THE DEMOCRATIC SOCIALIST
REPUBLIC OF SRI LANKA

MINISTRY OF POWER AND ENERGY
CEYLON ELECTRICITY BOARD

SAMANALAWEWA HYDRO-ELECTRIC PROJECT

REVIEW PANEL

REPORT NO 2

(SMW-2)

J. B. COOKE P. LONDE A.H. MERRITT G.R. POST

COLOMBO - FEBRUARY 1993

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

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B. COOKE	P. LONDE	A.H. MERRITT	G.H. POST
Barry Cooke	Pierre Londe		

COLOMBO - FEBRUARY 1993

SAMANALAWEWA HYDRO-ELECTRIC DEVELOPMENT

RIGHT BANK LEAKAGE - REVIEW PANEL

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RIGHT BANK LEAKAGE - REVIEW PANEL.

EXECUTIVE SUMMARY

TERMS OF REFERENCE AND RESPONSE

1) "To assess the stability of Samanalawewa Dam, as built and under the present hydrogeological condition".

Response: The dam is a conventional central core rockfill on a hard rock foundation designed and constructed to current standards and constructed of satisfactory materials. Its stability could not be affected by many times the maximum credible leakage that might pass through the right abutment ridge, with full reservoir level of el. 460.

2) "To assess the stability of the Right Bank of Samanalawewa Reservoir under present and short term future conditions before remedial measures are complete".

Response: The Right Bank ridge is of non-erodible and non-pipeable rock. There are shear zones, and open joints that exist to great depth. The right abutment perimeter of the reservoir will safely pass any amount of leakage for full reservoir before any measures are taken to reduce leakage.

3) "To review available proposals for conceptual design of remedial measures for the Samanalawewa Dam and Reservoir and to suggest the most appropriate proposal".

Response: The extensive grout curtain carried out according to current standard practice has not adequately sealed the abutment even for the low partial filling. The unusual geological conditions of open cracks at great depth make improvements of the curtain impractical. The most appropriate measure, with the probability of significant reduction in leakage, is blanketing.

CONCLUSIONS

1) Dam The dam is safe for full reservoir and is independent of right ridge leakage conditions.

2) Right Abutment The right abutment provides a reliable perimeter for the reservoir at full storage level and any credible amount of leakage. Work is required to reduce leakage for economic, not safety, reasons.

3) Geology Rock foundations are excellent for the dam. However, tectonic activity has resulted in a sheared, and fractured rock where the fissures are open to a great depth in the Right Bank Ridge. The rock, therefore, is excessively pervious.

4) Right Abutment Grout Gallery In contrast to the adequate rock conditions on the Left Bank, the rock on the Right Bank was found to present adverse conditions as more exposures became visible during construction. For these unusual conditions it was logical to increase the grouting program. The very deep open cracks made the curtain ineffective in adequately reducing leakage.

5) Trial Filling Combining the knowledge of the very low groundwater levels in the Right Bank with the high grout takes gave rise to concern for high leakage, and logically prompted the trial filling. The test to water el. 402 confirmed this concern.

6) October 1992 Event During the first filling the sudden release created only a local stability problem in the overburden material. The stabilised $2m^3/s$ leakage for water surface 426 is high and suggests that above $10m^3/s$ for full reservoir is possible. This event verified the need for measures to reduce leakage.

7) Measures for Reducing Leakage Evaluation of geology data, experience, and investigations indicate that wet blanketing is the most promising means of reducing leakage.

8) General Abutment Drainage The reservoir abutment rock drains itself freely and safely. With reservoir level higher than el. 440 some overburden slides can be expected. They would be of no consequence and no ridge drainage is necessary.

9) Dam Right Abutment Drainage The dam and the right abutment rock just downstream of the dam, is safe against high-abutment piezometric levels and drainage is not necessary. However, there is an unlined access gallery in exactly the correct location. Additional controlled drains in the gallery are advisable in this transition zone between dam and abutment.

10) Outlet Works Since it is firmly judged that the right abutment and dam are safe for full reservoir, no modification to the outlet works is necessary.

11) Flood Season 1993 There is no risk to the dam or right bank stability should the reservoir fill before remedial works are carried out. Frequent measurements and surface observations should be made during the rising reservoir.

12) Monitoring During Blanket Placement The principal observations will be measurement of the leakage and observance of sediment and coloration of the leakage, and recording of piezometric levels. At the bench end where placement takes place, the volume discharged for a meter progress in extension of bench should be recorded. Soundings would be made.

