY HELLALI

BEARING OF ANGLE HOLE _____ BEFORE T. ⑥ 11.1 / ⑦ 12.5 m AFTER T. 14.9 m

Test section (m) From	To	L (m)	H_1 (m)	H_2 (m)	P_o (kg/cm²)	P (kg/cm²)	t (min)	Q_t (ℓ)	Q_o (ℓ/min/m)	L_u (Lugeon)	H_3 (m)	Remarks
⑥ 55.0	60.0	5.0	0.3	13.0	3	4.33	10	0		0		
		〃	〃	〃	5	6.33	〃	0		0		
		〃	〃	〃	7	8.33	〃	0		0		
		〃	〃	〃	10	11.33	〃	4	0.08	0.07	-	
		〃	〃	〃	7	8.33	〃	0		0		
		〃	〃	〃	5	6.33	〃	0		0		
		〃	〃	〃	3	4.33	〃	0		0		
⑦ 60.0	65.0	5.0	0.3	13.6	3	4.33	10	0		0		
		〃	〃	〃	5	6.33	〃	0		0		
		〃	〃	〃	7	8.33	〃	0		0		
		〃	〃	〃	10	11.33	〃	2	0.04	0.04	-	
		〃	〃	〃	7	8.33	〃	0		0		
		〃	〃	〃	5	6.33	〃	0		0		
		〃	〃	〃	3	4.33	〃	0		0		
⑧ 65.0	70.0	This section wasn't tested due to the collapse of hole.										





① : Pump
② : Flow meter
③ : Pressure gauge
④ : Ground surface
⑤ : Drill hole
⑥ : Injection pipe
⑦ : Packer
⑧ : Water table
⑨ : Hydrostatic head
⑩ : Length of test section
⑪ : Diamater of hole

H_3 : Friction loss of water pressure.
P_o : Gauge pressure
H_1 : Height of Pressure gauge
H_2 : Depth of Ground water
P : Effective pressure
$P = P_o + H(m)/10$, $H = H_1 + H_2 - H_3$
t : Injected time
Q_t : Water volume during time in "t"
Q_o : Water volume per one min.
: Lugeon value in ℓ/min/m/10 kg/cm²
L_u : Coefficient of permeability
K

ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN