

資料

資料1 調査団員・氏名 (1/2)

< 現地調査 >

- | | | |
|---|----------------------------|---|
| 1. 団長
Leader | 中川 和夫
Kazuo NAKAGAWA | 国際協力事業団無償資金協力部次長兼審査室長
Managing Director,
Office of Technical Coordination and Examination,
Grant Aid Management Department, JICA |
| 2. 無償資金協力
Grand Aid
Cooperation | 岡本 敦
Atsushi OKAMOTO | 外務省経済協力局無償資金協力課課長補佐
Assistant Director,
Grant Aid Division, Economic Cooperation Bureau,
Ministry of Foreign Affairs |
| 3. 計画管理
Coordinator | 杉山 茂
Shigeru SUGIYAMA | 国際協力事業団無償資金協力部業務第三課
Third Project Management Division,
Grant Aid Management Department, JICA |
| 4. 業務主任/
維持管理計画/
電力計画
Chief Consultant/
Operation and
Maintenance
Planner/Power
System Planner | 中戸 直司
Naoji NAKATO | 日本工営株式会社
Nippon Koei Co., Ltd. |
| 5. 電気設備計画
Electrical
Equipment
Specialist | 安行 一彦
Kazuhiko YASUYUKI | 日本工営株式会社
Nippon Koei Co., Ltd. |
| 6. 機械設備計画
Mechanical
Equipment
Specialist | 瀬戸 憲司
Kenji SETO | 日本工営株式会社
Nippon Koei Co., Ltd. |
| 7. 調達計画/
積算計画
Procurement
Planner/Cost
Estimator | 亀田 昌明
Masaaki KAMEDA | 日本工営株式会社
Nippon Koei Co., Ltd. |

資料 1 調査団員・氏名 (2/2)

< 基本設計概要書説明調査 >

- | | | |
|---|----------------------------|---|
| 1. 団長
Leader | 上垣 素行
Motoyuki UEGAKI | 国際協力事業団無償資金協力部審査室室長代理
Deputy Director,
Office of Technical Coordination and Examination,
Grant Aid Management Department, JICA |
| 2. 計画管理
Coordinator | 杉山 茂
Shigeru SUGIYAMA | 国際協力事業団無償資金協力部業務第三課
Third Project Management Division,
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Mechanical
Equipment
Specialist | 瀬戸 憲司
Kenji SETO | 日本工営株式会社
Nippon Koei Co., Ltd. |

資料2 調査行程 (1/2)

<現地調査行程>

日順	月日	曜日	宿泊地	官団員	コンサルタント団員
1	1月22日	月	バンコク	TG641便でバンコクに移動	
2	1月23日	火	ウエイチャン	TG690便でウエイチャンに移動、大使館表敬及びJICA事務所報告	
3	1月24日	水	ウエイチャン	工業手工芸省表敬、EDLとインセプションレポートの説明・協議	
4	1月25日	木	ウエイチャン	ナムグム第一水力発電所視察	
5	1月26日	金	ウエイチャン	EDLとの協議	
6	1月27日	土	ウエイチャン	ナムルック水力発電所視察	
7	1月28日	日	ウエイチャン	ナムグム第一水力発電所視察	
8	1月29日	月	ウエイチャン	EDLとの協議、討議議事録案提示	
9	1月30日	火	ウエイチャン	工業手工芸省及びEDLとの協議(討議議事録案の合意に向けて)	
10	1月31日	水	ウエイチャン	討議議事録調印式、大使館及びJICA事務所への報告	
11	2月1日	木	ナムグム	TG691便でバンコクへ移動	ナムグム発電所現場に移動
12	2月2日	金	ナムグム	TG772便/JL719便で成田着	調査工程の検討
13	2月3日	土	ナムグム		調査工程・手順の協議・確認
14	2月4日	日	ナムグム		調査記録フォームの作成
15	2月5日	月	ナムグム		1号機内部調査 / 2号機運転中調査
16	2月6日	火	ナムグム		1号機内部調査
17	2月7日	水	ナムグム		1号機各設備の点検調査
18	2月8日	木	ナムグム		1号機各設備の点検調査
19	2月9日	金	ナムグム		所内共通設備の点検調査
20	2月10日	土	ナムグム		所内共通設備の点検調査
21	2月11日	日	ナムグム		調査結果のとりまとめ
22	2月12日	月	ナムグム		2号機内部調査 / 1号機運転中調査
23	2月13日	火	ナムグム		2号機内部調査
24	2月14日	水	ナムグム		2号機各設備の点検調査
25	2月15日	木	ナムグム		2号機各設備の点検調査
26	2月16日	金	ナムグム		積算関連調査 / 電力計画調査
27	2月17日	土	ナムグム		積算関連調査 / 維持管理調査
28	2月18日	日	ナムグム		調査結果のとりまとめ
29	2月19日	月	ナムグム		施工計画調査
30	2月20日	火	ナムグム		調査結果のとりまとめ
31	2月21日	水	ナムグム		調査結果のとりまとめ
32	2月22日	木	ウエイチャン		調査結果最終確認 / ウエイチャンに移動
33	2月23日	金	ウエイチャン		大使館及びJICA事務所に帰国報告
34	2月24日	土	バンコク		TG691便でバンコクへ移動
35	2月25日	日			TG772便で成田着