13) First Filling There should be no established short or long term objectives of permissible piezometric levels or of limits of permissible leakages.

SAMANALAWEWA HYDRO-ELECTRIC DEVELOPMENT

RIGHT BANK LEAKAGE - REVIEW PANEL

1 INTRODUCTION

The second meeting of the Review Panel for the Samanalawewa Hydro-Electric Project met in Colombo and at the project site from 13 - 22 February 1993. The various activities undertaken during the visit are as described in the agenda attached as Appendix A and the participants are given in Appendix B. Upon the Panel's arrival in Sri Lanka and at occasions during the visit, project documents were provided for review and are listed in Appendix C.

Since the first visit by Mr G. Post in November 1992, and Report No.1 written by Mr Post and Mr P. Londe dated February 1993, the Panel has been expanded to include Mr J.B Cooke and Mr A. H. Merritt. The current report represents the first efforts by the full Panel.

The Terms of Reference for the services of the Review Panel are as described in the letters of 26 November 1992 and 15 January 1993 from Mr N. A. J. Perera, Chairman Ceylon Electricity Board to the Panel and are as listed in the Executive Summary.

During the course of the field inspections, document review, and numerous meetings, the Panel's efforts have been enhanced by the participation of the CEB,JVS,GIBB,CECB,OECF, and ODA. The considerable efforts expended by all involved have greatly facilitated the Panel's work and the frank and open discussions are sincerely appreciated.

The Panel has addressed each of the items given in Chairman Perera's letters mentioned above and is pleased to submit the following report. It is hoped that the information and conclusions contained herein will assist the CEB in resolving the current situation.

2. DAM

The dam is a central core rockfill dam of 100m height and with 2.1H:1V upstream and 1.8H:1V downstream slopes. It is of conventional design: core, multiple filters and zoned compacted rockfill. It is the foundation, foundation treatment and immediate right abutment that requires attention.The Panel discussed these matters and geology with the project staff. Geology is reviewed in heading 3.1 of this report. The dam and the immediate right abutment are on sound tightly jointed rock, whereas the right abutment ridge, though of the same formation, is sheared and deeply open jointed to considerable depth.

In construction of the dam, the core and filter foundation was cleaned to hard rock. Surface joints were treated with slush grout and irregularities with dental concrete. Area grouting was in general 5m deep, and deeper near the main curtain at 2 by 3m in spacing. Grout takes were very small. It has been adequately verified that an effective cutoff has been achieved and that there are no caverns under the earth core and filters.

The dam foundation is on sound solid rock except for a small area of weathered rock in the right abutment at the crest of the dam, where a concrete paving was used.

The dam, on a hard rock foundation which is well exposed and treated, provides a safe and watertight structure.

3. RIGHT ABUTMENT

3.1 Geology

3.1.1 General

The Panel reviewed the geological mapping made during the progress of the works and examined the many right abutment core borings stored at the project. The various rock formations currently exposed were likewise observed and their implications to the seepage matter were discussed with CEB, JVS, Gibb, and CECB geologists. It is not the intent of this report to delve into the detailed geologic conditions at the site, but rather to briefly consider what, in the Panel's opinion, are the principal items concerning the transmission of water through the right abutment.

The folded metamorphic rock at the site have been locally fractured by a system of steeply dipping shear zones that strike across the right abutment ridge. In addition, the limestone lenses and more continuous limestone horizons have been affected by surface weathering and apparently by hydrothermal alteration.

Some karstification of the limestone has occurred that is believed to be a rather local phenomenon in the discontinuous horizons but could be more extensive in the so-called "CAL" unit that occurs below the current leakage area. Some caves and sinkholes were exposed during various site excavations and were inferred to exist in one area of grouting on the right abutment.

The ground surface is mantled by a layer of dense residual soil of apparent low permeability. The thickness of this material approaches 50m at the hill tops and thins out approaching river level. Locally, the lower slopes are covered by colluvial deposits.

Based on a review of many right abutment core borings, the Panel concludes that the core of the right abutment ridge contains a substantial amount of hard metamorphic rock although locally fractured, to a great depth. On the other hand, the rock in the dam foundation is tightly jointed and impermeability verified by low grout takes.

3.1.2 Rock Permeability

The Panel concurs with the site geologists that the principal reason for the continuous or through - going permeability of the right abutment ridge is the NE-SW striking (transverse) shear zones. These features apparently have caused the general opening of the adjacent rock joints and foliation planes.

