THE KINGDOM OF THAILAND

NATIONAL ENERGY ADMINISTRATION

MINISTRY OF SCIENCE, TECHNOLOGY AND ENERGY

NAM MAE YUAM HYDROELECTRIC DEVELOPMENT PROJECT FEASIBILITY REPORT

VOLUME II

(Appendix 1, 2, 3, 4, 5)

MARCH, 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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FEASIBILITY REPORT

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(Appendix 1, 2, 3, 4, 5)

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JAPAN INTERNATIONAL COOPERATION AGENCY

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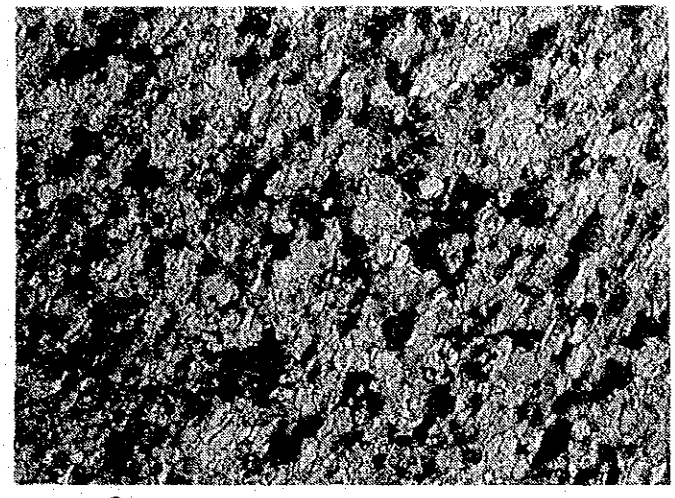
Micrograph and Petrographic Description of Rock

(Plate 1 of 5)

Locality: 5

600 m upstream of A dam axis, right bank of Yuam River.



(crossed nicols)

Rock name:

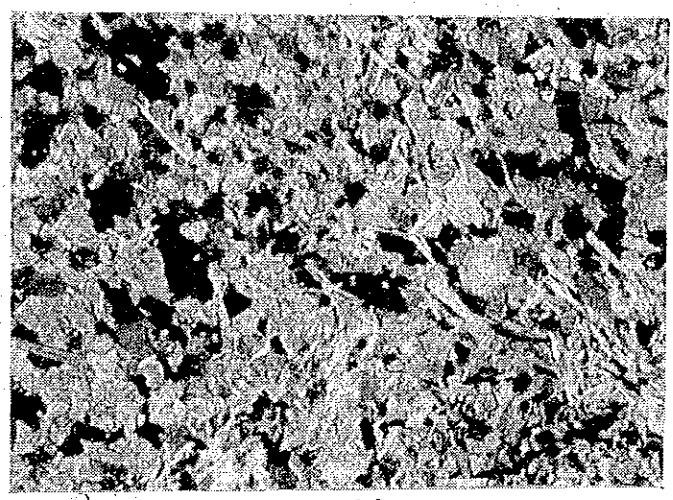
Limestone (massive)

Petrographic description:

Chief consisting minerals are calcite >> muscovite, quartz and chlorite. Dolomite and potassium feldspar are trace in amount.

Locality: 9

200 m upstream of A dam axis, right bank of Yuam River. (EL. 150 m)



(crossed nicols)

Rock name:

Limestone (laminated)

Petrographic description:

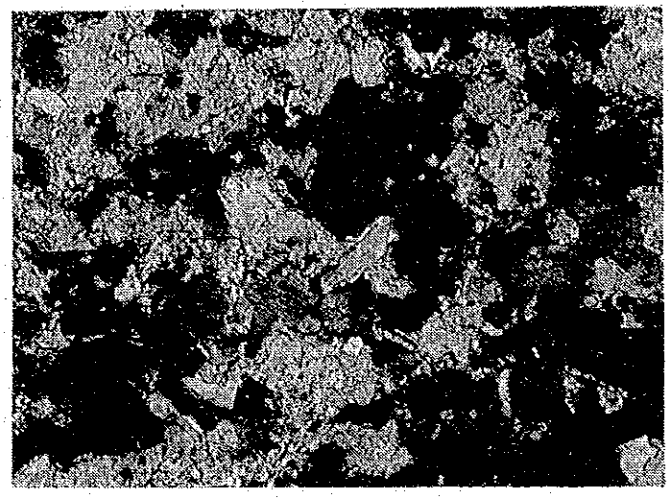
Chief consisting minerals are calcite > white mica, quartz. Banding texture consisting of calcite-rich and mica-rich layers is observed.

Micrograph and Petrographic Description of Rock

(Plate 2 of 5)

Locality: 13

1 km downstream of A dam axis,
left bank of Yuam River.



(crossed nicols)

Rock name:

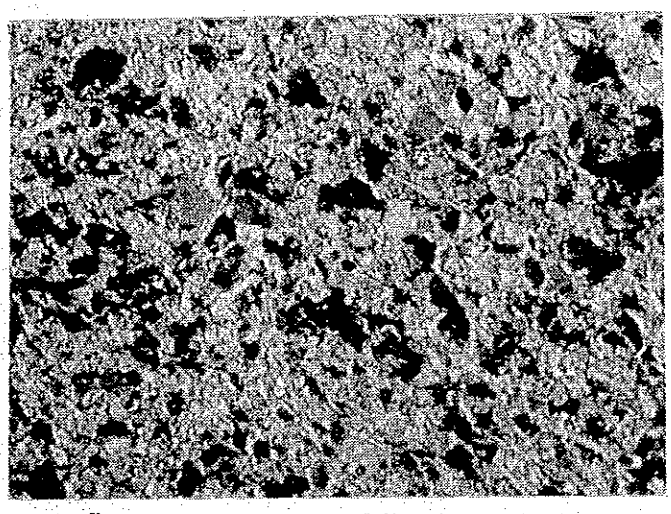
Sandy limestone

Petrographic description:

Chief consisting minerals are calcite, dolomite, quartz and muscovite.

Locality: 16

Tributary of Huai Uya Kra
(EL. 460 m)



(crossed nicols)

Rock name:

Siliceous limestone
(or calcareous sandstone)

Petrographic description:

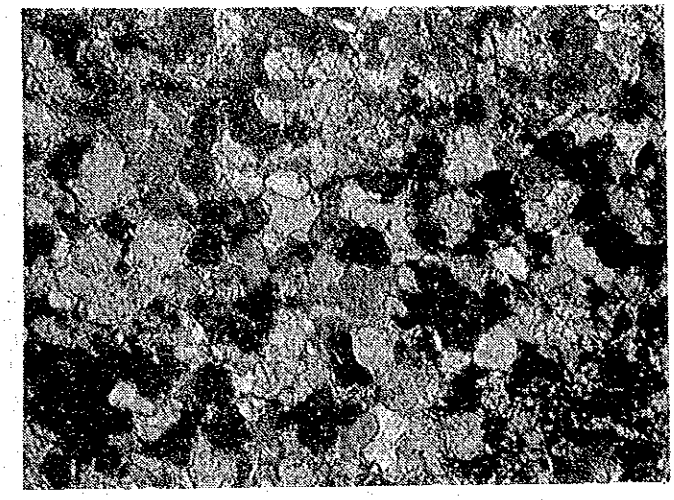
Chief consisting minerals are calcite, quartz and white mica.
Clay minerals are trace in amount, less than 0.1%.

Micrograph and Petrographic Description of Rock

(Plate 3 of 5)

Locality: 18

Huai Uya Kra



0 mm (crossed nicols)

Rock name:

Calcareous sandstone

Petrographic description:

Chief consisting minerals are dolomite, calcite, quartz.

Accessory minerals are muscouvite and pyrite.

Locality: 20

Huai Mae Lamu

0 0.2 mm (crossed nicols)

Rock name:

Sandstone

Petrographic description:

Chief consisting minerals are quartz, dolomite and plagioclase.

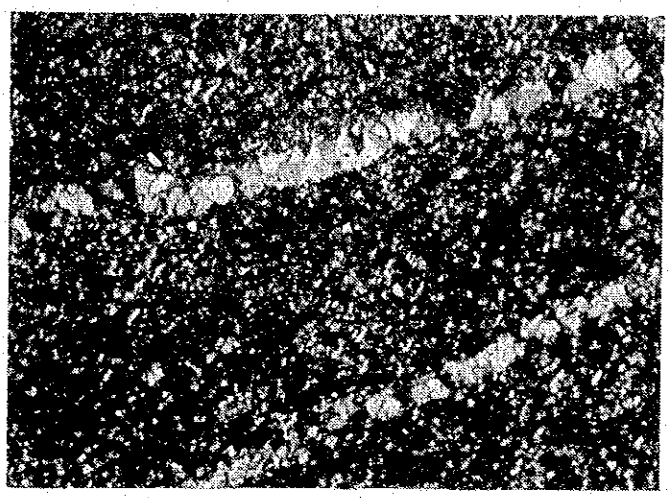
A trace amount of montmorillonite is found.

Micrograph and Petrographic Description of Rock

(Plate 4 of 5)

Locality: 19

Right bank of A dam axis



0 0.3 mm (crossed nicols)

Rock name:

Shale

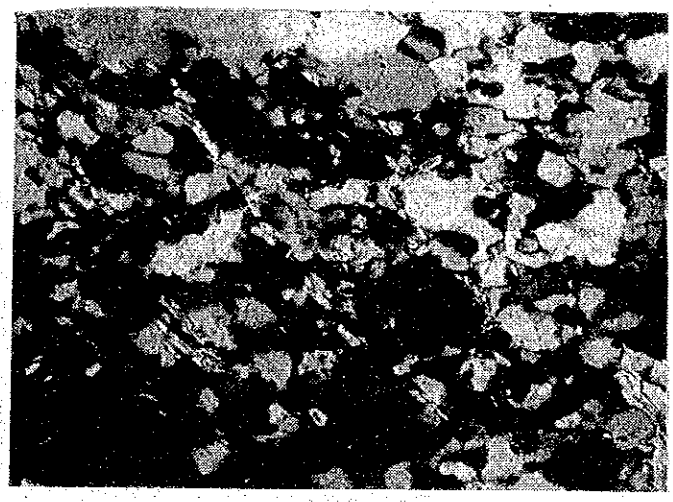
Petrographic description:

Chief consisting minerals are quartz, white mica, graphite and plagioclase. Quartz veins are common.

Locality:

Huai la cho Kra

(about 5 km upstream of Damsite A)



0 0.2 mm (crossed nicols)

Rock name:

Quartzose sandstone

Petrographic description:

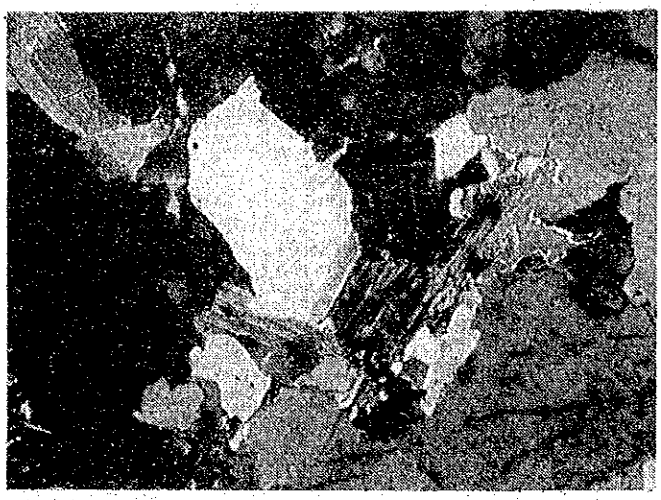
Chief consisting minerals are quartz, potassium feldspar and muscovite. A trace amount of tourmaline, zircon and apatite is found.

Micrograph and Petrographic Description of Rock

(Plate 5 of 5)

Locality:

Damsite C (about 12 km upstream of Damsite A)



Rock name:

Granite

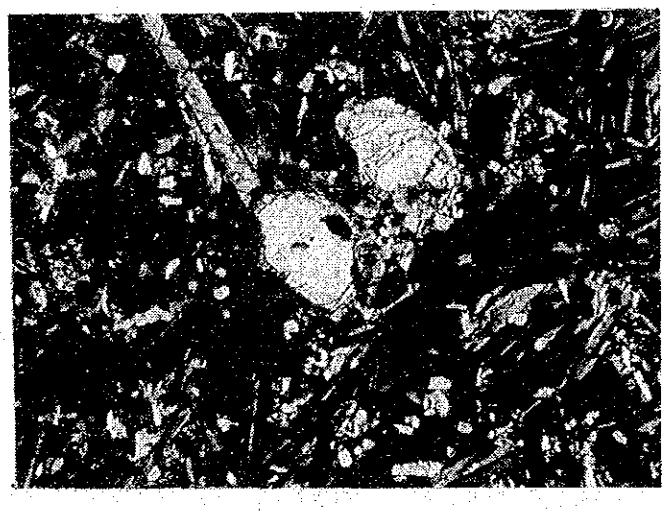
Petrographic description:

0 0.5mm (crossed nicols)

Chief consisting minerals are quartz, potassium feldspar, plagioclase, biotite and muscovite. Mica is partly replaced by chlorite and montmorillonite.

Locality:

Ngao river (about 3 km upstream of junction of Yuan river and Ngao river)



Rock name:

Basalt

Petrographic description:

0 0.5mm (crossed nicols)

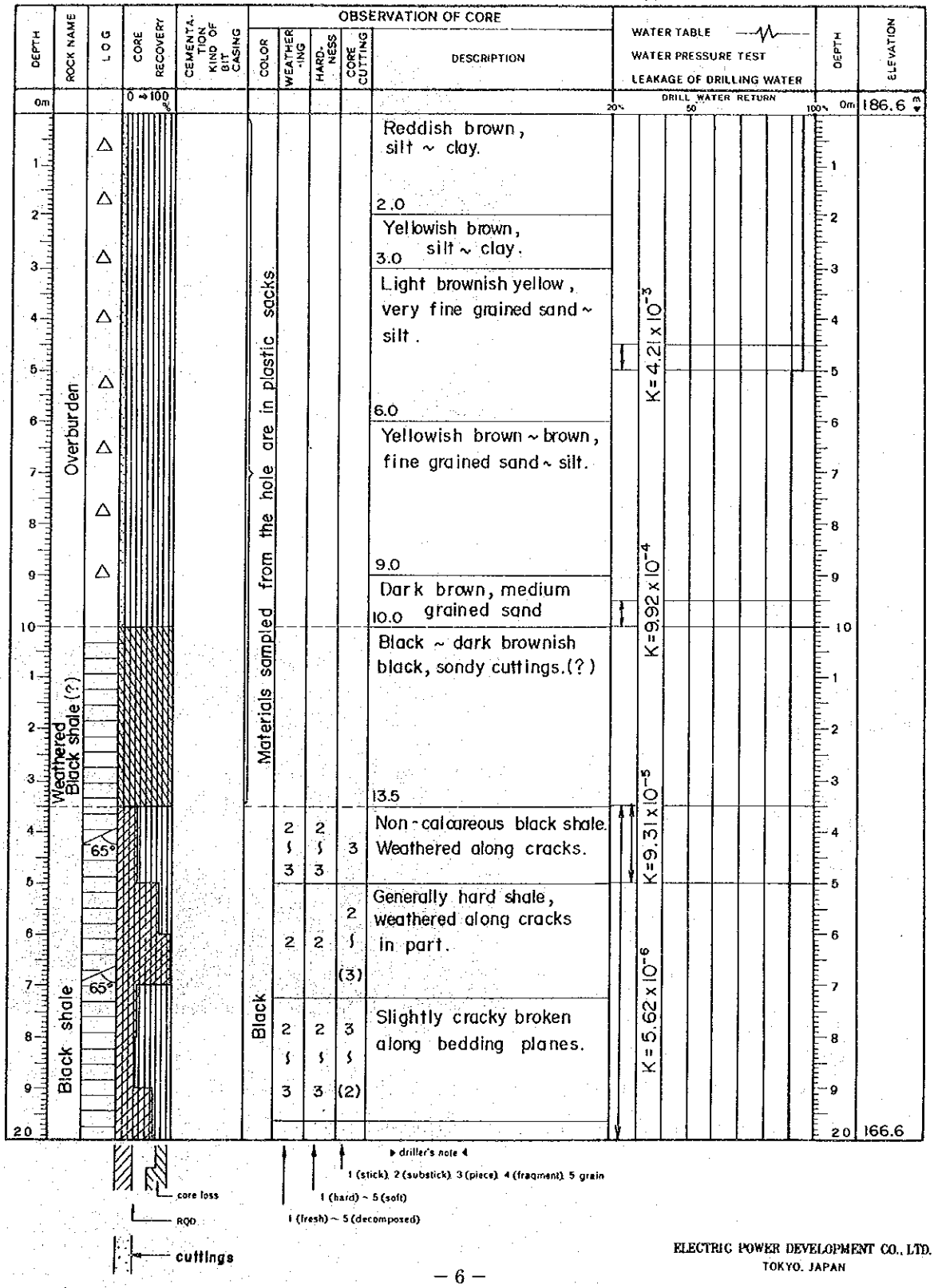
Phenocrysts are of olivine, plagioclase and clinopyroxne.

Microphenocrysts are of plagioclase, clinopyroxne and magnetite.

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL - 1 (SHEET 1 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Apr.- 13 - 1983
ELEVATION	186.6 m	DEPTH OF OVERBURDEN	10.0 m	COMPLETED	Apr.- 21 - 1983
COORDINATE	1966 286.9N 375 168.2E	LENGTH OF ROCK DRILLING	70.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90 °	TOTAL LENGTH OF CORE	19.34 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	—	CORE RECOVERY	27.6 %		



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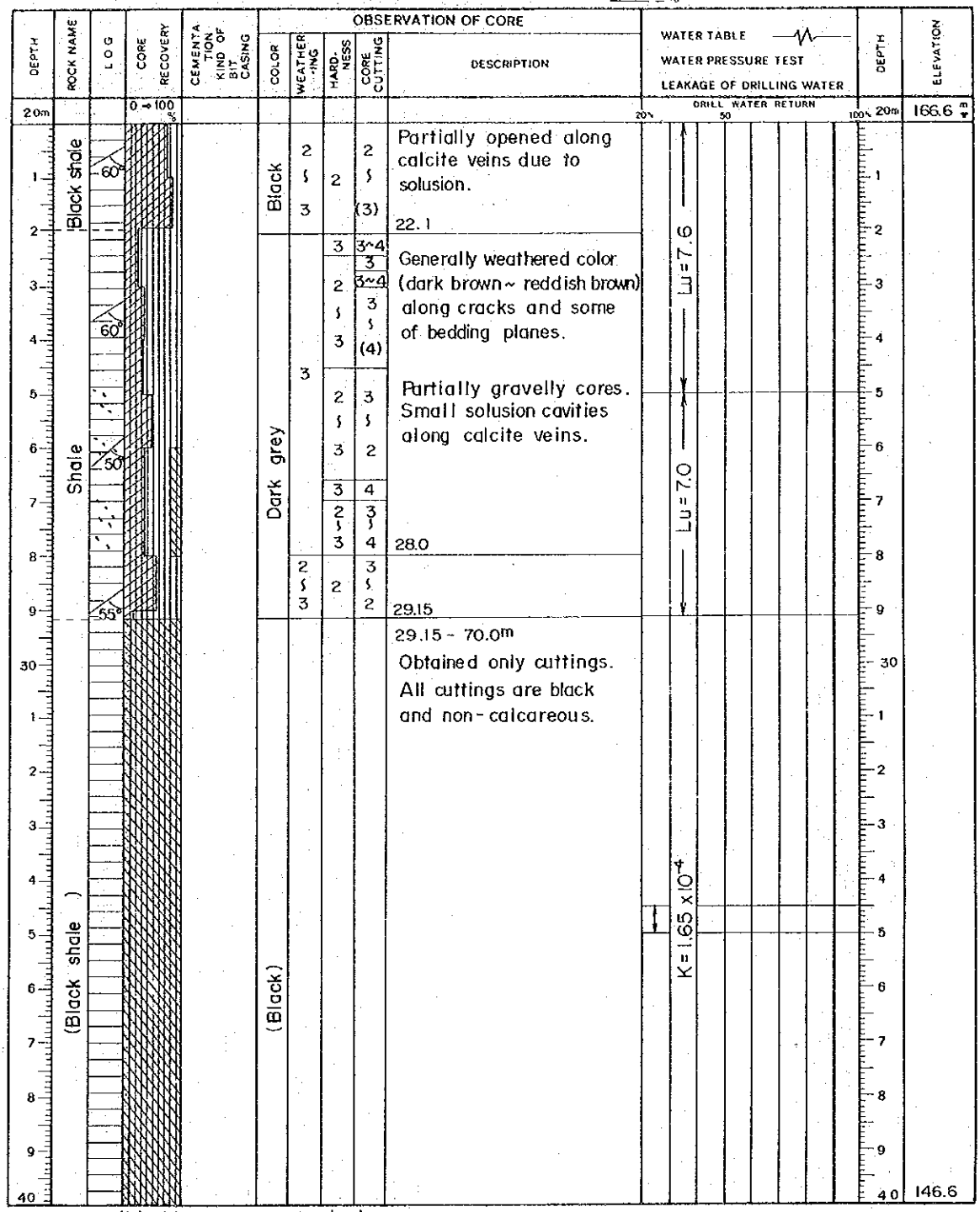
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-1 (SHEET 2 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Apr.-13-1983
ELEVATION	186.6 m	DEPTH OF OVERBURDEN	10.0 m	COMPLETED	Apr.-21-1983
COORDINATE	1966 286.9N 375 168.2E	LENGTH OF ROCK DRILLING	70.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	19.34 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	—	CORE RECOVERY	27.6 %		



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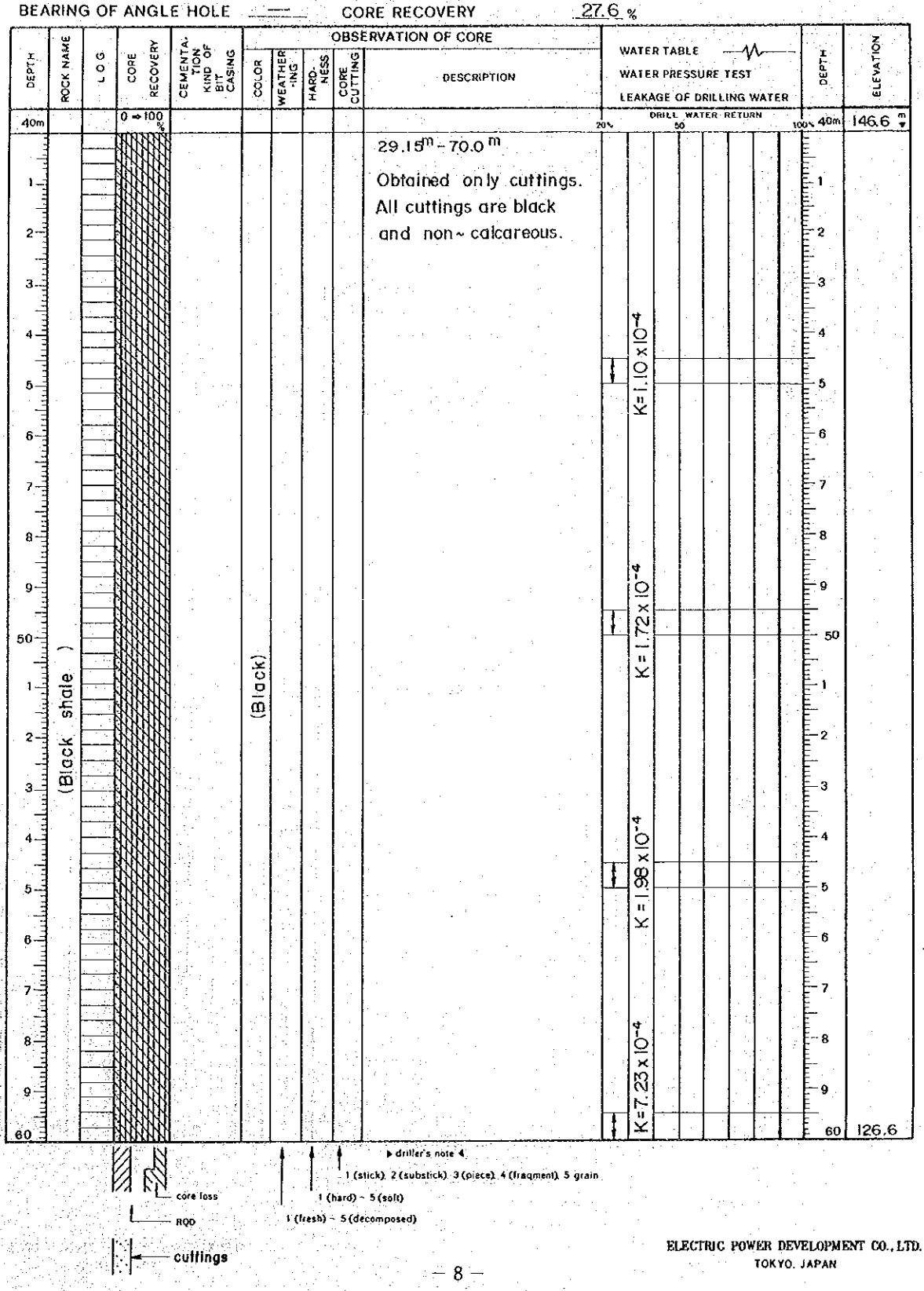
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-1 (SHEET 3 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Apr. 13 1983
ELEVATION	186.6 m	DEPTH OF OVERBURDEN	10.0 m	COMPLETED	Apr. 21 1983
COORDINATE	1966 286.9N 375 168.2E	LENGTH OF ROCK DRILLING	70.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	19.34 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	—	CORE RECOVERY	27.6 %		



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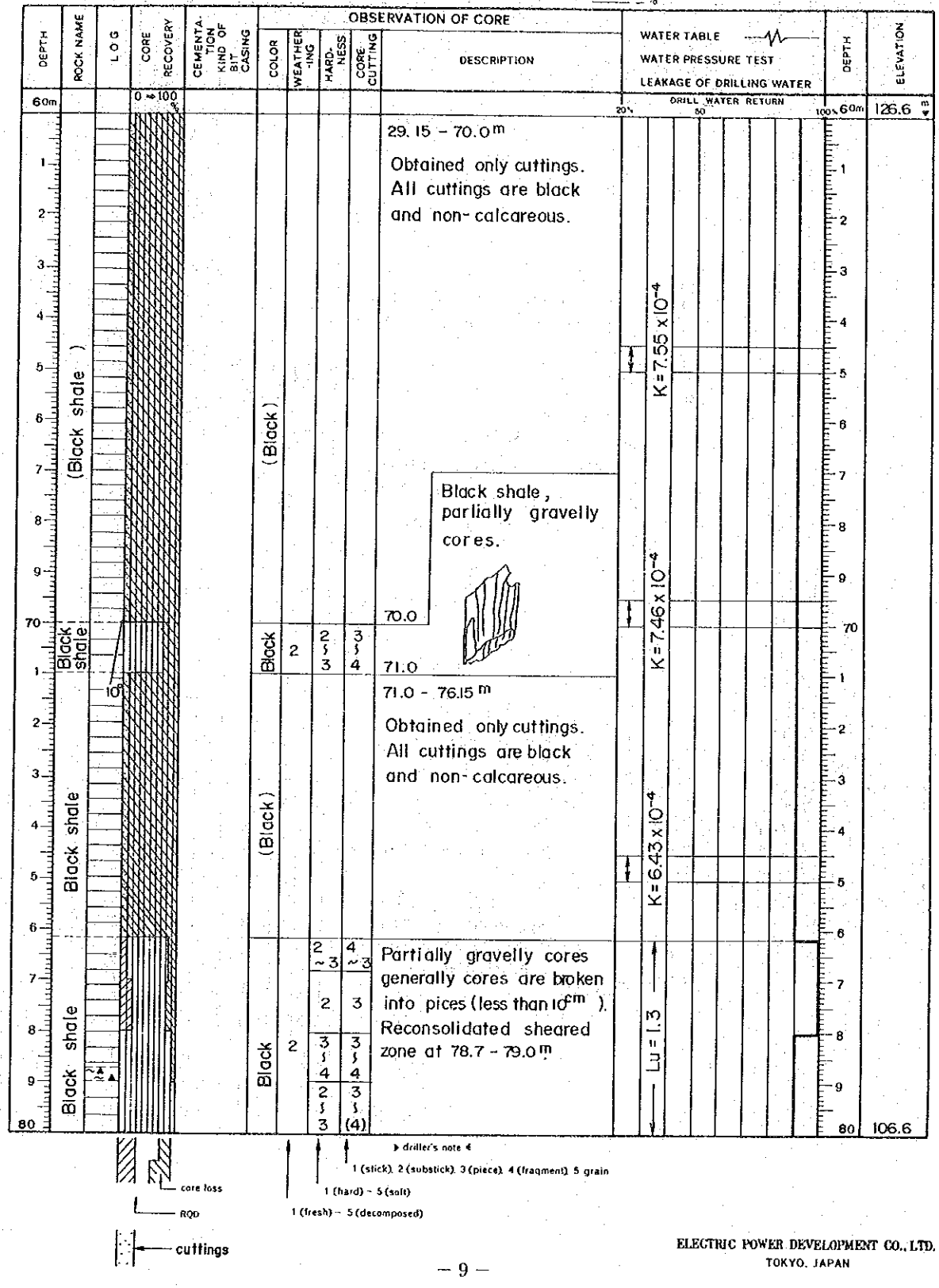
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-1 (SHEET 4 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Apr. - 13 - 1983
ELEVATION	186.6 m	DEPTH OF OVERBURDEN	10.0 m	COMPLETED	Apr. - 21 - 1983
COORDINATE	1966 286.9N 375 168.2E	LENGTH OF ROCK DRILLING	70.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90 °	TOTAL LENGTH OF CORE	19.34 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	—	CORE RECOVERY	27.6 %		



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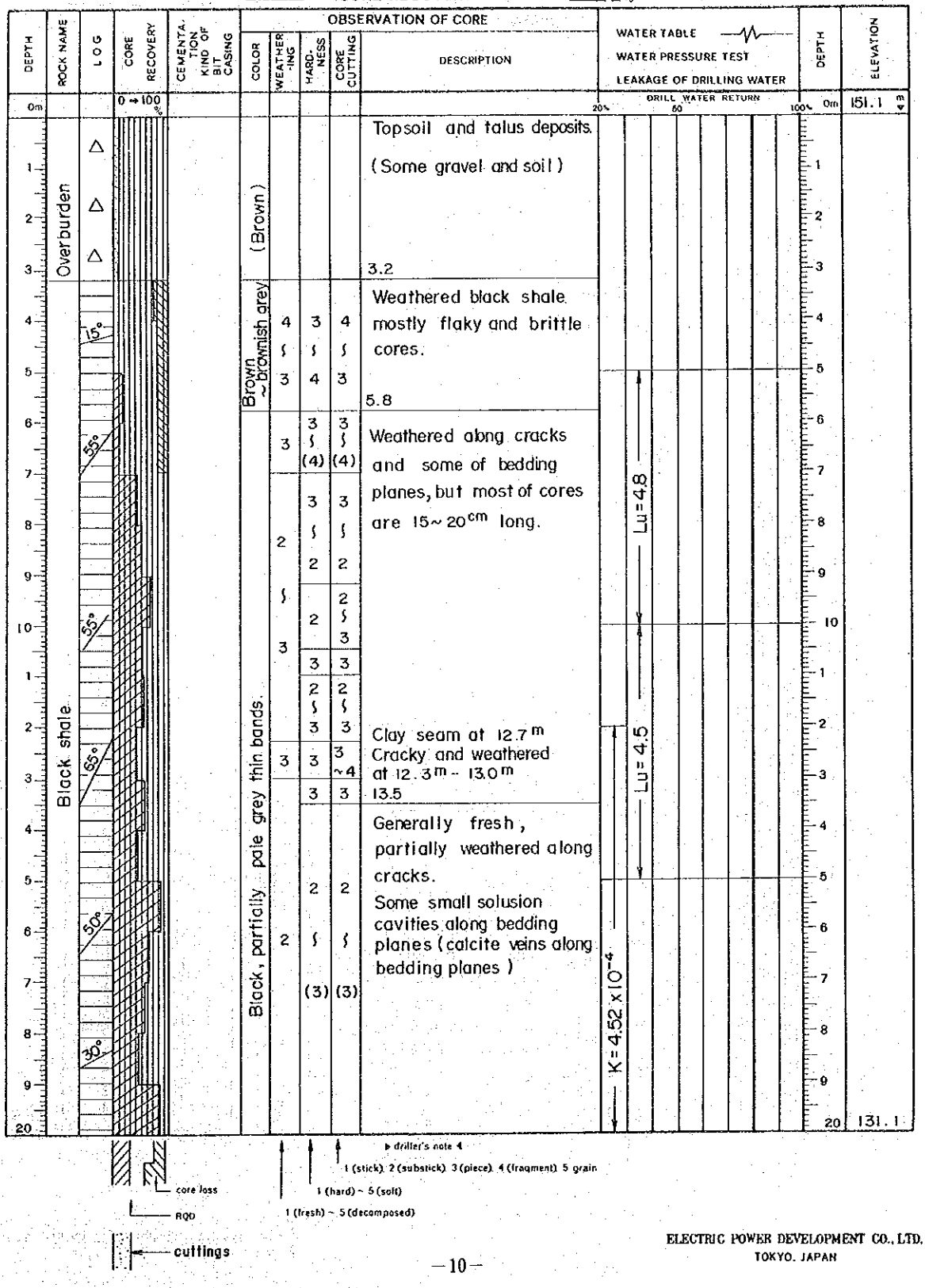
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-2 (SHEET 1 OF 3)

LOCATION	Dam left bank	DEPTH OF HOLE	60.0 m	COMMENCED	May - 1 - 1983
ELEVATION	151.1 m	DEPTH OF OVERBURDEN	3.2 m	COMPLETED	May - 14 - 1983
COORDINATE	1966 350.7N 375 194.1E	LENGTH OF ROCK DRILLING	56.8 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	53.8 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	———	CORE RECOVERY	94.7 %		



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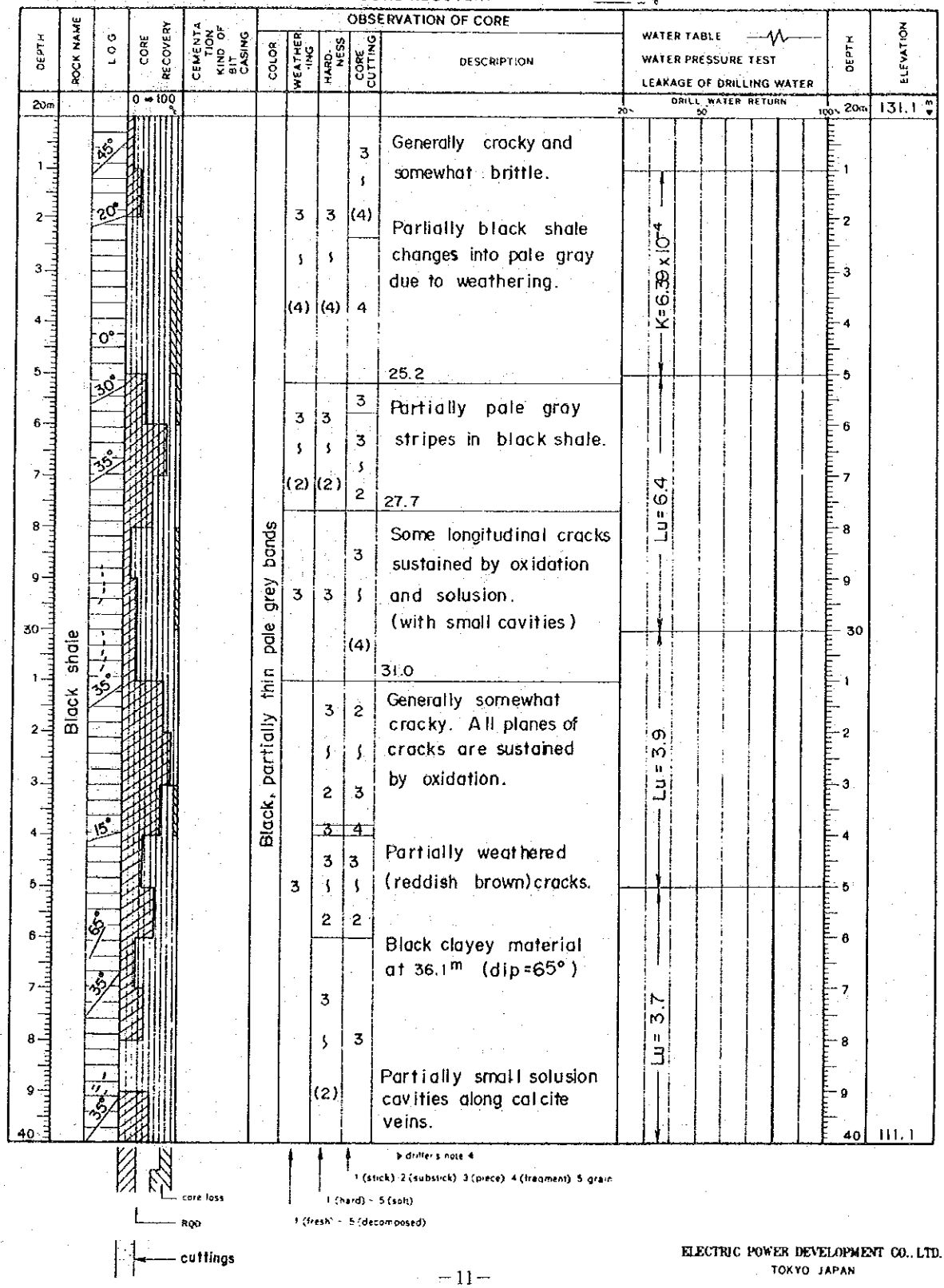
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No.DL-2 (SHEET 2 OF 3)

LOCATION	Dam left bank	DEPTH OF HOLE	60.0 m	COMMENCED	May - 1 - 1983
ELEVATION	151.1 m	DEPTH OF OVERBURDEN	3.2 m	COMPLETED	May - 14 - 1983
COORDINATE	1966 350.7N 375 194.1E	LENGTH OF ROCK DRILLING	56.8 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	53.8 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	94.7 %		



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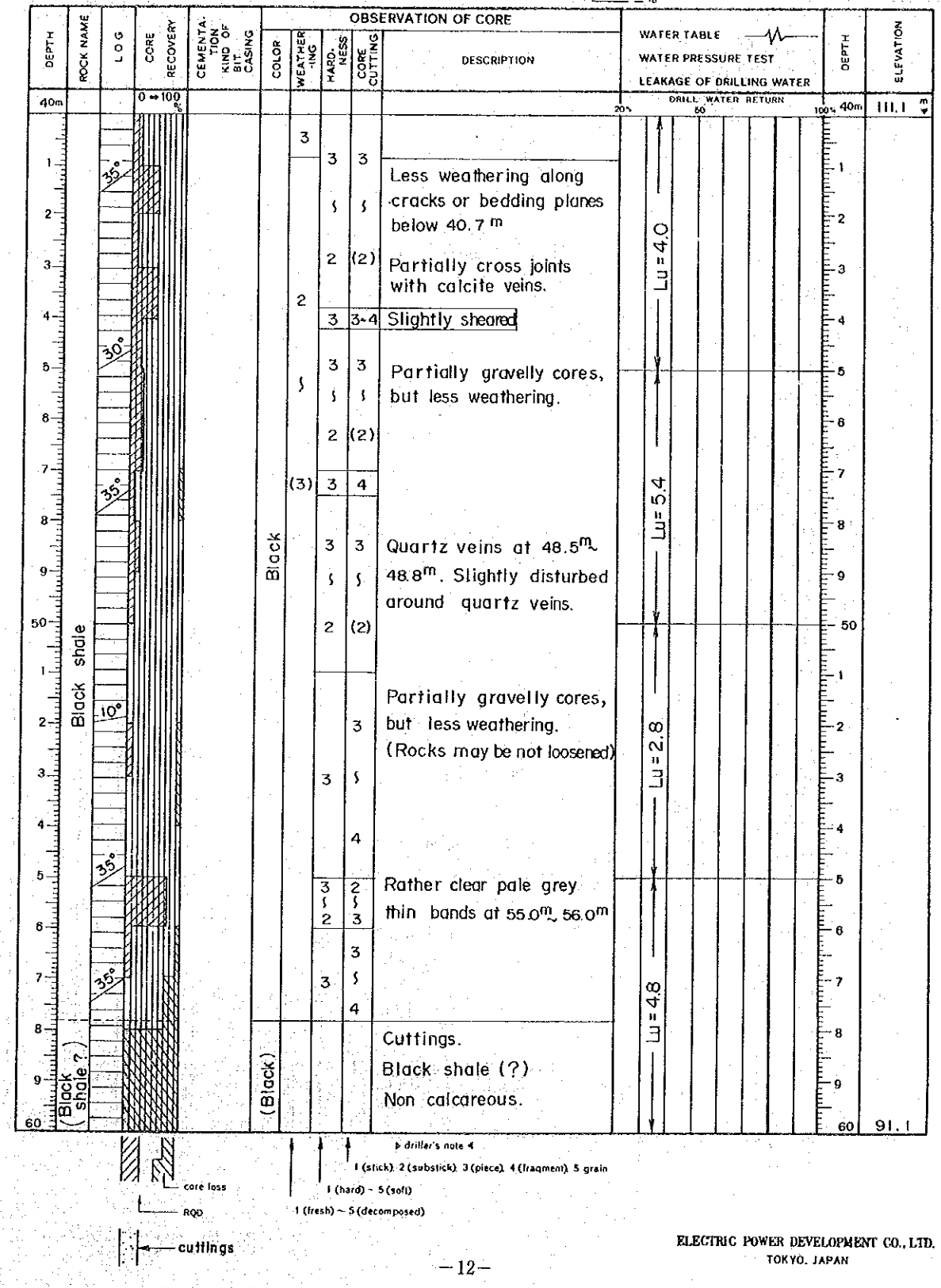
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-2 (SHEET 3 OF 3)

LOCATION	Dam left bank	DEPTH OF HOLE	60.0 m	COMMENCED	May - 1 - 1983
ELEVATION	151.1 m	DEPTH OF OVERBURDEN	3.2 m	COMPLETED	May - 14 - 1983
COORDINATE	1966 350.7N 375 194.1E	LENGTH OF ROCK DRILLING	56.8 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	53.8 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	94.7 %		



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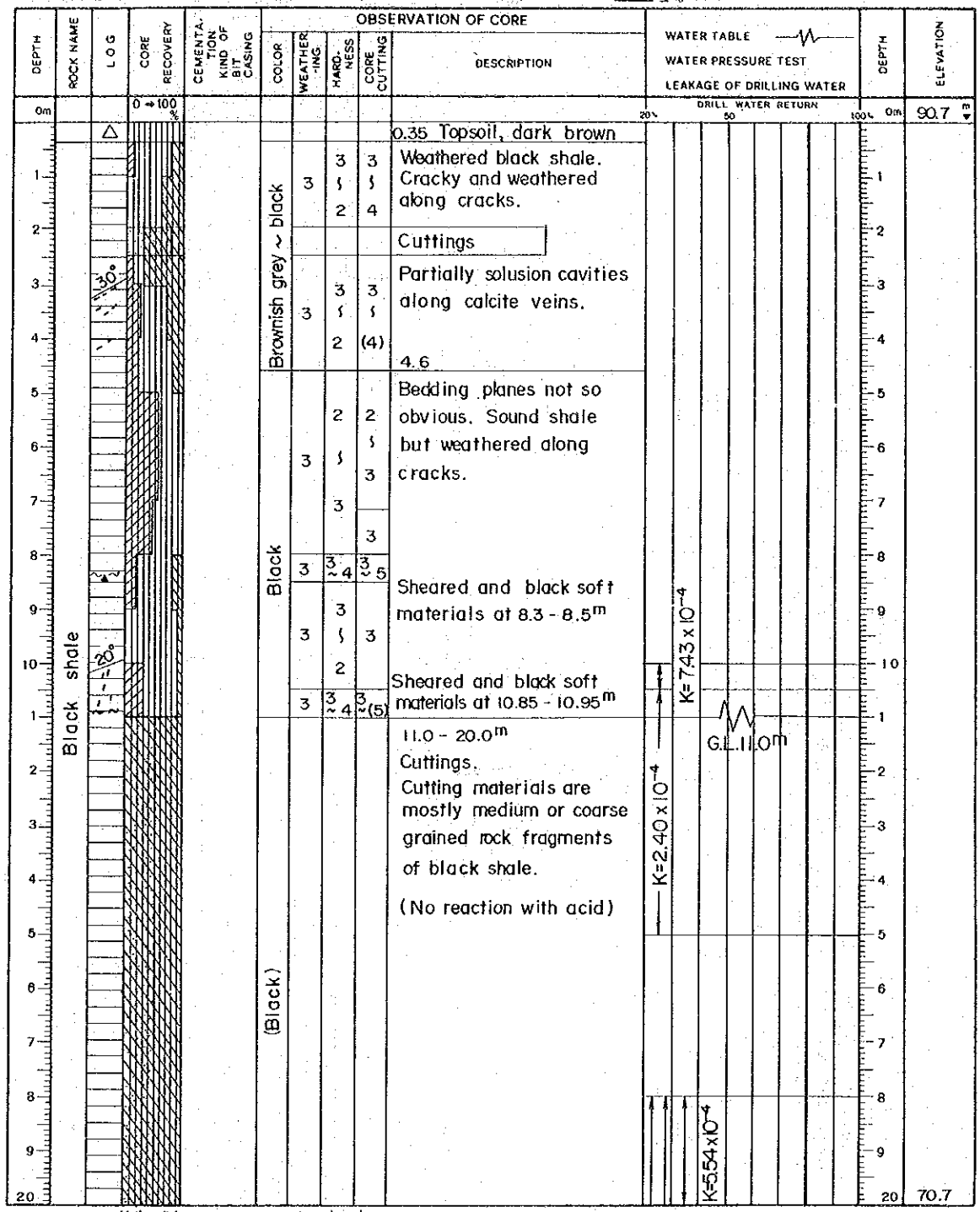
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-3 (SHEET 1 OF 6)

LOCATION	Dam left bank	DEPTH OF HOLE	120.0 m	COMMENCED	May- 18 -1983
ELEVATION	90.7 m	DEPTH OF OVERBURDEN	0.35 m	COMPLETED	Jun - 24 - 1983
COORDINATE	1966430.9N 375229.3E	LENGTH OF ROCK DRILLING	119.65 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	58.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	49.2 %		



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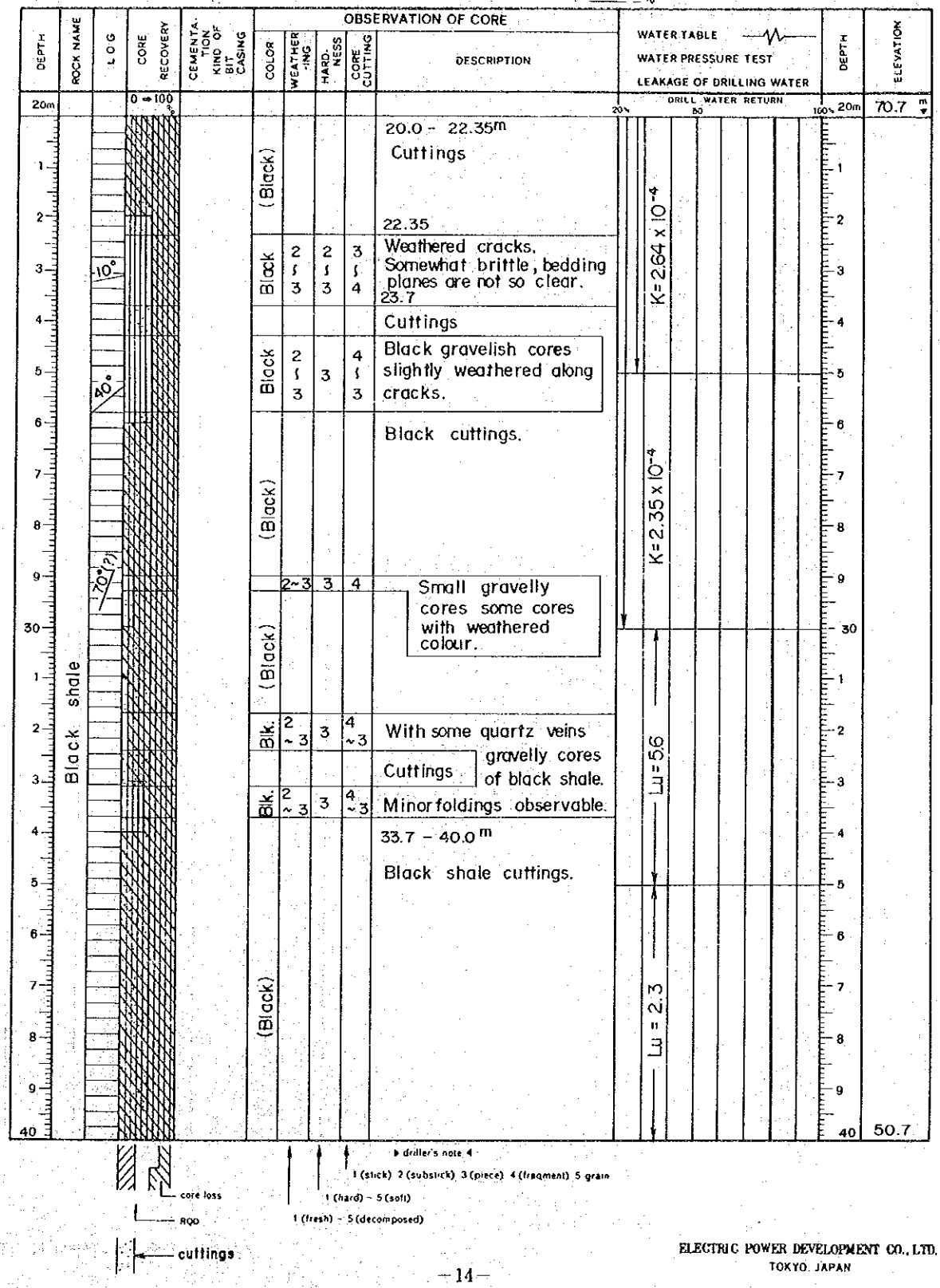
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT — HOLE No. DL-3 (SHEET 2 OF 6)

LOCATION	Dam left bank	DEPTH OF HOLE	120.0 m	COMMENCED	May - 18 - 1983
ELEVATION	90.7 m	DEPTH OF OVERBURDEN	0.35 m	COMPLETED	Jun - 24 - 1983
COORDINATE	1966430.9N 375229.3E	LENGTH OF ROCK DRILLING	119.65 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90 °	TOTAL LENGTH OF CORE	58.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	49.2 %		



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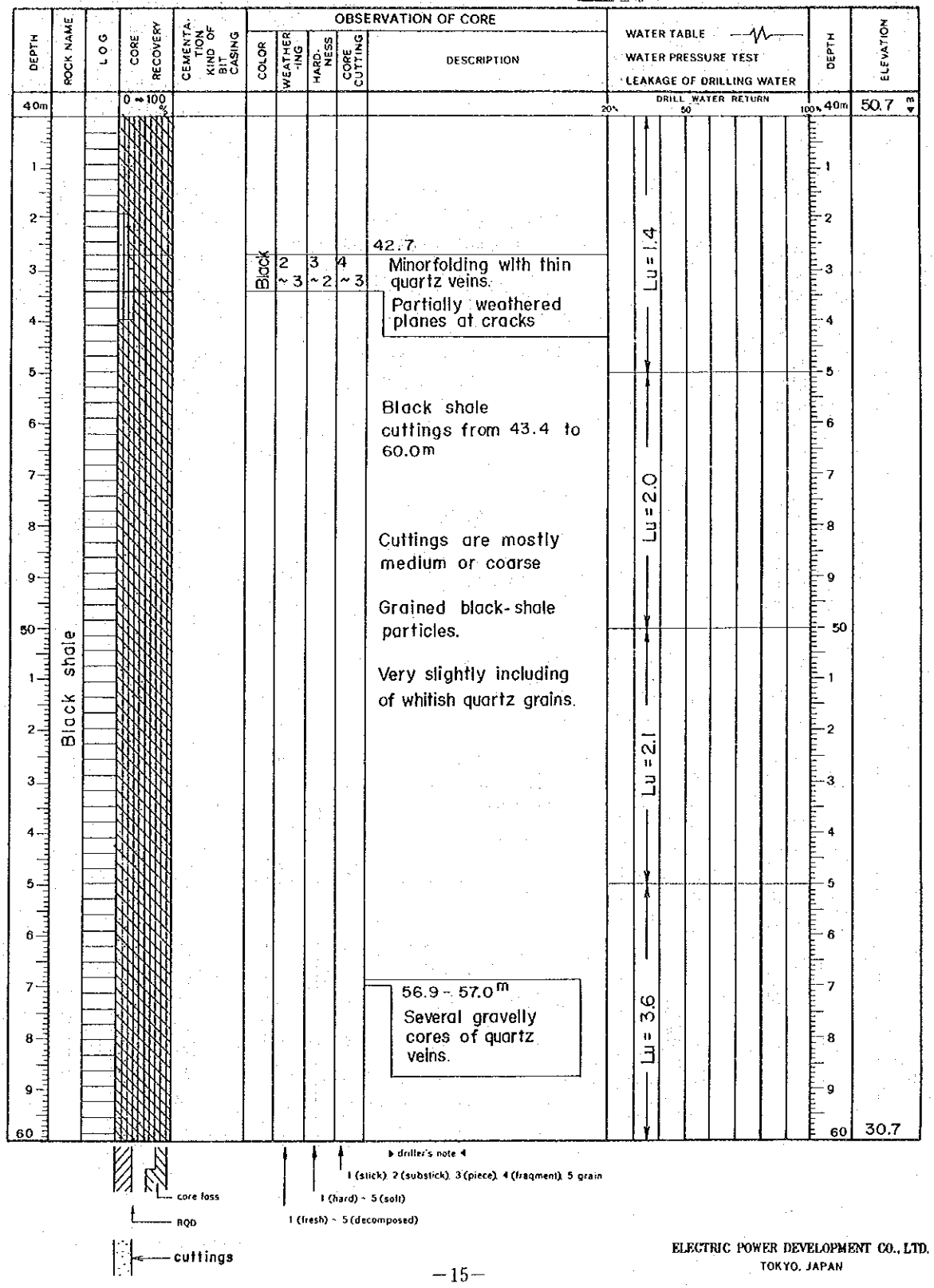
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-3 (SHEET 3 OF 6)

LOCATION	Dam left bank	DEPTH OF HOLE	120.0 m	COMMENCED	May-18 - 1983
ELEVATION	90.7 m	DEPTH OF OVERBURDEN	0.35 m	COMPLETED	Jun-24 - 1983
COORDINATE	1966430.9N 375229.3E	LENGTH OF ROCK DRILLING	119.65 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	58.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	———	CORE RECOVERY	49.2 %		



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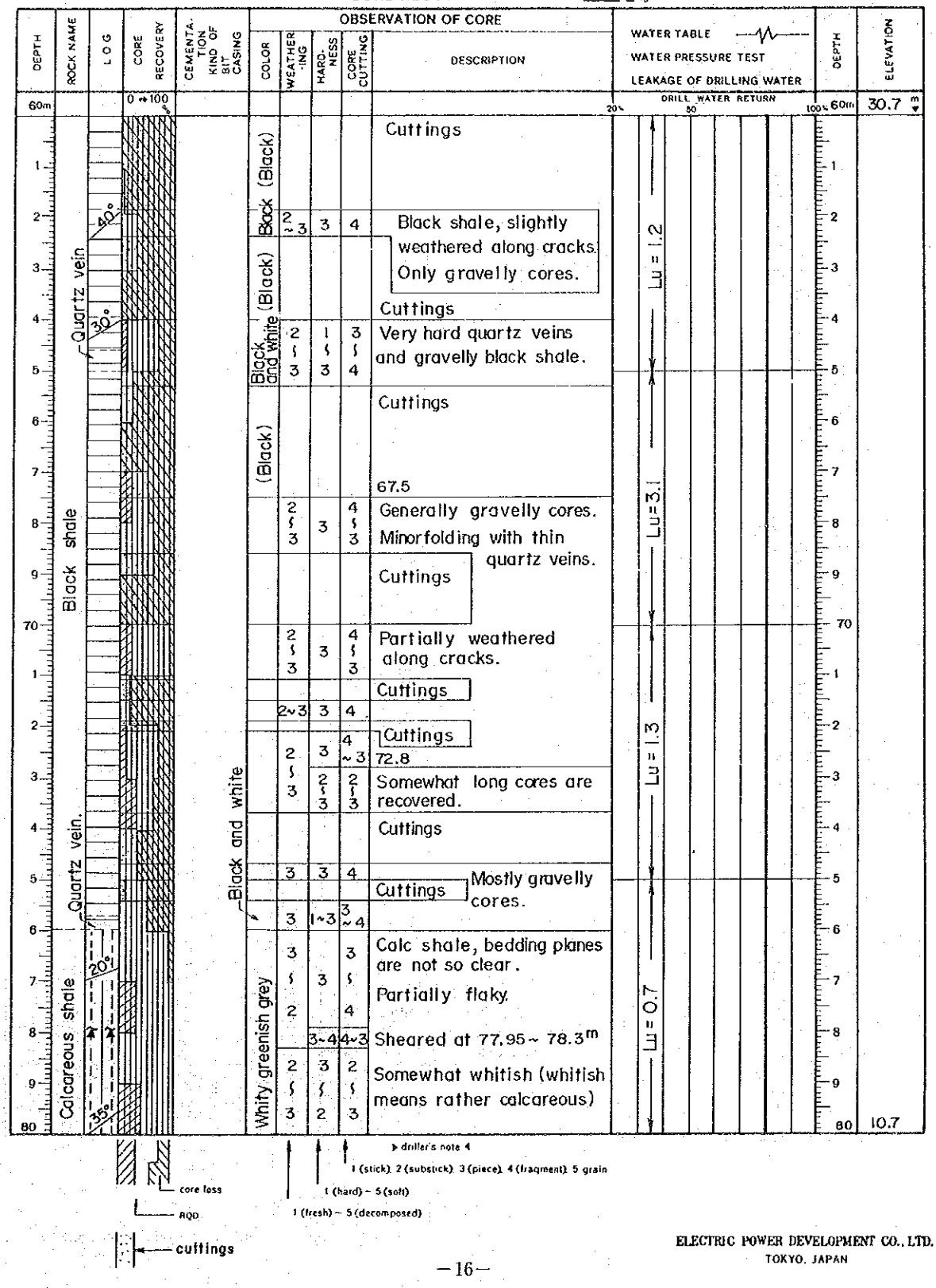
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-3 (SHEET 4 OF 6)

LOCATION	Dam left bank	DEPTH OF HOLE	120.0 m	COMMENCED	May - 18 - 1983
ELEVATION	90.7 m	DEPTH OF OVERBURDEN	0.35 m	COMPLETED	Jun - 24 - 1983
COORDINATE	1966 4309N 375 229.3E	LENGTH OF ROCK DRILLING	119.65 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	58.9 m	LOGGED BY	M.Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	49.2 %		



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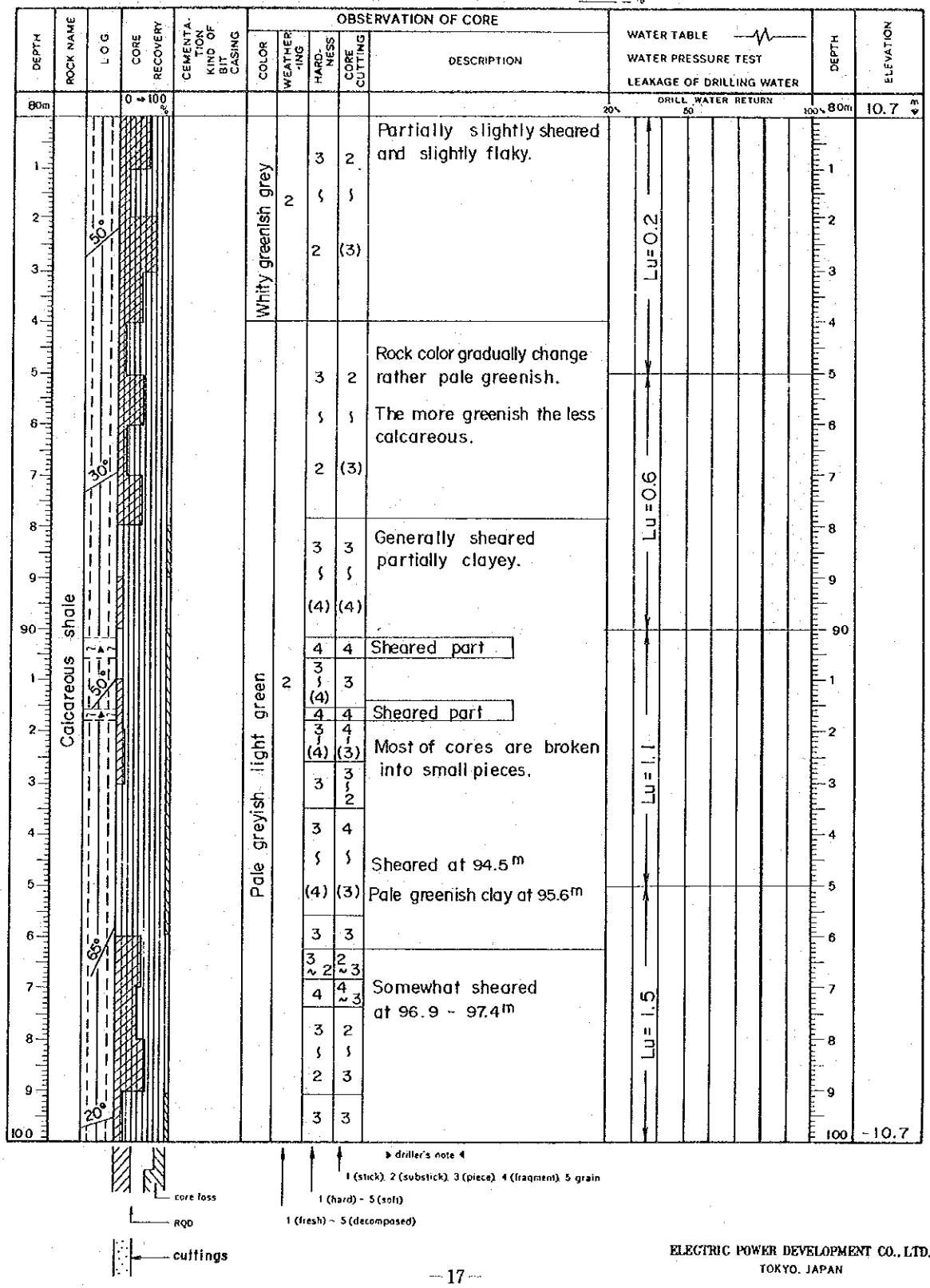
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT — HOLE No. DL-3 (SHEET 5 OF 6)

LOCATION	Dam left bank	DEPTH OF HOLE	120.0 m	COMMENCED	May - 18 - 1983
ELEVATION	90.7 m	DEPTH OF OVERBURDEN	0.35 m	COMPLETED	Jun - 24 - 1983
COORDINATE	9664309N 375229.3E	LENGTH OF ROCK DRILLING	119.65 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	58.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	———	CORE RECOVERY	49.2 %		



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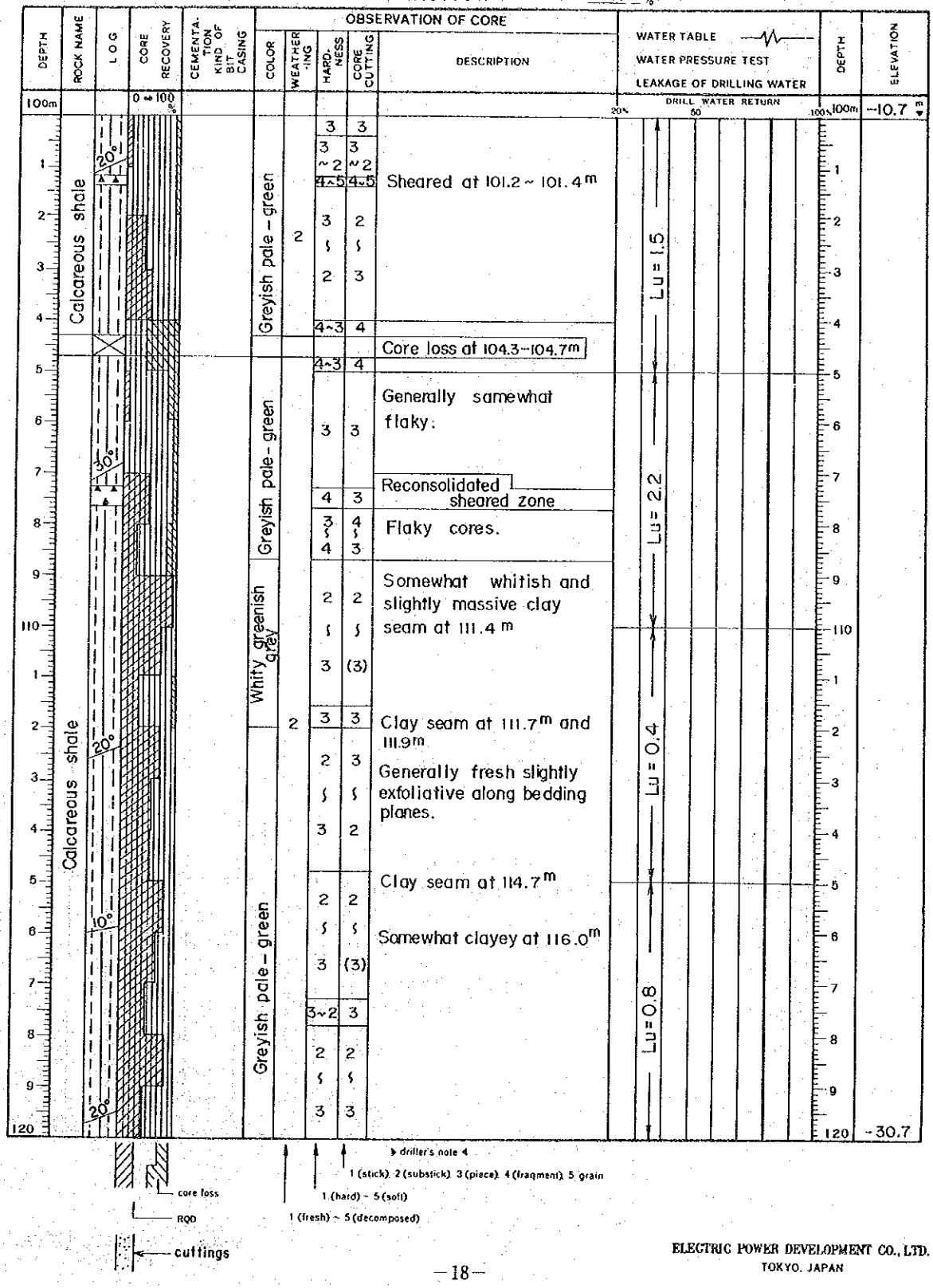
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-3 (SHEET 6 OF 6)

LOCATION	Dam left bank	DEPTH OF HOLE	120.0 m	COMMENCED	May-18-1983
ELEVATION	90.7 m	DEPTH OF OVERBURDEN	0.35 m	COMPLETED	Jun-24-1983
COORDINATE	196643.9N 375229.3E	LENGTH OF ROCK DRILLING	119.65 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	58.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	49.2 %		



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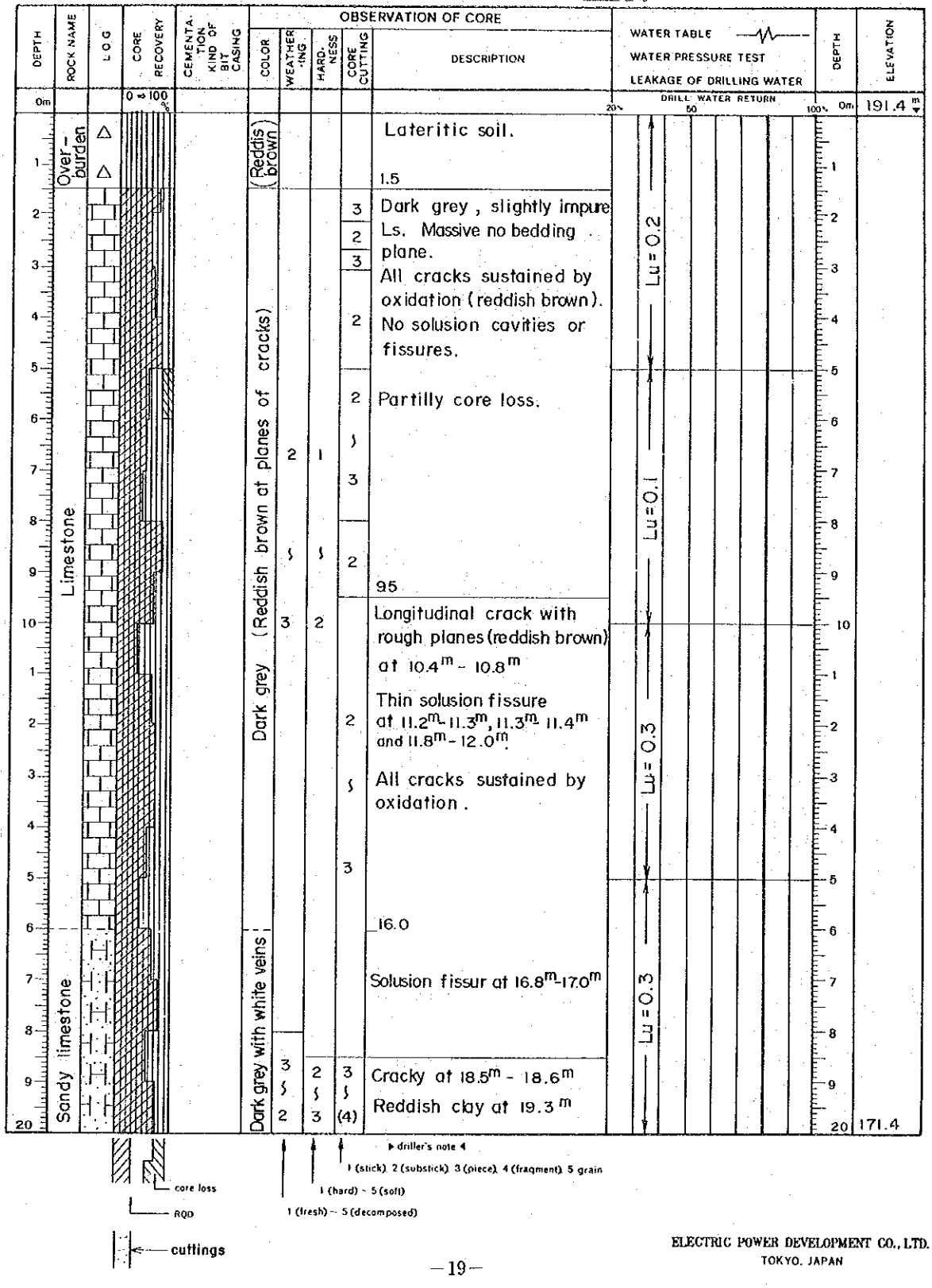
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-4 (SHEET 1 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Jul.-23-1983
ELEVATION	191.4 m	DEPTH OF OVERBURDEN	1.5 m	COMPLETED	Aug.-22-1983
COORDINATE	1965774.5N 375425.7E	LENGTH OF ROCK DRILLING	78.5 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	77.0 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	98.1 %		



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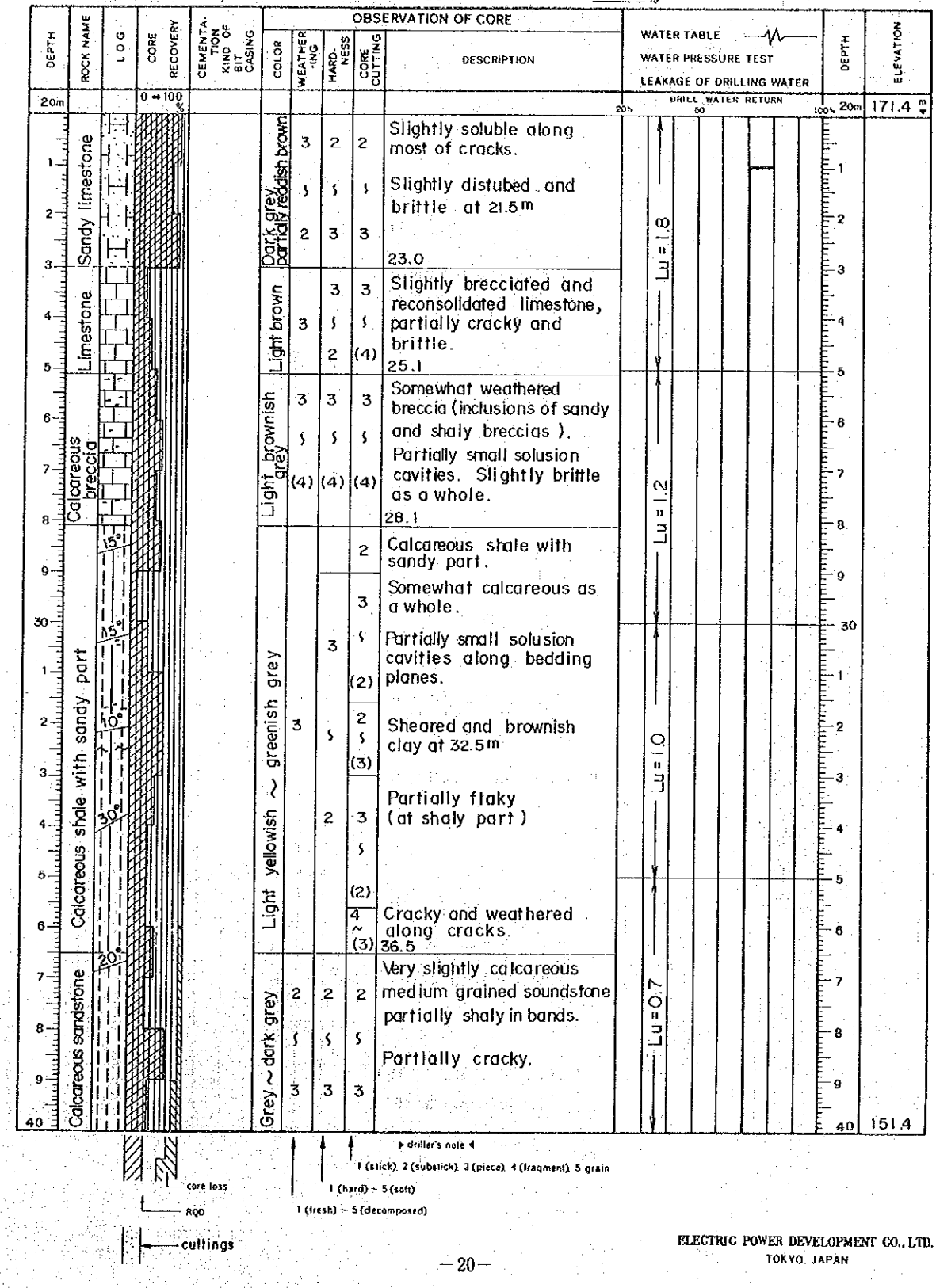
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT — HOLE No. DL-4 (SHEET 2 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Jul. 23 1983
ELEVATION	191.4 m	DEPTH OF OVERBURDEN	1.5 m	COMPLETED	Aug. 22 1983
COORDINATE	1965774.5N 375425.7E	LENGTH OF ROCK DRILLING	78.5 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	77.0 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	98.1 %		



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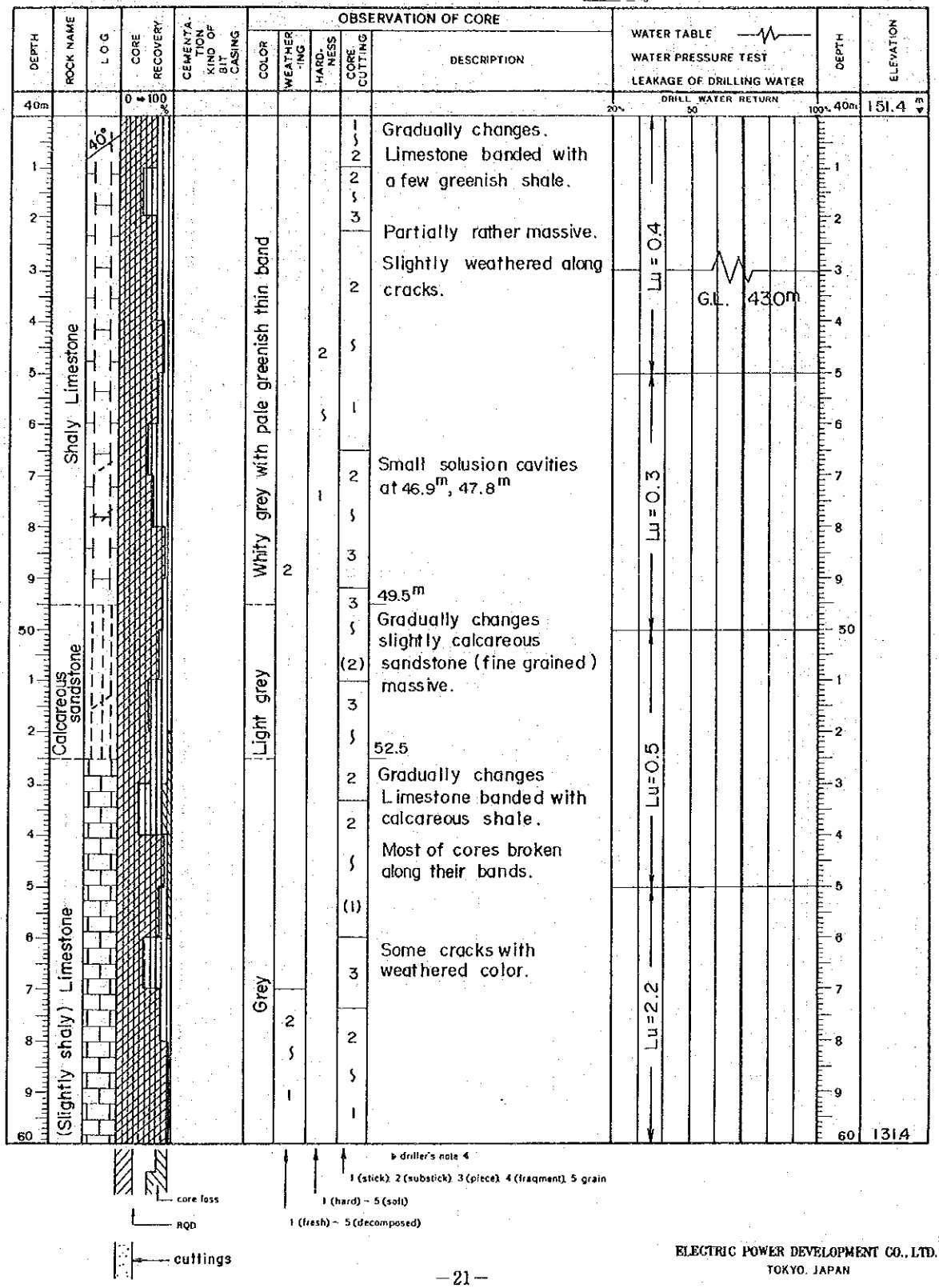
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-4 (SHEET 3 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Jul. - 23 - 1983
ELEVATION	191.4 m	DEPTH OF OVERBURDEN	1.5 m	COMPLETED	Aug. - 22 - 1983
COORDINATE	1965774.5N 375425.7E	LENGTH OF ROCK DRILLING	78.5 m	DRILLED BY	R O E M
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	77.0 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	98.1 %		



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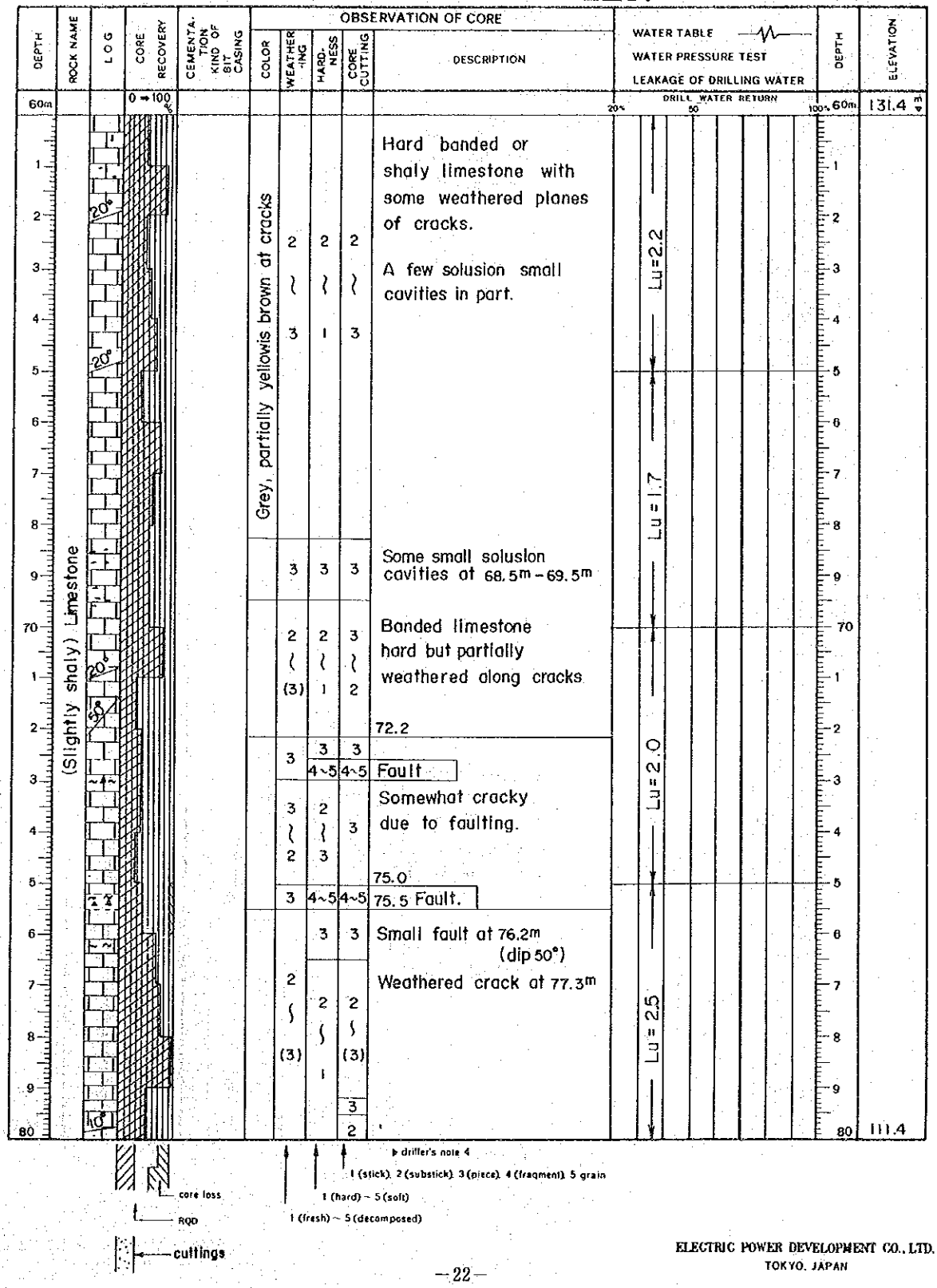
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DL-4 (SHEET 4 OF 4)

LOCATION	Dam left bank	DEPTH OF HOLE	80.0 m	COMMENCED	Jul. - 23 - 1983
ELEVATION	191.4 m	DEPTH OF OVERBURDEN	1.5 m	COMPLETED	Aug. - 22 - 1983
COORDINATE	1965 774.5N 375 425.7E	LENGTH OF ROCK DRILLING	78.5 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	77.0 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	98.1 %		