資料 2 調査行程 (2/2)

< 基本設計概要書説明調査行程 >

日順	月日	曜日	宿泊地	官団員	コンサルタント団員
1	5月9日	水	バンコク		TG641 便でバンコクへ移動
2	5月10日	木	ヴ ァンチャン		TG690 便でヴ ァンチャンに移動 大使館表敬及び JICA 事務所報告
3	5月11日	金	ヴ ァンチャン		EDL と基本設計内容の説明・協議
4	5月12日	土	ヴ ァンチャン		ナムグム発電所現場調査
5	5月13日	日	ヴ ァンチャン		ナムグム発電所現場調査
6	5月14日	月	ヴ ァンチャン		EDL と基本設計内容の説明・協議
7	5月15日	火	ヴ ァンチャン		EDL と基本設計内容の説明・協議
8	5月16日	水	ヴ ァンチャン	TG641 便でバンコクへ移動	EDL と主要仕様事項の説明・協議
9	5月17日	木	ヴ ァンチャン	TG690 便でヴ ァンチャンへ移動	EDL と主要仕様事項の説明・協議
10	5月18日	金	ヴ ァンチャン	EDL と基本設計概要書の協議	
11	5月19日	土	ヴ ァンチャン	ナムグム第一水力発電所及びナムルック水力発電所視察	
12	5月20日	日	ヴ ァンチャン	団内打合せ	
13	5月21日	月	ヴ ァンチャン	EDL と基本設計概要書の協議	
14	5月22日	火	ヴ ァンチャン	協議議事録案の協議	ナムグム発電所員への講義
15	5月23日	水	ヴ ァンチャン	協議議事録調印式、大使館及び JICA 事務所への帰国前報告	
16	5月24日	木	バンコク	TG691 便でバンコクへ移動	
17	5月25日	金		TG772 便で成田着	

資料3 関係者（面会者）リスト (1/2)

< 現地調査 >

1. 工業手工芸省（Ministry of Industry and Handicraft）

	面会者	役職・担当	備考
1	Mr. Soulivong Daravong	Minister	
2	Mr. Somboun Rasasombath	Vice Minister	
3	Mr. Houmphone Bulyaphol	Director of Electricity Department	

2. ラオス電力公社（Electricité du Laos）

	面会者	役職・担当	備考
1	Mr. Viraphonh Viravong	General Manager	
2	Mr. Khamphone Saignasane	Deputy General Manager	
3	Ms. Sisouda	Manager of Generation Office	
4	Mr. Phoummy Nettibanedith	Deputy Manager Nam Ngum I Power Station	
5	Mr. Phet Sychaleune	Chief of Electrical Department Nam Ngum I Power Station	
6	Mr. Boun Ome Philavanh	Chief of Operation and Control Dept. Nam Ngum I Power Station	
7	Mr. Khamvene Thongphanith	Chief of Mechanical Department Nam Ngum I Power Station	
8	Mr. Kham Phuoi Keorasvang	Deputy Chief of Mechanical Department Nam Ngum I Power Station	
9	Mr. Bouavanh Chansavath	Deputy Manager Nam Leuk Power Station	

資料3 関係者（面会者）リスト (2/2)