It is also believed that, where these major fracture zones intersect thick limestone layers, some degree of solution or karstification has occurred that could have produced caves of unknown dimensions.

Of particular importance to probable water movement is the Panel's belief that high permeability extends to a considerable depth.This is not a normal occurrence in rock masses since most fractures generally are closed within a reasonable distance from the rock surface. At Samanalawewa, the major shear zones are extension features and are related to deep seated tectonic forces rather than to near-surface stress-relief effects.

This is an important aspect to water seepage control measures since emphasis is more appropriately directed to controlling water at the point of ingress rather than to standard curtain grouting whose depth is normally selected based on well-known criteria applicable to normal rock masses.

3.1.3 Locations & Nature of Probable Water Courses

There is a general consensus that the principal area of water ingress that is responsible for the visible downstream flow, occurs along the Walawe Ganga about 1200m upstream of the dam. This area contains a number of the transverse shear zones that traverse the right abutment ridge. The reservoir water is believed to enter the rock mass below the mantle of residual soil and travel along open fractures in hard metamorphic rock and re-emerge near or within a limestone unit that is intersected by a transverse shear zone. This limestone probably contains caves and solution features. It seems most reasonable to expect that the water travels through hard rock throughout its course because of the nature of the ridge bedrock and the likelihood that the leakage path has been in existence for a long period.

It should be assumed that other water paths may exist that have, as yet, not been revealed by the reservoir at its current or past levels.

The watertightness of the reservoir outside of the right bank ridge has not been studied by the Panel. This question was not included in the Terms of Reference and no documents were provided during the visit to permit a study of the question.

3.2 GROUTING GALLERY

During the excavation of the lowest grouting gallery (D) on the right abutment, a fault was encountered that proved to be much wider than anticipated. It was determined that additional exploration would be required and following the drilling of boreholes, geophysical investigations, and measurements of permeability and groundwater levels, it was decided to attempt to seal the right abutment ridge by means of a grout curtain constructed from a long gallery that would cross potential seepage paths through the ridge.

The gallery was positioned at el. 396 to 390 m and extended some 1300m to cross Saddles #1, #2, and #3. The depth of the grout curtain was selected to be about 100m to 120m below the gallery which was the maximum practical depth using the available drilling equipment. The base of the curtain was at elevation 280m or about

110m below the river.

Based on discussions with field personnel, and on the January 1992 report by JVS and GIBB, it appears that standard grouting practices were followed and that considerable effort was employed to seal the open fractures that were encountered throughout most of the curtain. Total water loss was experienced in the primary and secondary holes and a substantial quantity of cement grout was injected into the rock.

It was concluded by project staff that, although the grouting works were done with the best practicable design and construction practices and techniques, excessive leakage might happen during reservoir filling because of the hanging nature of the curtain.

Subsequent experience has shown that, while the curtain itself may have been effective, reservoir water found its way to the river downstream of the dam. It is probable that a substantial amount of water passed beneath the curtain through the open fractured rock. As noted in Section 3.1 above, the Panel has concluded that highly pervious rock extends to a considerable depth as a result of the tectonic conditions particular to the site. It is not known to what depth these conditions may persist and consequently, methods other than conventional grouting are required to attempt to seal the reservoir.

3.3 Trial Impounding

The trial impounding (June 1991 to March 1992) with reservoir level fluctuations between 395 and 402m has shown that the groundwater table was very flat with no development of a significant gradient through the curtain which acts only as a partial cut-off. From the lack of change in ground water response of 16 deep piezometers, it was concluded that the leakage would stay within an acceptable value during the next impounding up to the maximum operating reservoir level (el.460) (see paragraph 2.5 of Report No.1)

3.4 October 1992 Event

This event occurred during the reservoir impounding. All the piezometers followed the R.W.L. very closely with about only one day time lag until October 22,1992, when a sudden burst punctured the clay cover washing out 25,000 m^3 of an old slide, with a seepage discharge around $7m^3/s$. At the same time all the piezometers dropped drastically by almost 25m down to el. 415 approx. The discharge decreased to $2m^3/s$ then the GWL rose by 6 - 7m (partial obstruction of the leakage privileged path around the hydraulic control section). A left bank spring close to Killekandura at about 3 km downstream apparently was significantly reduced by the burst of 22nd October.

All these facts confirm the great extent and permeability of the aquifers through tensional fractures found at great depth. The measurements since December 1992 confirm the hydraulic law proposed in Report No 1. These data indicate that some clogging has developed in the ingress area.