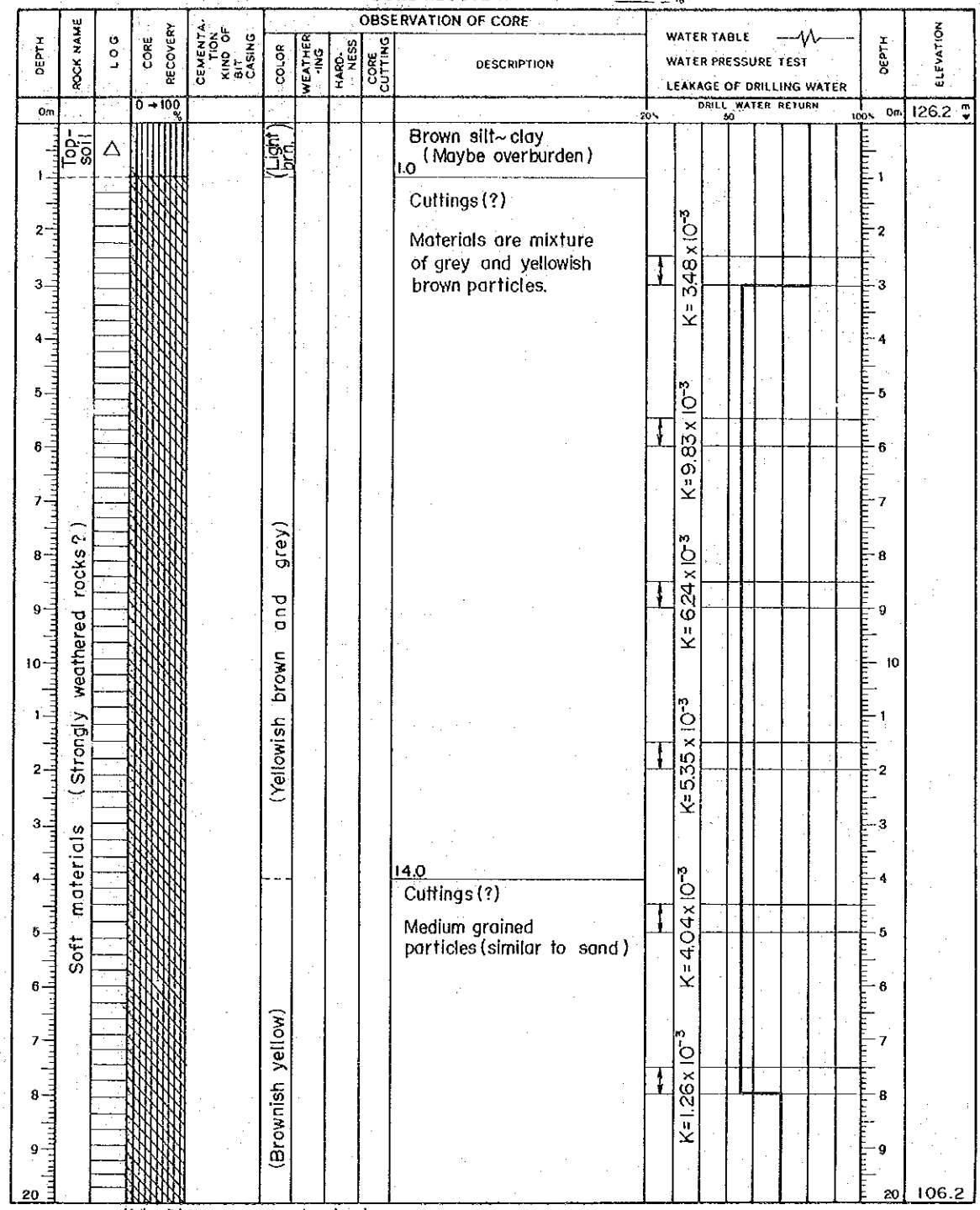


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. S-1 (SHEET 1 OF 3)

LOCATION	Spillway	DEPTH OF HOLE	43.5 m	COMMENCED	Mar. 24 - 1983
ELEVATION	126.2 m	DEPTH OF OVERBURDEN	1.0 m	COMPLETED	Apr. - 2 - 1983
COORDINATE	1966 3953N 375 014.2E	LENGTH OF ROCK DRILLING	42.5 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	6.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	19.2 %		



core loss
RQD
cuttings

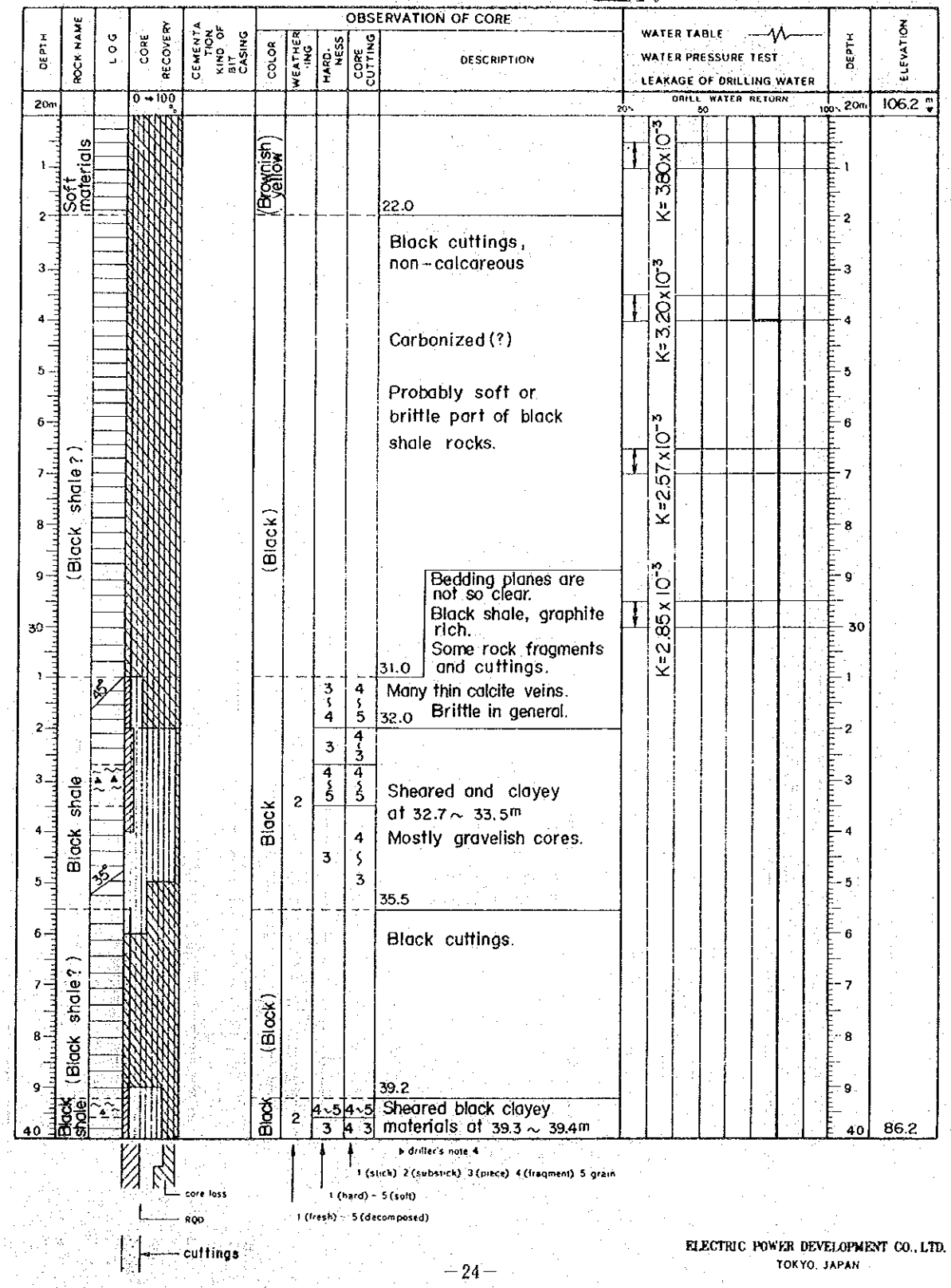
driller's note 4
1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. S-1 (SHEET 2 OF 3)

LOCATION	Spillway	DEPTH OF HOLE	43.5 m	COMMENCED	Mar.-24-1983
ELEVATION	126.2 m	DEPTH OF OVERBURDEN	1.0 m	COMPLETED	Apr.-2-1983
COORDINATE	1966 395.3N 375 014.2E	LENGTH OF ROCK DRILLING	42.5 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	6.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	19.2 %		



ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT — HOLE No. S-1 (SHEET 3 OF 3)

LOCATION	Spillway	DEPTH OF HOLE	43.5 m	COMMENCED	Mar.-24-1983
ELEVATION	126.2 m	DEPTH OF OVERBURDEN	1.0 m	COMPLETED	Apr.-2-1983
COORDINATE	1966395.3N 375014.2E	LENGTH OF ROCK DRILLING	42.5 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	6.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	—	CORE RECOVERY	19.2 %		

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
40m			0 ~ 100 %							20% DRILL WATER RETURN 100%	40m	86.2 m
1–3	Black shale	20°			Black	2	3	4 ⟆ (3)	Generally brittle. Partially calcite veins.		1–3	
							4~5	4~5	Sheared black clayey materials at 41.3 - 41.4m			
							3	4 ⟆ (3)	Black clayey materials at bottom of hole. Bottom of hole at 43.5m			82.7
4–0											4–0	
1–3											1–3	
4–8											4–8	
9–0											9–0	
1–3											1–3	
4–8											4–8	
9–0											9–0	

core loss
RQD
cuttings

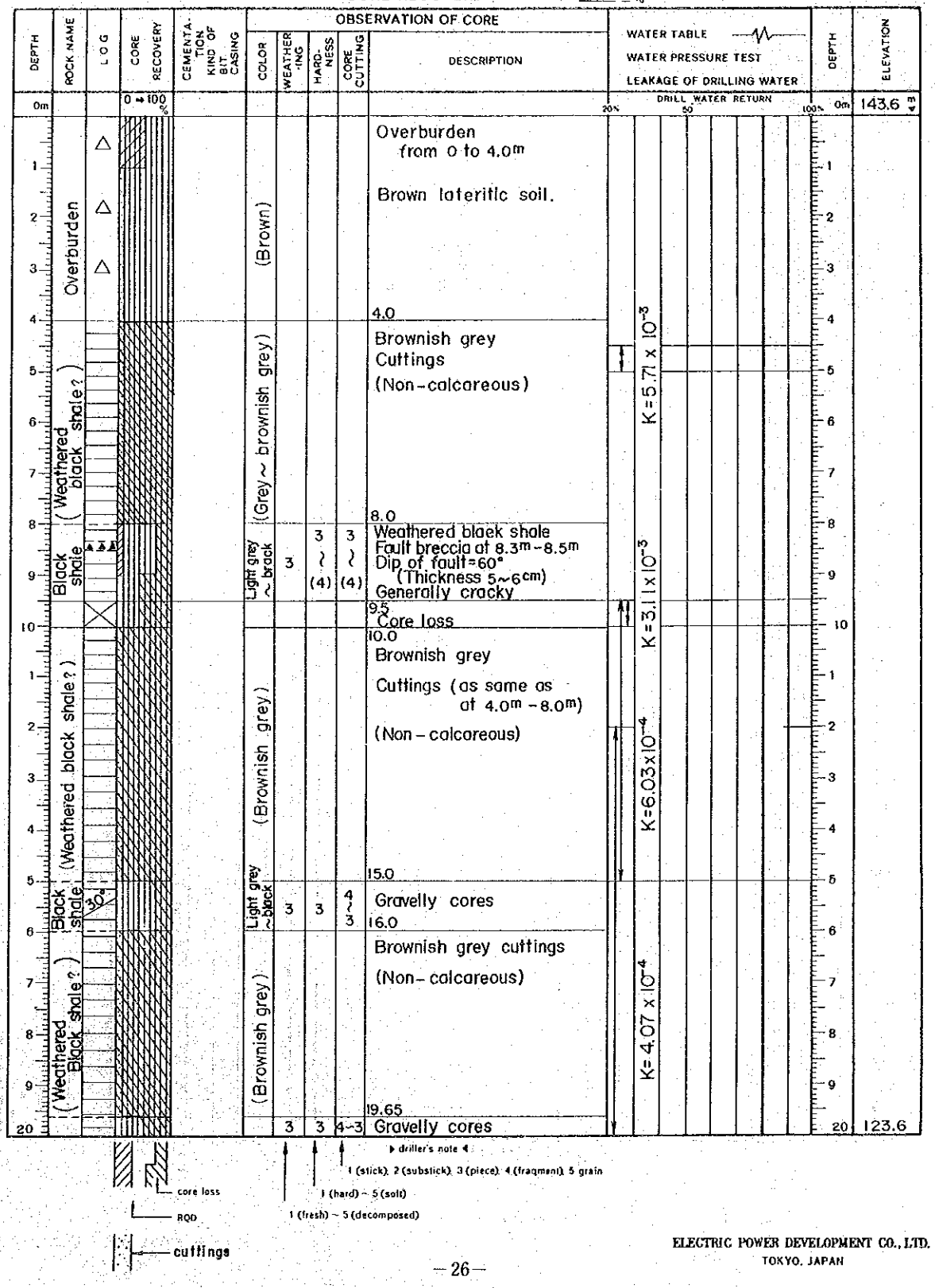
▶ driller's note 4
1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. I - 1 (SHEET 1 OF 2)

LOCATION	Intake	DEPTH OF HOLE	40.0 m	COMMENCED	May - 18 - 1983
ELEVATION	143.6 m	DEPTH OF OVERBURDEN	4.0 m	COMPLETED	Jul - 27 - 1983
COORDINATE	1966516.2N 375483.6E	LENGTH OF ROCK DRILLING	36.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	13.4 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	31.5 %		



ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. I - 1 (SHEET 2 OF 2)

LOCATION	Intake	DEPTH OF HOLE	40.0 m	COMMENCED	May-18-1983
ELEVATION	143.6 m	DEPTH OF OVERBURDEN	4.0 m	COMPLETED	Jul.-27-1983
COORDINATE	196516.2N 375483.6E	LENGTH OF ROCK DRILLING	36.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	13.4 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	31.5 %		

DEPTH	ROCK NAME	LOG	CORE RECOVERY 0 ~ 100 %	CEMENTATION · KIND OF BIT · CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
20m									20.0 Cuttings 21.15
1	(Black) shale?				(Grey)				
2		20°			Light grey	3	3	4 ~ 3	Gravelly cores of wheathed black shale 22.0
3	(Black shale?)				(Black)				Black cuttings 24.0
4		35°							
5	Black shale				Brownish grey ~ black	3	3 ~ (4)	3 ~ 4	Weathered black shale. Partially and slightly brittle. Weathered along some bedding planes and cracks. 27.4
6		30°							
7		15°							
8	(Black shale?)				(Black)				Black cuttings
9		15°						3 ~ (4)	Black shale weathered along cracks and some bedding planes.
30									
1								4	Cores are generally broken into small pieces.
2							3	~ (3)	Partially minor folding. (With quartz veins)
3		15°			Grey ~ black, Partially brown (along cracks)	3	(4)		Generally somewhat cracky rocks.
4									
5	Black shale	40°							
6		30°						3 ~ (4)	Small solusion cavities along calcite veins at 37.4m ~ 37.5m
7		20°							
8		15°				3 ~ (4)	3 ~ (4)		
9									
40						3	3	3	

WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER — DRILL WATER RETURN 20% 50 100%

Lu = 1.1 (20m ~ 30m)
Lu = 1.2 (30m ~ 37.4m)
Lu = 1.7 (37.4m ~ 37.5m)
Lu = 1.1 (37.5m ~ 40m)

DEPTH 20m ~ 40m — ELEVATION 123.6 m ~ 103.6

core loss
RQD
cuttings

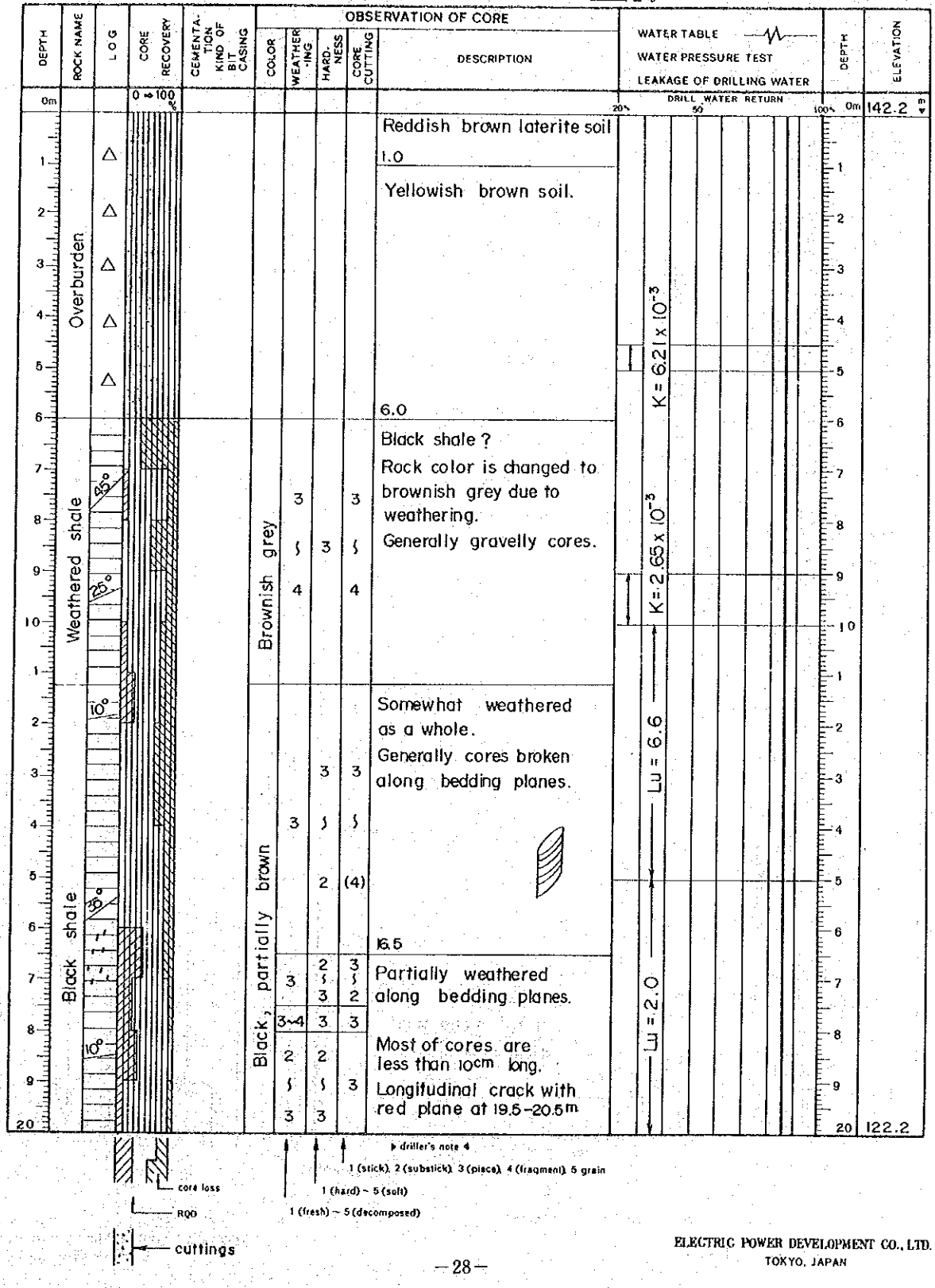
▶ driller's note 4
1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT — HOLE No. DR-1 (SHEET 1 OF 3)

LOCATION	Dam right bank	DEPTH OF HOLE	60.0 m	COMMENCED	Aug.-18-1983
ELEVATION	142.2 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Sep.-1-1983
COORDINATE	1966561.8N 375447.3E	LENGTH OF ROCK DRILLING	54.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	34.8 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	64.4 %		

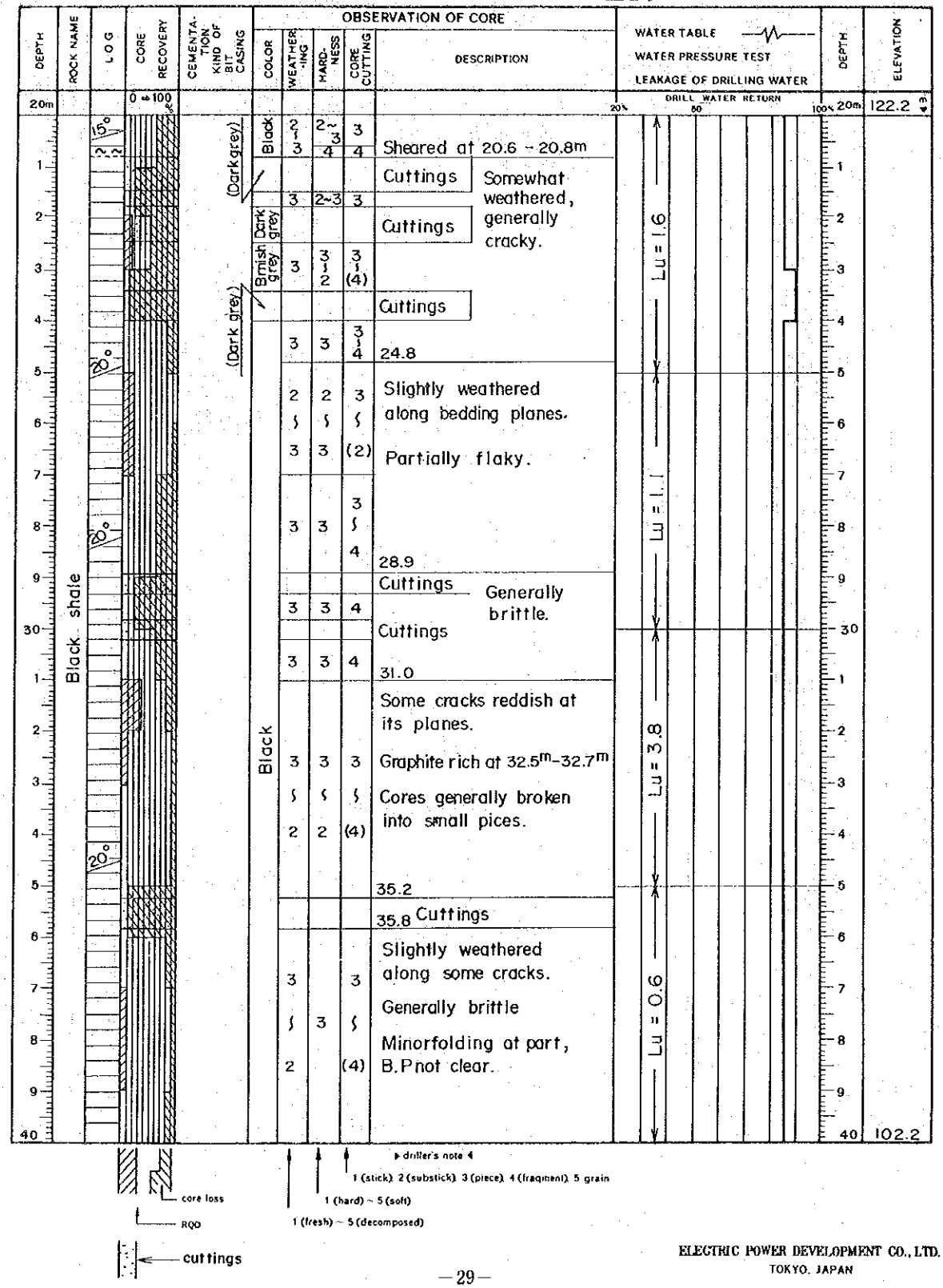


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DR-1 (SHEET 2 OF 3)

LOCATION	Dam right bank	DEPTH OF HOLE	60.0 m	COMMENCED	Aug-18-1983
ELEVATION	142.2 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Sep-1-1983
COORDINATE	1966551.8N 375447.3E	LENGTH OF ROCK DRILLING	54.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	34.8 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	64.4 %		

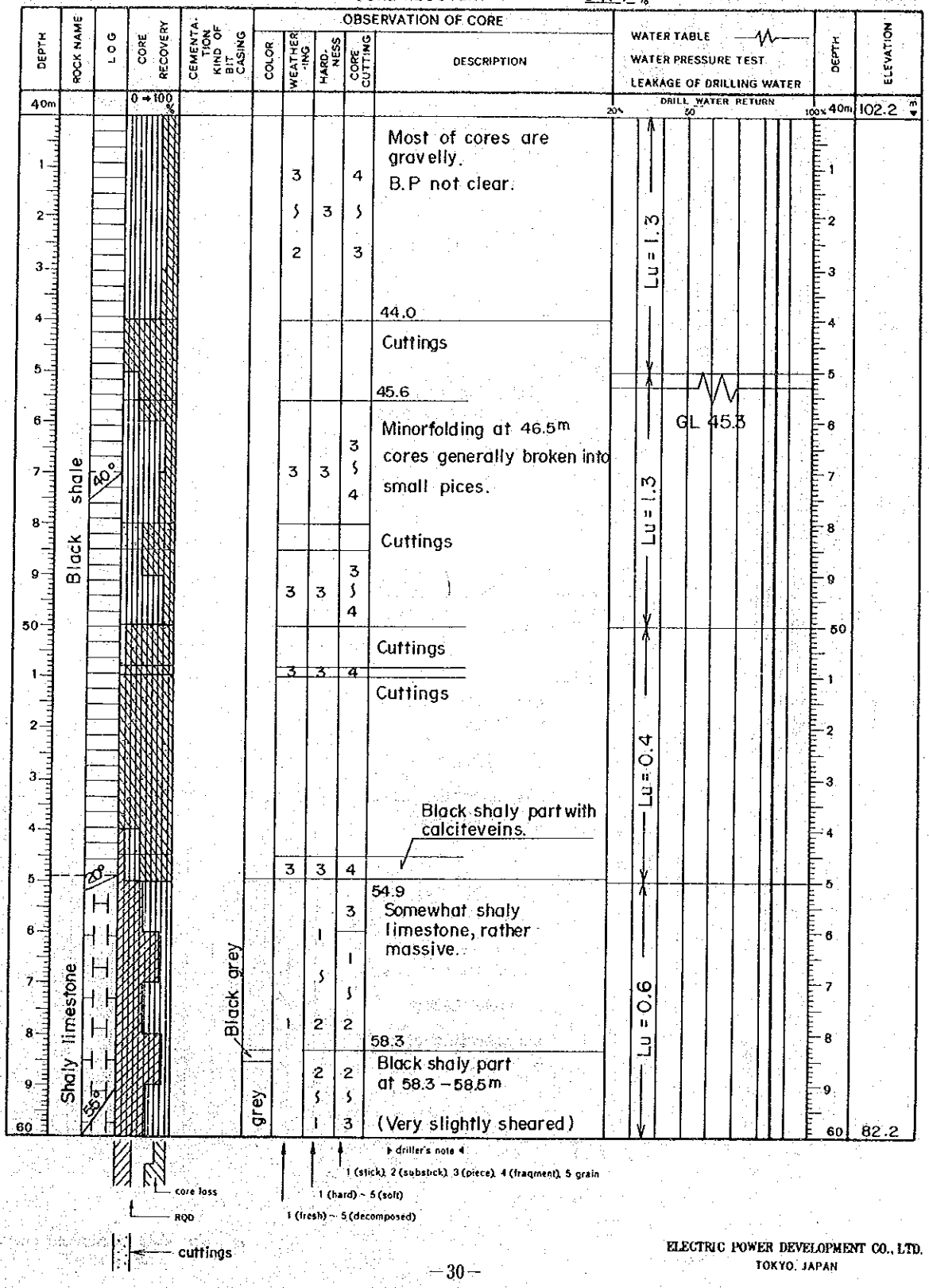


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DR-1 (SHEET 3 OF 3)

LOCATION	Dam right bank	DEPTH OF HOLE	60.0 m	COMMENCED	Aug.-18-1983
ELEVATION	142.2 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Sep-1-1983
COORDINATE	1966 551.8N 375 447.3E	LENGTH OF ROCK DRILLING	54.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90 °	TOTAL LENGTH OF CORE	34.8 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	64.4 %		



ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DR-2 (SHEET 1 OF 4)

LOCATION	Dam right bank	DEPTH OF HOLE	80.0 m	COMMENCED	Sep-10-1983
ELEVATION	103.9 m	DEPTH OF OVERBURDEN	2.0 m	COMPLETED	Oct.-14-1983
COORDINATE	1966502.2N 375412.9E	LENGTH OF ROCK DRILLING	78.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	52.95 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	67.9 %		

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
0m			0 → 100 %						
1–2	Overburden (Black shale ?)	△			Yell. brn.	Materials obtained from the hole are in plastic		sacks.	0 – 1.0 m Silt, sand, small gravels and rock fragments
2–3		△			Yell. brn.				1.0 – 2.0 m Silt, sand, small rock fragments.
3–4					Dark grey				2.0 – 3.0 m Dark grey cuttings (non-calcareous)
4–5	Black shale	88			Dark grey				3.0 – 4.0 Dark grey cuttings 4.0 (non-calcareous)
5–6		20°			Dark grey ~ black	3	3	4 5 3	Black shale, weathered along cracks and some bedding planes generally cracks 6.4
7–8					Black	2 3	2	3 (5) (4)	Hard shale, some cracks are sustained by oxidation in reddish colour. 7.9
8–20	(Black shale ?)				(Black)				7.9 – 21.90 Obtained only cuttings. Black cuttings at 7.9 m – 20.0 m

WATER TABLE
WATER PRESSURE TEST
LEAKAGE OF DRILLING WATER
DRILL WATER RETURN 20% 50 100%

$K = 2.21 \times 10^{-3}$
$K = 2.94 \times 10^{-3}$
$K = 1.74 \times 10^{-3}$
$K = 1.75 \times 10^{-3}$

DEPTH 0m

ELEVATION 103.9 m
83.9

▶ driller's note 4

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 grain
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

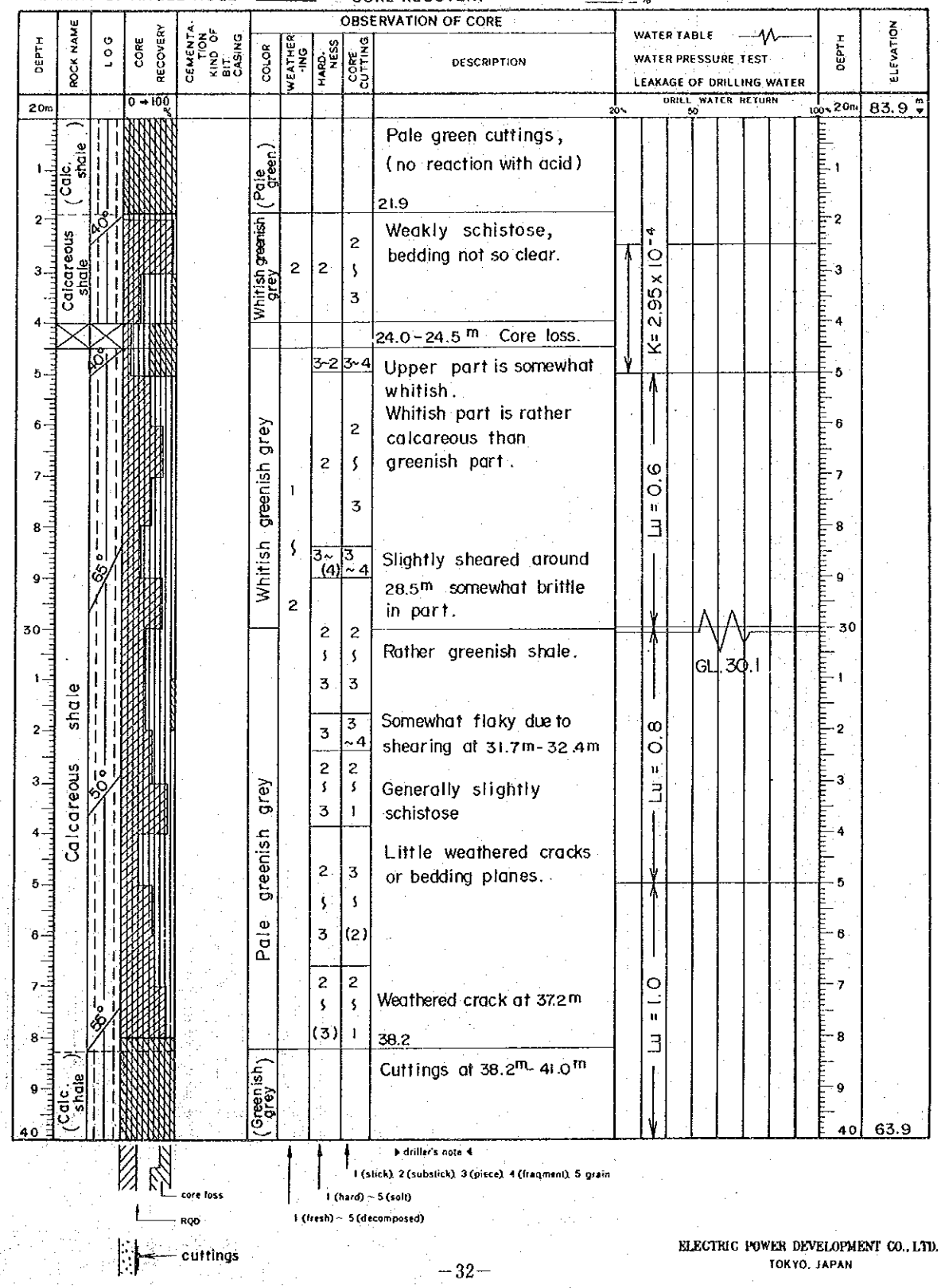
core loss
RQD
cuttings

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DR-2 (SHEET 2 OF 4)

LOCATION	Dam right bank	DEPTH OF HOLE	80.0 m	COMMENCED	Sep-10-1983
ELEVATION	103.9 m	DEPTH OF OVERBURDEN	2.0 m	COMPLETED	Oct.-14-1983
COORDINATE	1966 502.2N 3754 12.9E	LENGTH OF ROCK DRILLING	78.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	52.95 m	LOGGED BY	M.Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	67.9 %		

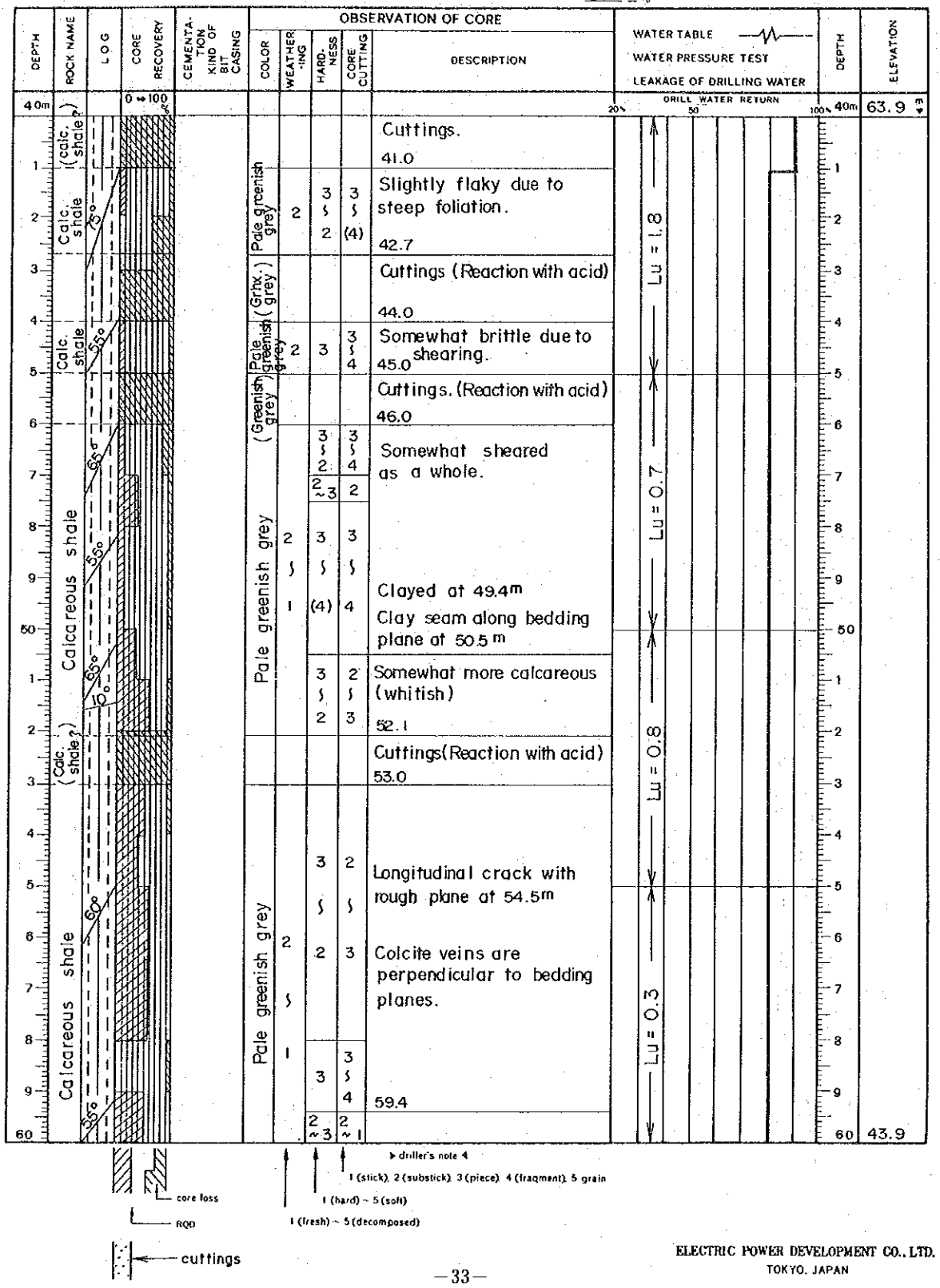


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DR-2 (SHEET 3 OF 4)

LOCATION	Dam right bank	DEPTH OF HOLE	80 m	COMMENCED	Sep-10-1983
ELEVATION	103.9 m	DEPTH OF OVERBURDEN	2.0 m	COMPLETED	Oct.-14-1983
COORDINATE	1966502.2N 375412.9E	LENGTH OF ROCK DRILLING	78.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	52.95 m	LOGGED BY	M.Shibata
BEARING OF ANGLE HOLE	———	CORE RECOVERY	67.9 %		

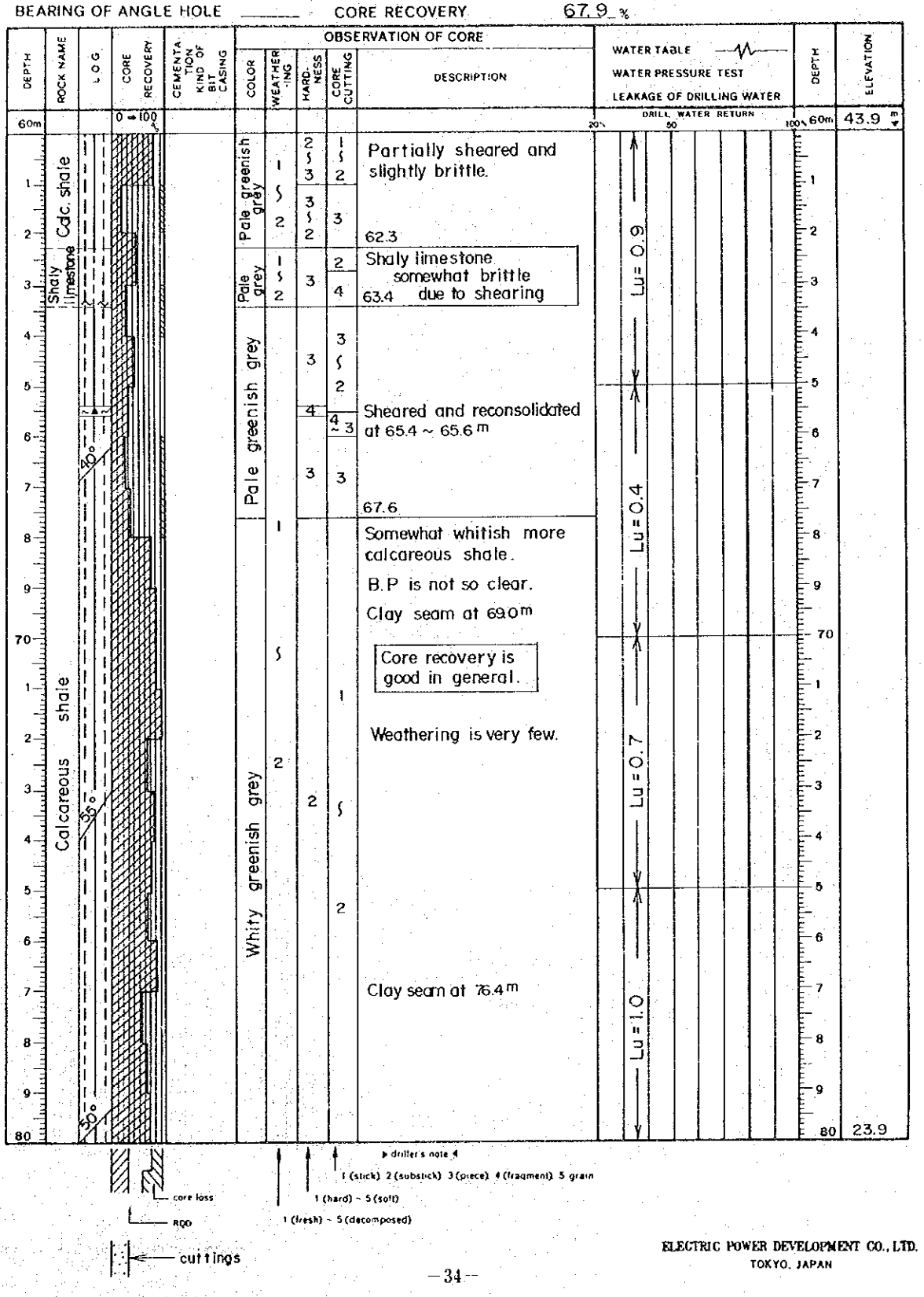


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DR-2 (SHEET 4 OF 4)

LOCATION	Dam right bank	DEPTH OF HOLE	80.0 m	COMMENCED	Sep. 10 1983
ELEVATION	103.9 m	DEPTH OF OVERBURDEN	2.0 m	COMPLETED	Oct. 14 1983
COORDINATE	1966 502.2N 375 412.9E	LENGTH OF ROCK DRILLING	78.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	52.95 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	———	CORE RECOVERY	67.9 %		