3.5 Blanket

The blanket concept was conceived by the engineer, endorsed in Panel Report No 1 and is again endorsed in this report as the promising method of reducing leakage. There are two possible methods, dry and wet placement of impervious material. For the conditions at Samanalawewa the wet method is the practical and economical method to seal the river bed and the lower slope of the right ridge face.

The wet method can be described as dumping impervious material underwater. The water level would be the level which enables powerplant operation during placement. Above that elevation, dry placement is appropriate to thicken the existing thickness of the saprolite blanket, were it considered necessary. Little dry placement is anticipated to be required.

The mechanism of sealing by the wet method for the open jointed hard rock, where it is not covered by an adequate thickness of saprolite, is that leakage into the rock mass will draw the fine material into fissures in the rock mass until it is sealed. Strength of underwater placed material is not needed. The important consideration is to use fine material such as the saprolite. Some sand sizes are, of course, desirable. The important material is minus # 200 mesh. Occasional rocks, but not a load of rocky material, are acceptable.

There is much precedent for sealing by underwater placement by bottom dump barge, by end dumping from trucks, and by dredging.

For Samanalawewa creating a bench along the abutment seems to be the appropriate method. This will take more volume, but would be substantially the lowest unit cost method and the method that could be more quickly mobilised for.

3.6 DRAINAGE

During the wet season before the blanket has been in place, additional drainage of a provisional nature should be provided. The existing access gallery D(a) is the appropriate location for these drains. All drains should be fitted with a closure valve.

The drainage adit suggested in Report No 1 is no longer considered necessary, because new local slides in the overburden can be accepted.

3.7 Investigations

In view of the type of sealing recommended (wet blanketing), and of the observational approach associated with its implementation, it is considered that no additional investigations are required before starting blanketing. The large amount of data obtained by the geologists, particularly during the process of grout curtain execution (type of rock fractures, location of shear zones, permeability tests, grout takes), indicate the most probable location of the ingress area for leakage (vicinity of Adit G). Even though other ingress areas exist, the vicinity of Adit G is most probably responsible for most of the discharge.

It is therefore not necessary to proceed with the various investigations which have been proposed during this meeting. Results, of the proposed further investigations, often of uncertain interpretation, would not modify the decision made of using the wet blanket technique, and would not change the selection of vicinity of Adit G for first placement of the blanket. The investigation will then be the observation of leakage flow (discharge, muddy water) during the progress of placement. Should, however, some of these on going investigations be carried out for scientific purpose, they should in no way delay the start of blanketing.

3.8 Outlet Works

A greater capacity low level outlet could have been useful in the light of events. However, at this stage in the project it is not justified to increase capacity for implementation of the blanket, since it is firmly judged that the perimeter of the reservoir and dam are safe for full reservoir

3.9 Flood Season Of 1993

The Panel reasserts its position that there is no risk to safe performance of the dam and right bank for full reservoir operation before the blanket is constructed. However, as a principle in dam engineering, spillway gates should remain open when remedial works are judged to be necessary.

3.10 Monitoring During Blanket Placement

Monitoring will be for leakage and for blanket placement.

For leakage monitoring, a calibrated weir is required. Observations would be made for new locations in the event of new points of leakage. A continuous record of the nature of leakage would be made: ie. clear, turbid or sediment content. Samples of sediment would be taken.

For the blanket, the volume progress bench ratio and changing topography of surface would be recorded. Inspections would include occasional grading .curves to verify placement of fine material.

3.11 Reservoir Filling

During the meeting the Panel was asked to recommend a "long term allowable leakage amount" and a "long term allowable underground potential head". The answer is that no such criteria are advisable as they may conflict with the proper future actions, dictated by sound engineering and economical requirements.

SAMANALAWEWA HYDRO-ELECTRIC PROJECT

RIGHT BANK LEAKAGE - REVIEW PANEL

APPENDIX A - AGENDA

Sat 13 February 1993	Arrival of Mr P. Londe and Mr G. R. Post at Katunayake International Airport on Flight No. AF156 at 06:45. Mr Sivarajah of CEB will meet the Panel Members at the airport and take them to the Taj Hotel where they will commence study of available project information.
Sun 14 February 1993	All day - Taj Hotel. Mr Post and Mr Londe will continue their studies of the available project information. Mr Sivarajah of CEB will assist the panel in any problems.
Mon 15 February 1993	Arrival of Mr. A. H. Merritt at Katunayake International Airport on Flight No. UL558 at 05:30. Mr Sivarajah of CEB will meet the Panel Member and take him to the Taj Hotel. Arrival of Mr J. B. Cooke at Katunayake International Airport on Flight No. UL403 at 19:30. Mr Sivarajah of CEB will meet the Panel Member and take him to the Taj Hotel. All day -Taj Hotel. The Panel will continue their studies of the available information.
Tues 16 February 1993	06:30 - 07:00 Mr Sivarajah of CEB will meet the Panel Members at the Taj Hotel and organise their transport which will depart for Samanalawewa site. ETA on site 11:00. 11:00 - 12:00 JVS Conference Room. Introductory meeting between the Panel and ODA/OECF/CEB/CECB/JVS/GIBB. 12:00 - 13:30 Buffet lunch at Pambahina Camp Restaurant. All parties. Mr Sivarajah of CEB will also take Panel Members and luggage to their accommodation.

13:30 - 15:30 Site visit all parties. View of dam site from crest of dam. Inspection of new leakage point and adjacent slopes. Inspection of Adit E and Piezometers within grouting gallery and Adit D, Investigation Drain holes. Inspection of possible area of ingress on Right Bank near Adit G.

15:30 - 16:00 JVS Conference Room - Hot Beverages/Soft Drinks. All parties.

16:00 - 18:00 JVS Conference Room. Meeting and discussion between Panel and JVS/GIBB/CEB

20:00 Buffet Dinner at Pambahina Camp Restaurant. All parties.

Wed 17 February 1993

07:00 - 07:30 Breakfast Pambahina Camp Restaurant. Panel/OECF/ODA

08:00 - 10:00 Examination of cores recovered from previous investigations. All parties.

10:00 - 12:00 Panel internal meeting and further study of available documentation in JVS Conference Room.

12:00 - 13:30 Buffet lunch at Pambahina Camp Restaurant. All parties.

13:30 - 15:30 JVS Conference Room . Meeting and discussion between Panel and JVS/GIBB/CEB.

15:30 - 16:00 JVS Conference Room - Hot Beverages/Soft Drinks. All parties.

16:00 - 18:00 JVS Conference Room. Meeting and discussion between Panel and ODA/OECF/CEB

20:00 Buffet Dinner at Pambahina Camp Restaurant. All parties.

Thurs 18 February 1993

05:00 - 05:30 Breakfast Pambahina Camp Restaurant Panel Members and CEB.

06:00 - 06:30 Mr Sivarajah of CEB will meet the Panel Members and organise their transport which will depart for Colombo.

10:00 - 12:00 CECB Office in Colombo. Meeting with Dr A. N. S. Kulasinghe.

12:30 Panel Members move to the Taj Hotel. Mr Sivarajah of CEB will assist the Panel Members if necessary.

pm - Taj Hotel. The Panel will continue their studies of the available information collected at their hotel.

Fri 19 February 1993

07:30 Mr Sivarajah will meet the Panel Members and transport them to CEB office. He will also assist the Panel when necessary.

08:00 - 12:00 CEB Board Room. Meeting Panel with CEB\ODA\OECF

pm - Taj Hotel. The Panel will continue their studies of the available information collected at their hotel.

Sat 20 February 1993

All day - Taj Hotel. Preparation by Panel of their report. Mr Sivarajah of CEB will be available during the day to assist the Panel Members if required.

Sun 21 February 1993

All day - The Panel will finalise and submit their report to CEB. Mr Sivarajah of CEB will be available during the day to assist the Panel Members.

Departure of Mr. A. H. Merritt from Katunayake International Airport am **Flight details and time to be confirmed by Mr Merritt.** CEB's Mr Sivarajah to liaise with Mr Merritt to organise transport as appropriate.

Mon 22 February 1993

10:45 - 11:00 Mr Sivarajah will meet the Panel and organise their transport to see the Hon. Prime Minister at Temple Trees.

11:30 Temple Trees, Colombo 3. Remaining members of the Panel report with GIBB/JVS/CECB/CEB to the Hon. Prime Minister and the Cabinet Sub Committee.

pm - After Meeting CEB Boardroom. Debriefing CEB/Panel/GIBB/JVS.

Late pm - Departure of Mr J.B. Cooke, Mr P. Londe and Mr G. Post from Katunayake International Airport. **Flight details and times to be confirmed by Panel.** CEB's Mr Sivarajah to liaise with Panel and to organise transport as appropriate.