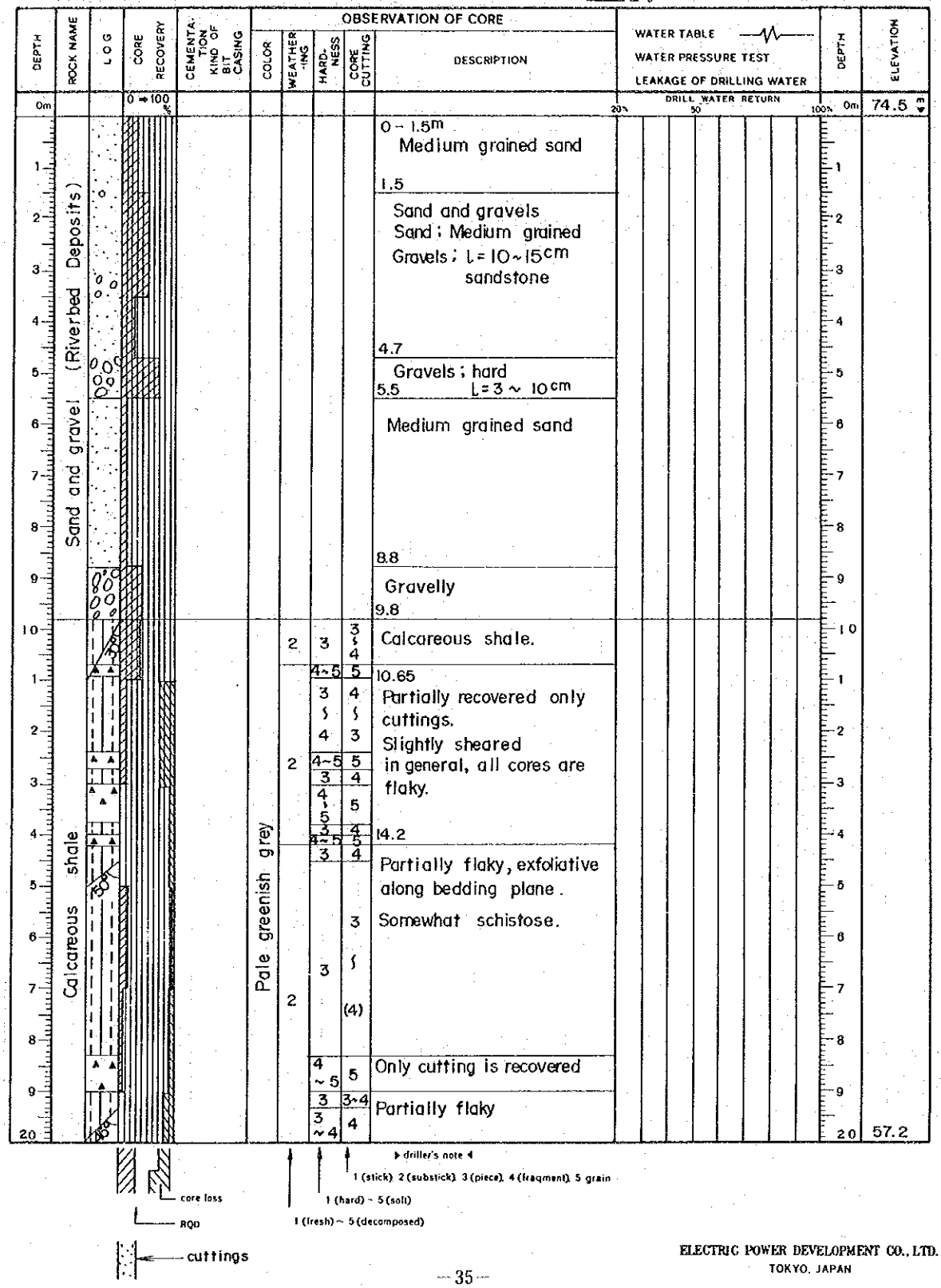


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DU-1 (SHEET 1 OF 2)

LOCATION	Dam upstream	DEPTH OF HOLE	22.0 m	COMMENCED	– –
ELEVATION	74.5 m	DEPTH OF OVERBURDEN	9.8 m	COMPLETED	– –
COORDINATE	1966424.9N 375397.6E	LENGTH OF ROCK DRILLING	12.2 m	DRILLED BY	
ANGLE FROM HORIZONTAL	60°	TOTAL LENGTH OF CORE	10.6 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	S59°W	CORE RECOVERY	86.9 %		



ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

Page

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DU-1 (SHEET 2 OF 2)

LOCATION	Dam upstream	DEPTH OF HOLE	22.0 m	COMMENCED	- -
ELEVATION	74.5 m	DEPTH OF OVERBURDEN	9.8 m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	12.2 m	DRILLED BY	
ANGLE FROM HORIZONTAL	60°	TOTAL LENGTH OF CORE	10.6 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	S59°W	CORE RECOVERY	86.9 %		

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: DRILL WATER RETURN	DEPTH	ELEVATION
20m			0 → 100 %							20% 50 100%	20m	57.2 m
1	Calcareous shale	50°			Pale greenish grey	2	3 (4)	3 4	Partially minorfolding with calcite veins		1	
2											2	55.5
									End of hole at 22m			
3–9, 0–9											3–9, 0–9	

core loss
RQD
cuttings

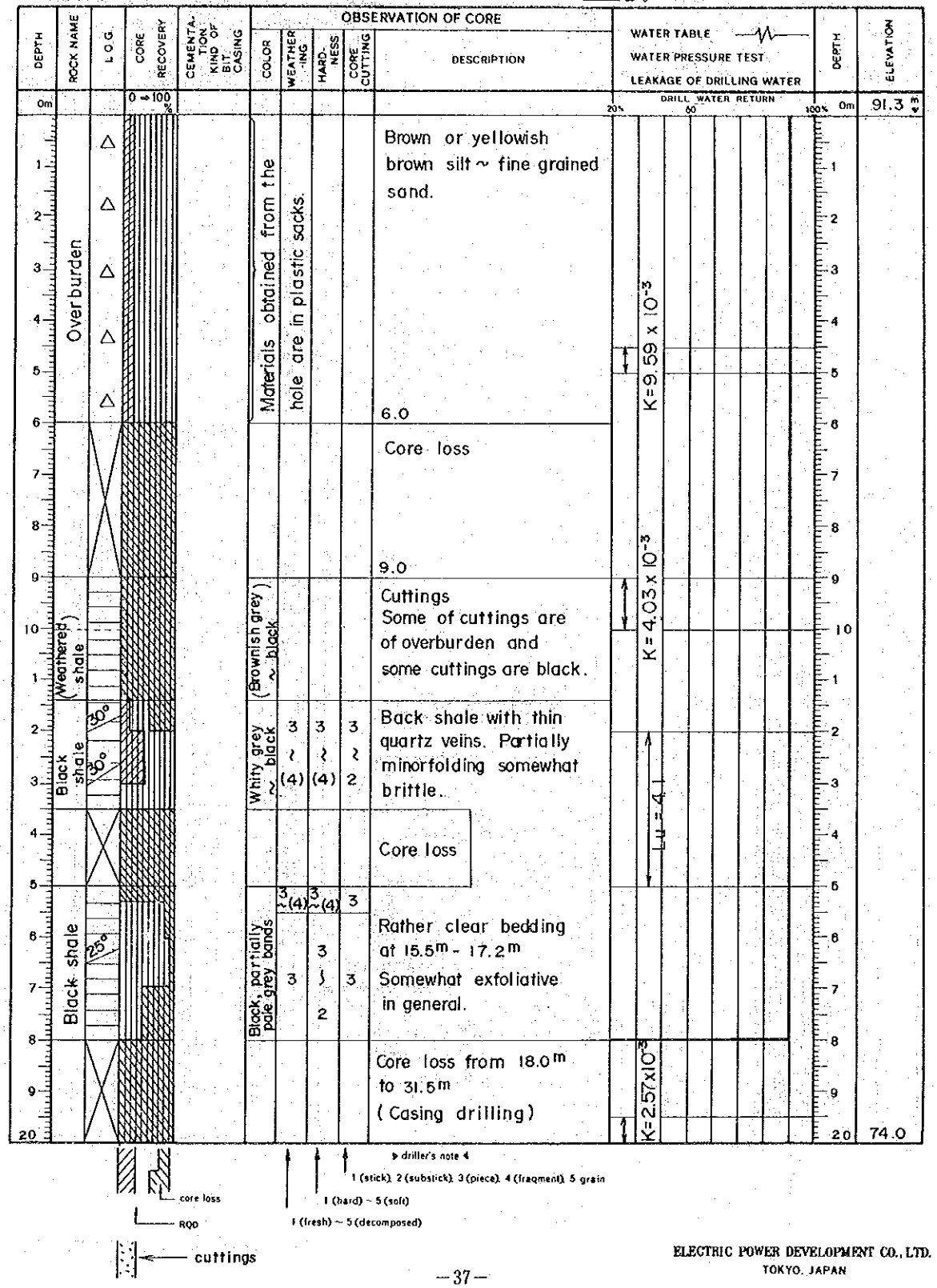
▶ driller's note ◀
1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 grain
1 (hard) ~ 5 (soil)
1 (fresh) ~ 5 (decomposed)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DU-2 (SHEET 1 OF 6)

LOCATION	Dam upstream	DEPTH OF HOLE	120.0 m	COMMENCED	Sep. - 3 - 1983
ELEVATION	91.3 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Oct. - 21 - 1983
COORDINATE	1966 333.3N 375 398.2E	LENGTH OF ROCK DRILLING	114.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	60 °	TOTAL LENGTH OF CORE	79.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	N31°E	CORE RECOVERY	70.1 %		

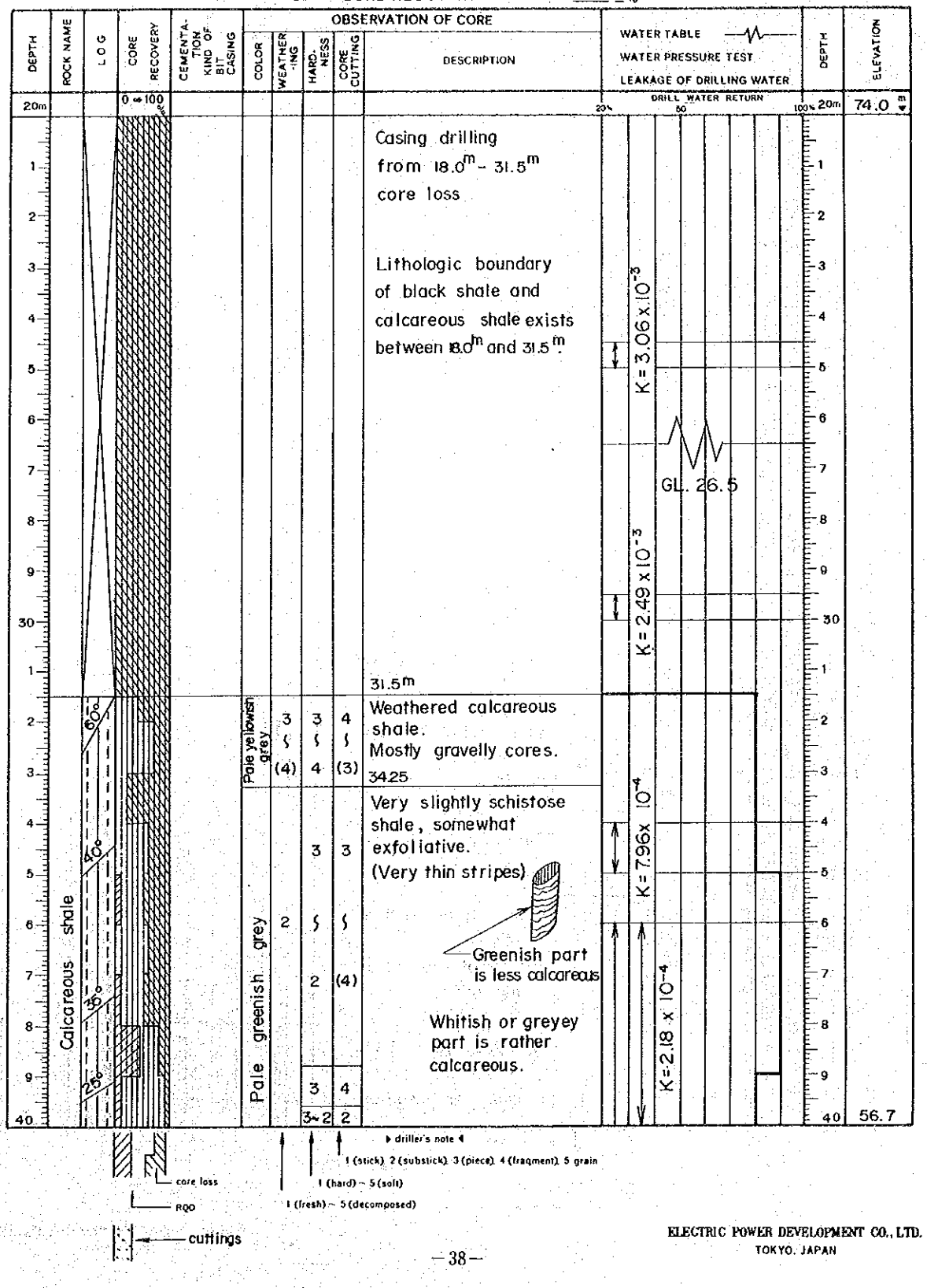


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DU-2 (SHEET 2 OF 6)

LOCATION	Dam upstream	DEPTH OF HOLE	120.0 m	COMMENCED	Sep. - 3 - 1983
ELEVATION	91.3 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Oct. - 21 - 1983
COORDINATE	966 333.3N 375 398.2E	LENGTH OF ROCK DRILLING	114.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	60°	TOTAL LENGTH OF CORE	79.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	N31°E	CORE RECOVERY	70.1 %		

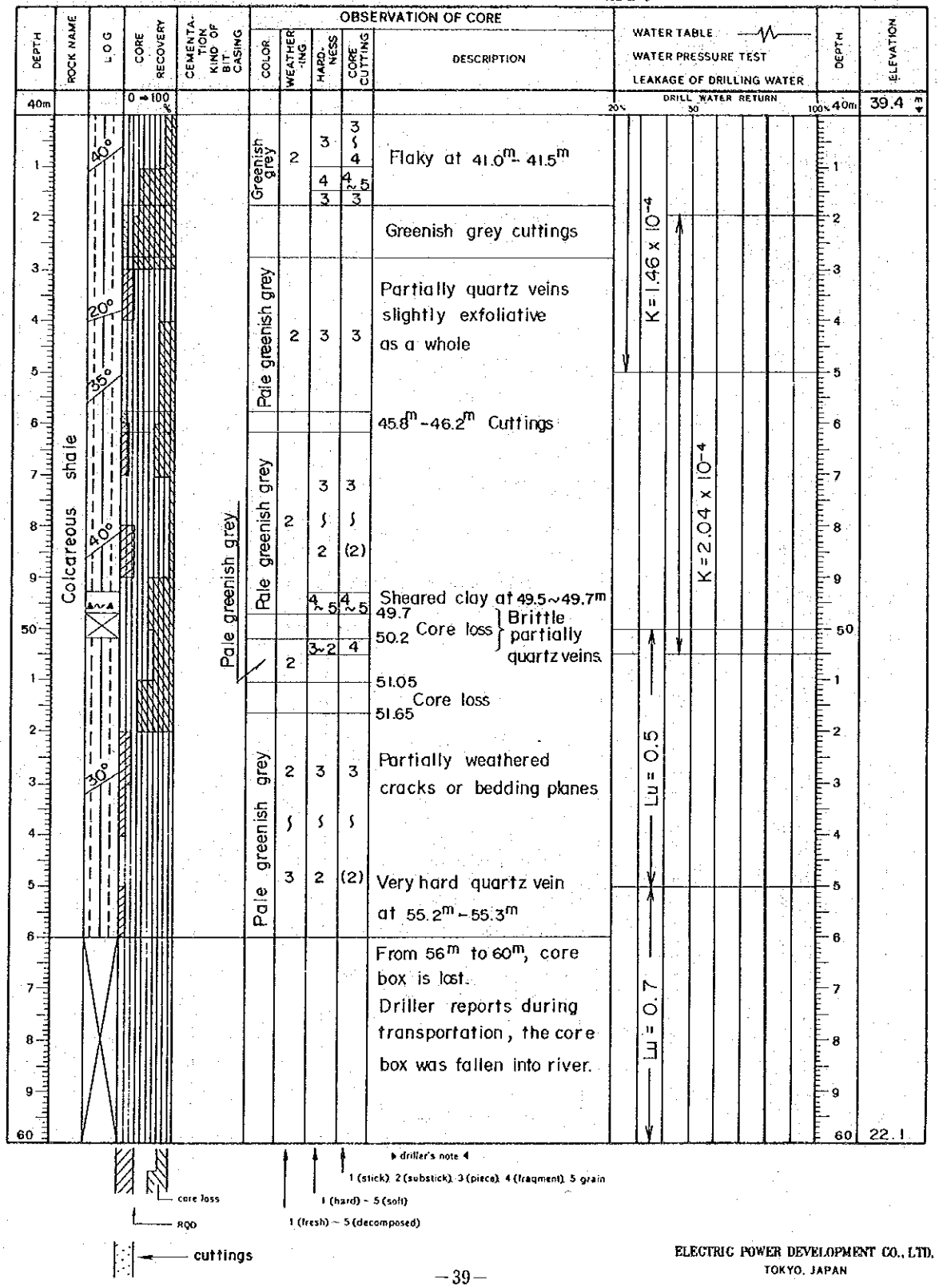


ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DU-2 (SHEET 3 OF 6)

LOCATION	Dam upstream	DEPTH OF HOLE	120.0 m	COMMENCED	Sep. - 3 - 1983
ELEVATION	91.3 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Oct. - 21 - 1983
COORDINATE	1966333.3N 375398.2E	LENGTH OF ROCK DRILLING	114.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	60°	TOTAL LENGTH OF CORE	79.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	N31E	CORE RECOVERY	70.1 %		



ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DU-2 (SHEET 4 OF 6)

LOCATION	Dam upstream	DEPTH OF HOLE	120.0 m	COMMENCED	Sep. - 3 - 1983
ELEVATION	91.3 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Oct. - 21 - 1983
COORDINATE	1966 333.3N375 398.2E	LENGTH OF ROCK DRILLING	114.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	60°	TOTAL LENGTH OF CORE	79.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	N31E	CORE RECOVERY	70.1 %		

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 %							DRILL WATER RETURN 20% 50 100%	60m	22.1
1–4	Calcareous shale	25°, 20°, 15°			Pail greenish grey	2	3, ⟆, (4)	3, ⟆, (4)	Quartz veins at 60.6m - 60.7m and 61.55 - 61.65m Somewhat brecciated in part and brittle.	Lu = 1.2	1–4	
									64.6m			
5–7	Fault zone	65°, 30°			Pale greenish grey	3 ⟆ 2	4, 3 ⟆ 4, 4	4 ⟆ 3, 3, 3 ≳ 4	Fault zone with clay and breccia and sheared rocks. Generally brittle. (Sheared at shaly part) Not sheared at limestone	Lu = 0.6	5–7	
									67.6m			
8–70	Shaly limestone	35°			Grey with thin grey, partially light yellowish grey	3 ⟆ 2	2, ⟆, 1, 2 ⟆ 3, 2 ⟆ 1	2, ⟆, 3, 3 ⟆ (4), 2, ⟆ 3, 3	Very slightly weathered as a whole. Most of cracks somewhat weathered. Slightly banded and shaly. Sheared and brecciated at 73.4 - 73.5m (reconsdidated) Weathered a long cracks. Slightly banded (with greyish stripes) limestone. Partially slightly weathered along cracks or cross joints.	Lu = 0.7 Lu = 0.5	70–80	
		80°, 45°							Clay seam at 79.8m			4.8

core loss
RQD
cuttings

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

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. DU-2 (SHEET 5 OF 6)

LOCATION	Dam upstream	DEPTH OF HOLE	120.0 m	COMMENCED	Sep. 3 1983
ELEVATION	91.3 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	Oct. - 21 -1983
COORDINATE	1966 333.3N 375 398.2E	LENGTH OF ROCK DRILLING	114.0 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	60 °	TOTAL LENGTH OF CORE	79.9 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	N31E	CORE RECOVERY	70.1 %		