SAMANALAWEWA HYDRO-ELECTRIC DEVELOPMENT

RIGHT BANK LEAKAGE - REVIEW PANEL

Appendix B. - List of Participants

I. Introductory Meeting Held In JVS Dam Site Conference Room, Between CEB/ODA/CECB/GIBB/JVS/Review Panel on 16 February 1993, Starting at 11:05, followed by Site Inspection.

NAME	POSITION	ORGANISATION
1. Mr G. R .Post	Review Panel, SHEP	Individual Consultant
2. Mr P. Londe	Review Panel, SHEP	Individual Consultant
3. Mr J. B. Cooke	Review Panel, SHEP	Individual Consultant
4. Mr A. H. Merritt	Review Panel, SHEP	Individual Consultant
5. Mr S. Ganesharajah	Project Director	C.E.B. (SHEP)
6. Mr G. N. Samaranayake	Power Station Manager	C.E.B. (SHEP)
7. Dr G. P. Rajapakse	Geologist	C.E.B.
8. Mr K. Laksiri	Reservoir Engineer	C.E.B.
9. Mr N. Sivarajah	Civil Engineer	C.E.B.
10. Mr A. Jayasena	Civil Superintendent	C.E.B.
11. Mr S. A. Justin	Engineer	C.E.B.
12. Mr V. F.Pereira	Senior Geologist	C.E.C.B.
13. Mr H. G. Chandrasiri	Monitoring Engineer	C.E.C.B.
14. Mr T. D. Pike	Chief Engineering Advisor	O.D.A.
15. Mr M. R. Foord	Representative	British High Commission
16. Mr B. R. Cope	Representative	British High Commission
17. Mr M. Yamaguchi	Director	J.V.S. (Nippon Koei)
18. Mr K. Wada	Construction Manager	J.V.S. (Nippon Koei)

19. Mr J. S. Takahashi	Geologist	J.V.S. (Nippon Koei)
20. Mr H. Srikanthan	Grouting Engineer	C.E.C.B.
21. Dr. P. A. A. Back	Director	GIBB
22. Mr P. O. Squire	Senior Geologist	GIBB
23. Mr D. C. Chisnall	Engineering Geologist	GIBB

II. Meeting Held In JVS Dam Site Conference Room, Between CEB/GIBB/JVS/Review Panel on 17 February 1993, Starting at 09:30

NAME	POSITION	ORGANISATION
1. Mr G. R. Post	Review Panel, SHEP	Individual Consultant
2. Mr P. Londe	Review Panel, SHEP	Individual Consultant
3. Mr J. B. Cooke	Review Panel, SHEP	Individual Consultant
4. Mr A. H. Merritt	Review Panel, SHEP	Individual Consultant
5. Mr S. Ganesharajah	Project Director	C.E.B. (SHEP)
6. Dr G. P. Rajapakse	Geologist	C.E.B.
7. Mr K. Laksiri	Reservoir Engineer	C.E.B.
8. Mr N. Sivarajah	Civil Engineer	C.E.B.
9 . Mr T. D. Pike	Chief Engineering Advisor	O.D.A.
10. Mr M. R. Foord	Representative	British High Commission
11. Mr B. R. Cope	Representative	British High Commission
12. Mr M. Yamaguchi	Director	J.V.S. (Nippon Koei)
13. Mr K. Wada	Construction Manager	J.V.S. (Nippon Koei)
14. Mr J. S. Takahashi	Geologist	J.V.S. (Nippon Koei)
15. Dr H.E. Minor	Director	J.V.S. (Electrowatt)
16. Dr P. A. A. Back	Director	GIBB

17. Mr P. O. Squire	Senior Geologist	GIBB
18. Mr D. C. Chisnall	Engineering Geologist	GIBB

III. Meeting Held In JVS Dam Site Conference Room, Between CEB/OECF/ODA/Review Panel on 17 February 1993, Starting at 14:00