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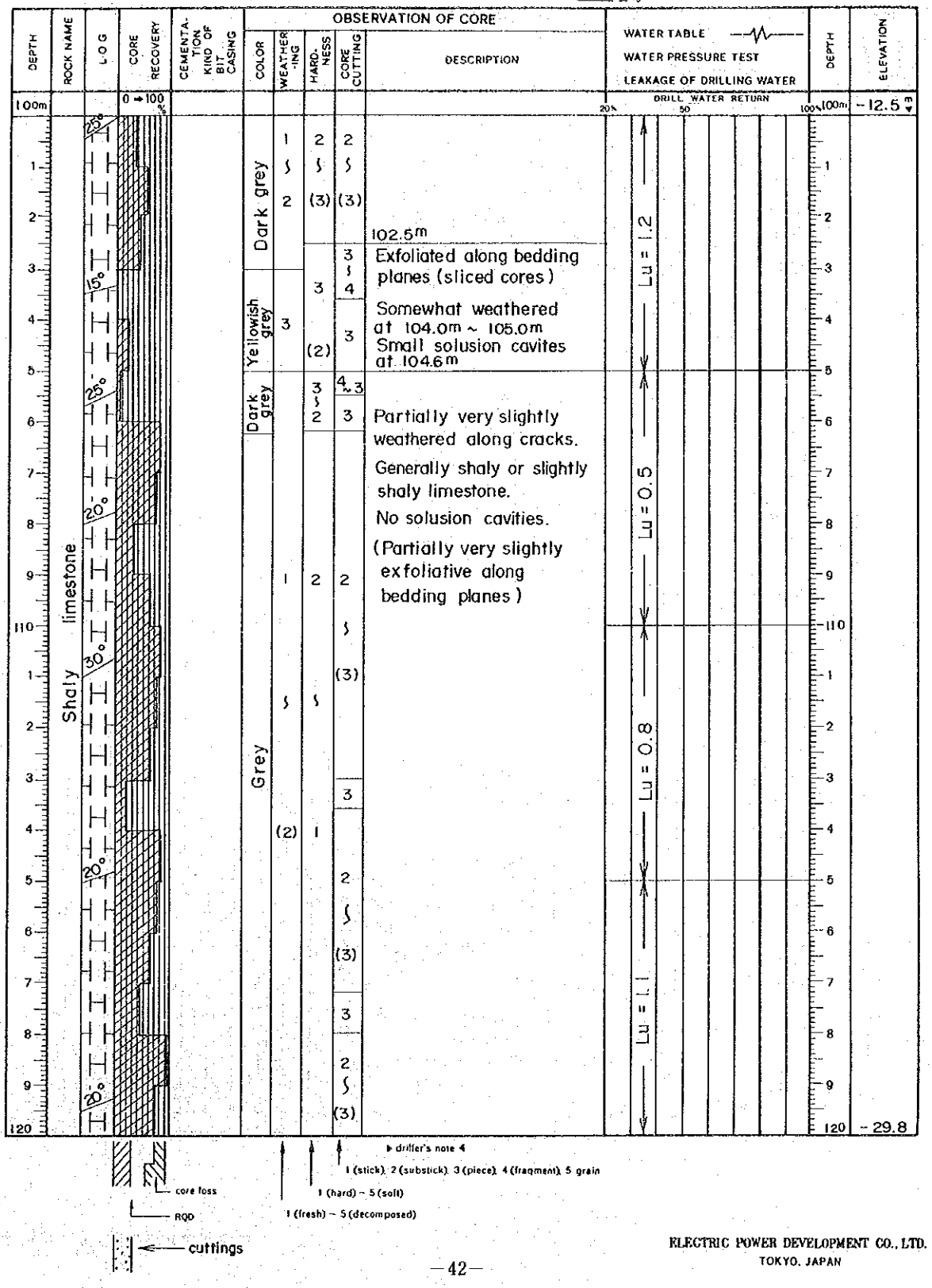

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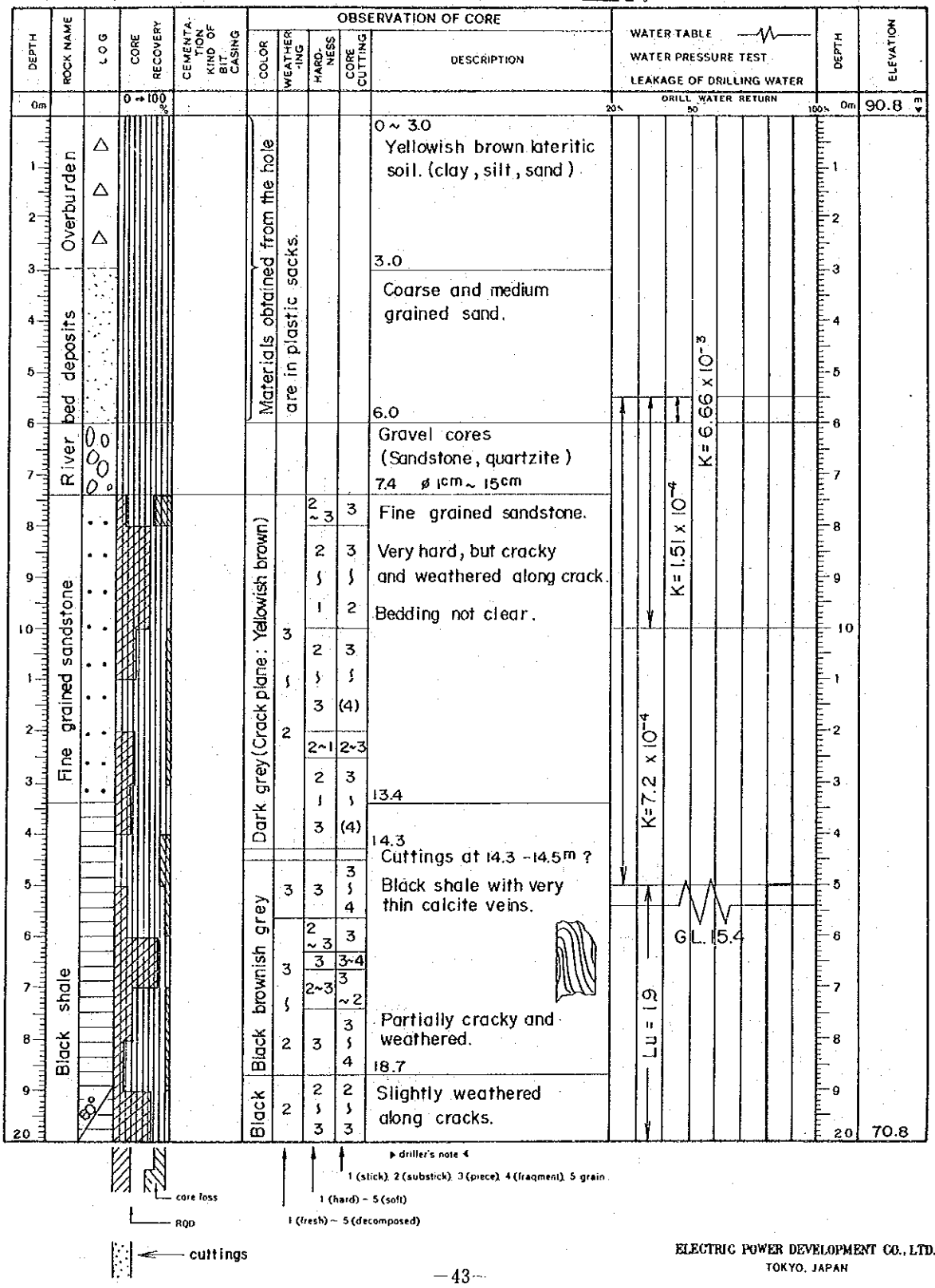
GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. P-1 (SHEET 1 OF 2)

LOCATION	Power house	DEPTH OF HOLE	40.0 m	COMMENCED	Oct.-19-1983
ELEVATION	90.8 m	DEPTH OF OVERBURDEN	7.4 m	COMPLETED	Oct.-23-1983
COORDINATE	1966 669.5N 375 088.3E	LENGTH OF ROCK DRILLING	32.6 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	31.5 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE		CORE RECOVERY	96.6 %		



ELECTRIC POWER DEVELOPMENT CO., LTD.
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GEOLOGIC LOG OF DRILL HOLE

Nam Yuam PROJECT HOLE No. P – 1 (SHEET 2 OF 2)

LOCATION	Power house	DEPTH OF HOLE	40.0 m	COMMENCED	Oct - 19 - 1983
ELEVATION	90.8 m	DEPTH OF OVERBURDEN	7.4 m	COMPLETED	Oct. - 23 - 1983
COORDINATE	966 669.5N 375 088.3E	LENGTH OF ROCK DRILLING	32.6 m	DRILLED BY	ROEM
ANGLE FROM HORIZONTAL	90 °	TOTAL LENGTH OF CORE	31.5 m	LOGGED BY	M. Shibata
BEARING OF ANGLE HOLE	———	CORE RECOVERY	96.6 %		

DEPTH	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION KIND OF BIT CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION
20m			0 ⇒ 100 %						
1	Black shale	50°			Black	2	2	2	Small solusion cavities along
						≷ 3		≷ 3	20.7 colcite veins at 20.7m
								3	
2								2	Very slightly weathered
								3	along bedding planes or joints.
3						2	2	2	
									Partially exfoliative along bedding planes.
4		55°				≷	≷	3	
								≷	Some planes of cross joints are smooth.
5								2	
						1	(3)	2	(with dark greenish mineral- chlorite ?)
6								≷	
								(3)	
7								3	
								≷	
8									
								(4)	29.0
9		45°							
30									Generally few cracks, partially cross joints with calcite veins.
1						1	2	2	No weathering at 29.0 – 33.5m
2		30°							
3									
4						1		2	Cores separated along cross joints in parts.
5						≷	2	≷	
6						2		3	
7					Black with white bands	2	2	3	Many calcite veins and somewhat folding.
8						≷	≷	≷	Partially small solusiom cavities along calcites veins.
9						(3)	3	(4)	Slightly brittle in general.
40		30°							

DEPTH	WATER TABLE / WATER PRESSURE TEST / LEAKAGE OF DRILLING WATER / DRILL WATER RETURN (20% 60 100)	ELEVATION
20m		70.8
1	Lu = 1.3	
5	Lu = 4.2	
30	Lu = 2.5	
40	Lu = 2.3	50.8

core loss

RQD

cuttings

▸ driller's note ◂
1 (stick) 2 (substick) 3 (piece) 4 (fragment) 5 grain

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A 2 HYDROLOGY

1. Catchment Area of the Damsites

In this study, two damsites, i.e. site A and B were proposed for investigation. Catchment areas of both sites were measured with the available topographical maps (scale: 1/250,000, "Chiangwat Chiang Mai" and "Amphoe Li") published by U.S. Army Map Service, Far East.

Catchment area of Ban Tha Rua G.S. was also measured with the said map.

The catchment areas employed in the study were as follows.

Damsite A	:	5,920 km^2
Damsite B	:	5,810 km^2
Ban Tha Rua G.S.	:	5,770 km^2

2. Evapotranspiration

Evapotranspiration was calculated by the following two methods.

(1) Thernthwaite Method

$$E_{PT} = 0.533\ Do\ \left(\frac{10tj}{J}\right)^{a}$$

where $a = 6.75 \times 10^{-7}J^3 - 7.71 \times 10^{-5}J^2 + 1.79 \times 10^{-2}J + 0.49$

$$J = \sum_{j=1}^{12} \left(\frac{ti}{5}\right)^{1.514}$$

E_{PT} = Monthly average of daily evapotranspiration [mm/day]

Do = Daytime ratio i.e. daily daytime/12 hrs

t = Monthly average temperature [°C]

j = Month (1 - 12)

J = Indicator of Month

(2) Blaney and Criddle Method

$$E_{PT} = KCt$$

where E_{PT} = Monthly average evaporation [inch/month]

C = Ratio of monthly daytime to annual daytime

t = Monthly average temperature [°F]

K = Coefficient corresponding to kind of flora

When units are converted to metric system, the equation becomes:

$$E_{PT} = K \cdot C \cdot (45.72^{t} + 812.8)$$

In these equations, daytime ratios Do and C were obtained by the following way.

Do; based on the table below, the value at latitude 18° North was interporated.

C; given by the following figure.

Coefficient for flora (K) is 0.7 corresponding to deciduous forest in semi-dry region(1).

References

(1) Hideaki Nakano, "Forestry Hydrology" p.p.95 - 120, 1980. 3rd ed. Kyo-ritsu Press.

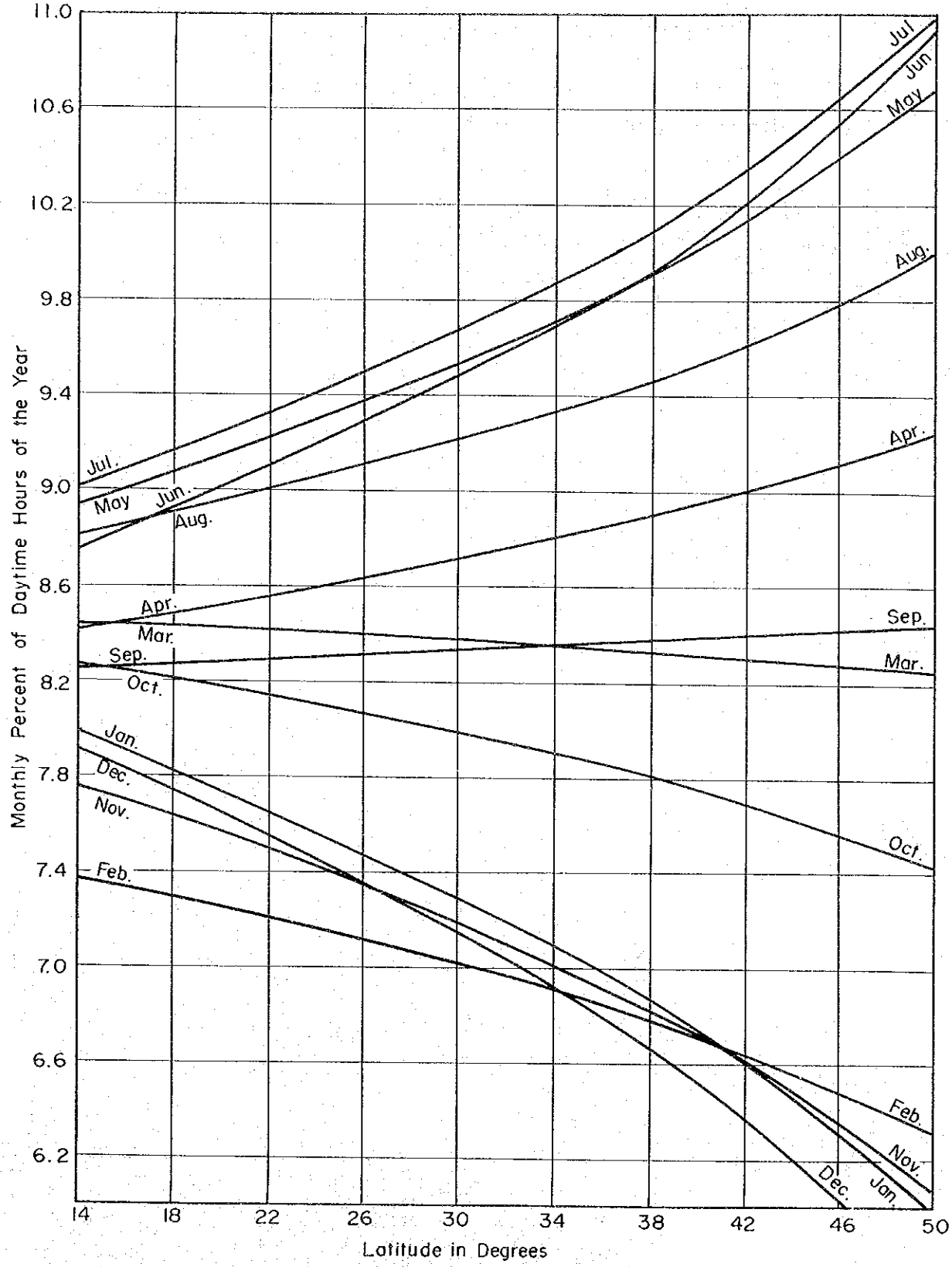

Fig. 2.1 Percent of Annual Sunshine Hours Occurring During the Indicated Month

Table 2.1 Daytime Ratio, ref. (1)

(Unit: 12 hr/day)

Lat. N. / Mon.	10	18*	20	24	26	28	30	32	34	36	38	40	42	44	46
JAN	0.965	0.929	0.920	0.899	0.889	0.878	0.867	0.855	0.843	0.830	0.817	0.802	0.787	0.770	0.752
FEB (28)	0.982	0.961	0.956	0.941	0.935	0.929	0.922	0.915	0.908	0.900	0.893	0.884	0.875	0.865	0.855
FEB (29)	0.982	0.961	0.956	0.942	0.936	0.930	0.923	0.916	0.909	0.902	0.894	0.885	0.877	0.867	0.857
MAR	1.003	1.001	1.000	0.997	0.996	0.996	0.995	0.994	0.993	0.992	0.991	0.990	0.989	0.988	0.986
APR	1.026	1.044	1.048	1.055	1.060	1.065	1.070	1.076	1.081	1.087	1.093	1.100	1.107	1.115	1.123
MAY	1.045	1.079	1.087	1.104	1.114	1.123	1.134	1.144	1.156	1.167	1.180	1.193	1.208	1.223	1.240
JUN	1.055	1.096	1.106	1.129	1.141	1.153	1.166	1.180	1.194	1.209	1.225	1.242	1.261	1.280	1.302
JUL	1.051	1.088	1.097	1.118	1.129	1.140	1.152	1.164	1.177	1.191	1.206	1.221	1.237	1.255	1.274
AUG	1.034	1.057	1.063	1.077	1.084	1.091	1.098	1.106	1.114	1.123	1.132	1.141	1.151	1.162	1.174
SEP	1.012	1.017	1.018	1.022	1.024	1.025	1.027	1.029	1.031	1.033	1.035	1.037	1.039	1.041	1.045
OCT	0.990	0.975	0.971	0.964	0.960	0.956	0.952	0.947	0.942	0.938	0.932	0.927	0.921	0.915	0.909
NOV	0.970	0.937	0.929	0.913	0.904	0.895	0.885	0.875	0.865	0.854	0.842	0.830	0.817	0.803	0.787
DEC	0.960	0.919	0.909	0.887	0.875	0.863	0.850	0.838	0.824	0.809	0.794	0.778	0.760	0.742	0.721

Note: *; Lat. 18°N. was interporated

3. Sedimentation

3.1 Geology in the project area

The project area stretches from North to South with distance of 160 km while from West to East with 30 to 50 km width, covering catchment of 6,000 km^2. In the area, rugged topography in youthfulage is widely seen.

The area is mainly composed of sedimentary rock of Paleozoic and Mesozoic age, and granite of Mesozoic age. The ground is covered in most area by laterite which is generally formed by weathering in humid and high temperature region.

3.2 Sediment

Due to the laterite covering the ground, eroded and flowing material in the river is very fine. In other words, the river flow contains suspended load. On the other hand, since the river gradient is rather mild and river flow is relatively slow, bed material would not be very involved in the flow. Measurement of suspended load has been conducted at three gaging stations along the river. But one gaging station was omitted because it measures on a tributary. Instead, a measurement on the Moei river was taken into account.

(1) Density of sediment deposit

The following equation gives an average density of sediment deposit after t years.

$$W_{av.} = W_1 + 0.434\ K\ \left[\frac{t}{t-1}(\ln t - 1)\right]$$

ref.(1)

where $W_{av.}$ = Average density of sediment deposit after t years.

W_1 = Initial density of sediment deposit shown in the table below.

K = Coefficient

t = Years

Table 3.1 Initial Density and Coefficient

(Unit: lb/ft^3)

Reservoir Operation	Sand (>0.05 mm)		Silt (0.005 to 0.05 mm)		Clay (0.005 mm)	
	W_1	K	W_1	K	W_1	K
Sediment always submerged or nearly submerged	93	0	65	5.7	30	16.0
Normally a moderate reservoir drawdown	93	0	74	2.7	46	10.7
Normally a considerable reservoir drawdown	93	0	79	1.0	60	6.0
Reservoir normally empty	93	0	82	0.0	78	0.0

For a hundred year sedimentation, the following densities were derived

Table 3.2 Average Density after 100 years

(Unit: gr/cm^3)

Reservoir Operation	Sand	Silt	Clay
	W_{100}	W_{100}	W_{100}
Sediment always submerged or nearly submerged	1.490	1.185	0.886
Normally a moderate reservoir drawdown	1.490	1.254	1.008
Normally a considerable reservoir drawdown	1.490	1.291	1.113
Reservoir normally empty	1.490	1.313	1.249

In this study stage, no information is available for composition of sediment deposit in Nam Yuam reservoir. Therefore, an average figure of the said densities could be employed, i.e. 1.30 gr/cm^3.

(2) Estimation of sediment

Using the average density derived above, the suspended load measured in weight at gaging stations was converted to load in volume. At the same time the amount of load was expressed by form of specific discharge.

In addition, bed load was considered, referring other report. The report of Lower Quae Yai Environmental and Ecological Invistigation mentiones 10% of bed load against suspended load in terms of volume, while the Feasibility Study Report of Upper Quae Yai mentiones 20% thereof. In this report, thus, it is decided to consider 20% of bed load against suspended load in terms of volume.

Consequently, following sediments are estimated at each gaging stations.

Sop Han	(C.A. = 2,496 km^2)	136.2 $m^3/km^2/yr$
Ban Tha Rua	(C.A. = 5,770 km^2)	109.6 $m^3/km^2/yr$
Tha Song Yang	(C.A. = 8,360 km^2)	196.9 $m^3/km^2/yr$

Finally the specific sediment discharge of 140 $m^3/km^2/yr$ which is conservatively obtained by enlarging the figure at Sop Han has been adopted in this study.
Therefore, the total amount of sediment deposit is estimated to be 82.9×10^6 m^3

$$140 \times 5,920 \times 100 = 82.9 \times 10^6$$

This sediment occupies only 18.6% of total storage volume of the reservoir. Assuming horizontal surface of deposit, sediment level becomes EL.129.0 m.

References

(1) Davis, Sorensen "Handbook of Applied Hydraulics" McGraw-Hill, 1969

(2) SETEC, "Environmental and Ecological Investigation of L.Q.Y. Project" Vol.II : Main Report, 1978. Aug.

(3) JICA, "Feasibility Study Report of U.Q.Y. Project" Vol.I : Main Report, 1980 Jun.