NAME	POSITION	ORGANISATION
1. Mr G. R .Post	Review Panel, SHEP	Individual Consultant
2. Mr P. Londe	Review Panel, SHEP	Individual Consultant
3. Mr J. B. Cooke	Review Panel, SHEP	Individual Consultant
4. Mr A. H. Merritt	Review Panel, SHEP	Individual Consultant
5. Mr S. Ganesharajah	Project Director	C.E.B. (SHEP)
6. Dr G. P. Rajapakse	Geologist	C.E.B.
7. Mr K. Laksiri	Reservoir Engineer	C.E.B.
8. Mr N. Sivarajah	Civil Engineer	C.E.B.
9. Prof. Masao Hayashi	O.E.C.F. Technical Advisor	Tokai University
10.Mr Masahiko Kaneko	Technical Director	O.E.C.F.
11.Mr Kei Hara	Director	O.E.C.F.
12.Mr Yasuo Takashima	Technical Advisor	O.E.C.F.
13.Mr.Kentarou Takahai	O.E.C.F. Technical Advisor	W.R.D.P.C
14.Mr Kei Ichikawa	O.E.C.F. Technical Advisor	Public Water Research Institute
15.Mr T. Takasaki	Coordinator	J.V.S. (Nippon Koei)
16.Mr T. D. Pike	Chief Engineering Advisor	O.D.A.
17.Mr M. R. Foord	Representative	British High Commission

18.Mr B. R. Cope	Representative	British High Commission
19.Mr M. Yamaguchi	Director	J.V.S. (Nippon Koei)
20.Mr K. Wada	Construction Manager	J.V.S. (Nippon Koei)
21.Mr J. S. Takahashi	Geologist	J.V.S. (Nippon Koei)
22.Dr H.E. Minor	Director	J.V.S. (Electrowatt)
23.Mr S. Nishioka	Senior Geologist	J.V.S. (Nippon Koei)
23.Mr H. Srikanthan	Grouting Engineer	C.E.C.B.
24.Dr. P. A. A. Back	Director	GIBB
25.Mr P. O. Squire	Senior Geologist	GIBB
26.Mr D. C. Chisnall	Engineering Geologist	GIBB
27.Mr V. F.Pereira	Senior Geologist	C.E.C.B.
28.Mr H. G. Chandrasiri	Monitoring Engineer	C.E.C.B.
29.Mr R. B. W. Nilaweera	Civil Engineer	C.E.C.B.

IV. Meeting Held In CECB Head Office Colombo, Between CEB/CECB/Review Panel on 18 February 1993, Starting at 10:30

NAME	POSITION	ORGANISATION
1. Mr G. R .Post	Review Panel, SHEP	Individual Consultant
2. Mr P. Londe	Review Panel, SHEP	Individual Consultant
3. Mr J. B. Cooke	Review Panel, SHEP	Individual Consultant
4. Mr A. H. Merritt	Review Panel, SHEP	Individual Consultant
5. Dr A.N.S Kulasinghe	Chairman	C.E.C.B.
6. Mr G.G Jayawardene	General Manager	C.E.C.B.
7. Mr Tandon	Consultant	C.E.C.B.
8. Mr V. Pereira	Senior Geologist	C.E.C.B.
9. Mr T.D Wickremasinghe	Hydrologist	C.E.C.B.

10.Mr S. Ganesharajah	Project Director	C.E.B. (SHEP)
11.Mr S. Sivarajah	Civil Engineer	C.E.B

V. Meeting Held In CEB Board Room, Colombo, Between CEB/OECF/ODA/Review Panel on 19 February 1993, Starting at 08:15

NAME	POSITION	ORGANISATION
1. Mr G. R .Post	Review Panel, SHEP	Individual Consultant
2. Mr P. Londe	Review Panel, SHEP	Individual Consultant
3. Mr J. B. Cooke	Review Panel, SHEP	Individual Consultant
4. Mr A. H. Merritt	Review Panel, SHEP	Individual Consultant
5. Mr N.A.J Perera	Chairman	C.E.B.
6. Mr Senadipathy	Vice Chairman	C.E.B.
7. Mr K.A Ranaweera	General Manager	C.E.B.
8. Mr S Ganesharajah	Project Director	C.E.B. (SHEP)
9. Mr W.O.S Karunatileke	Add.General Manager	C.E.B.
10.Dr G. P. Rajapakse	Geologist	C.E.B.
11. Mr K. Laksiri	Reservoir Engineer	C.E.B.
12. Mr N. Sivarajah	Civil Engineer	C.E.B.
13. Prof. Masao Hayashi	O.E.C.F. Technical Advisor	Tokai University
14.Mr Masahiko Kaneko	Technical Director	O.E.C.F.
15.Mr Kei Hara	Director	O.E.C.F.
16.Mr Yasuo Takashima	Technical Advisor	O.E.C.F.
17.Mr.Kentarou Takahai	O.E.C.F. Technical Advisor	W.R.D.P.C.
18.Mr Kei Ichikawa	O.E.C.F. Technical Advisor	Public Water Research Institute

19.Mr T. Takasaki	Coordinator	JVS (Nippon Koei)
20.Mr Yuzo Tsuzi	Representative	O.C.E.F. (Colombo)
21.Mr T. D. Pike	Chief Engineering Advisor	O.D.A.
22.Mr M. R. Foord	Representative	British High Commission
23.Mr B. R. Cope	Representative	British High Commission
24.Mr M. Yamaguchi	Director	J.V.S. (Nippon Koei)
25.Mr K. Wada	Construction Manager	J.V.S. (Nippon Koei)
26.Mr J. S. Takahashi	Geologist	J.V.S. (Nippon Koei)
27.Dr H.E. Minor	Director	J.V.S. (Electrowatt)
28.Mr S. Nishioka	Senior Geologist	J.V.S. (Nippon Koei)
29.Dr. P. A. A. Back	Director	GIBB
31.Mr P. O. Squire	Senior Geologist	GIBB
32.Mr D. C. Chisnall	Engineering Geologist	GIBB
33.Mr.K.Doi	1st Secretary	Japanese Embassy

VI. CABINET SUB COMMITTEE MEETING HELD AT 11.30 A.M. ON 22.02.1993 AT THE PRIME MINISTERS OFFICE AT TEMPLE TREES WITH THE REVIEW PANEL

Attendance:

Hon. D.B.Wijetunga - Prime Minister and Minister of Finance
Hon. K.D.M.C.Bandara - Minister of Power and Energy
Hon. P.Dayaratne - Minister of Re-Construction,Rehabilitation and Social Welfare

Mr.N.A.J.Perera - Chairman, CEB
Dr.A.N.S.Kulasinghe - Chairman, CECB
Mr.S.Ganesharajah - Project Director Samanalawewa HEP
Mr.N.Sivarajah - Civil Engineer, CEB
Dr.H.E.Minor - Director,JVS(Eelctrowatt)
Mr.K.Wada, - Construction Manager, JVS
Mr.S.Takahashi - Joint Venture Samanalawewa
Dr.P.A.A.Back - Director, Sir Alexander Gibb & Partners
Mr.P.O.Squire - Sir Alexander Gibb & Partners
Mr.D.C.Chisnall - Sir Alexander Gibb & Partners
Mr.Barry Cooke - Member, Review Panel
Mr.G.R.Post - Member, Review Panel
Mr.P.Londe - Member, Review Panel

SAMANALAWEWA HYDRO-ELECTRIC PROJECT

RIGHT BANK LEAKAGE - REVIEW PANEL

APPENDIX C

DOCUMENTS HANDED TO REVIEW PANEL

A DOCUMENTS SUPPLIED BY GIBB/JVS ON ARRIVAL IN COLOMBO

1.	Report	Main Issues and Approaches to be Taken. JVS. February 1993.
2.	Report	Proposed Investigations for Required Remedial Works. JVS. February 1993.
3.	Drawings	Information - 1. Summary of Leakage Incident on 22nd October 1992. Information - 2. Piezometric Levels Before Impounding in Area A and Area B (28th March 1990 - 6th July 1990. JVS. February 1993.
4.	Report	The Remedial Measures Required for Samanalawewa Reservoir. A Summary of Proposed Principles. JVS/GIBB. November 1992.
5.	Paper	Lot II: Right Bank Cut-Off Works. Review of Grouting Results. JVS/GIBB. January 1992.
6.	Paper	Reservoir Watertightness and The Right Bank Cut-Off Works. A Summary. P.O.Squire, S. Takahashi, V.F. Pereira, H.L. Gunuratna. November 1991.

B. DOCUMENTS SUPPLIED BY GIBB/JVS ON SITE

1.	Report	Reservoir Remedial Measures. Results of Investigations, Monitoring and Stabilisation Works Carried Out Since 22nd October 1992. JVS/GIBB. February 1993.
2.	Drawings	Information for the Third Party Panel Review. Dam and Reservoir Monitoring, October 1992 - January 1993. JVS. February 1992.
3.	Record	Additional Data. Statements issued by JVS and GIBB following the Water Burst on 22nd October 1992.
4.	Paper	Dam Safety. GIBB. December 1992.
5.	Drawing	No. 82870/II/456/Z. Embankment Dam Typical Cross Section.

C. DOCUMENTS SUPPLIED BY CECB IN COLOMBO

1. Report Remedial Measures for Leakage Along Right Abutment Hill.

2. Drawings Relating to the above report.

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