<基本設計概要書説明調査>

1. 工業手工芸省（Ministry of Industry and Handicraft）

	面会者	役職・担当	備考
1	Mr. Houmphone Bulyaphol	Director of Electricity Department	

2. 投資協力委員会（Committee for Investment and Cooperation）

	面会者	役職・担当	備考
1	Ms. Khempheng Pholsena	Vice Minister	

3. ラオス電力公社（Electricité du Laos）

	面会者	役職・担当	備考
1	Mr. Viraphonh Viravong	General Manager	
2	Mr. Khamphone Saignasane	Deputy General Manager	
3	Mr. Phuommy Nettibanedith	Deputy Manager Nam Ngum I Power Station	
4	Mr. Phet Sychaleune	Chief of Electrical Department Nam Ngum I Power Station	
5	Mr. Boun Ome Philavanh	Chief of Operation and Control Dept. Nam Ngum I Power Station	
6	Mr. Khamvene Thongphanith	Chief of Mechanical Department Nam Ngum I Power Station	
7	Mr. Kham Phuoi Keorasvang	Deputy Chief of Mechanical Department Nam Ngum I Power Station	

資料4 当該国の社会 経済事情 (1/2)

国名	ラオス人民民主共和国
	Lao People's Democratic Republic

(1/2)

一般指標				首都	ヴィエンチャン
政体	人民民主共和制			主要都市名	サバナケット、ルアンプラバン
元首	カムタイ・シーパンドン大統領			経済活動可能人口	2,200 千人 (1995年)
独立記念日	1953年10月22日			義務教育年数	5年間 (1999年)
人種(部族)構成	低地ラオ族(60%)、他約60数種族			初等教育就学率	111.90% (1997年)
言語・公用語	ラオス語			初等教育終了率	28.50% (1997年)
宗教	仏教			識字率	61.80% (2000年)
				人口密度	21.55 人/km (1998年)
国連加盟	1955年12月14日			人口増加率	2.44% (1980年～1998年)
世銀	1961年7月5日			平均寿命	53.7才 (1998年)
IMF加盟	1961年7月5日			5才児未満死亡率	104/1,000 (1995年)
面積	236.8 千 km ²			カロリー供給率	2,108 kcal/人/日 (1997年)
人口	509万人 (1999年) *1)				
経済指標					
通貨単位	キップ			貿易量	(1999年)
為替(1US\$)	8,190 キップ (2001年2月)			輸出	310.9 百万ドル
会計年度	1月～12月			輸入	524.6 百万ドル
国家予算	(1998年度)			輸入カバー率	2.3月 (1998年)
歳入	202.7 百万ドル *3)			主要輸出品目	電力、木材、コーヒー、縫製品
歳出	385.1 百万ドル *3)			主要輸入品目	燃料、日用品、繊維材料
国際収支	- 150.1 百万ドル (1998年)			日本への輸出	1,548 百万円 (1999年)
ODA受取額	281.4 百万ドル (1998年)			日本からの輸入	2,576 百万円 (1999年)
国内総生産(GDP)	1,220 百万ドル (1999年)				
一人当りGNP	320 ドル (1998年)			外貨準備総額	121.8 百万ドル (1998年)
GDPの産業別構成	農業 51.2% (1999年)			対外債務残高	2,436 百万ドル (1998年)
	鉱工業 22.9% (1999年)			対外債務返済率	2.52% (1998年)
	サービス業 25.9% (1999年)			インフレ率	23.2% (2000年) *2)
産業別雇用	農業				
	鉱工業				
	サービス業			国家開発計画	2001年～2005年(第5次)
経済成長率	5.20% (1999年)				

気象 (1976年～1999年平均) 場所：ヴィエンチャン首都(降水量はナムグム発電所サイト)													
月	1	2	3	4	5	6	7	8	9	10	11	12	平均/計
最高気温	29.3	31.5	34.7	32.8	30.8	31.7	32.1	30.7	30.7	31.0	30.4	25.5	30.9 *1
最低気温	18.0	19.3	22.2	24.4	24.2	25.0	25.1	24.3	23.6	23.2	21.3	15.2	22.2 *1
平均気温	22.1	24.1	27.0	28.7	28.5	28.2	28.0	27.5	27.4	26.8	24.8	22.6	26.3
降水量	14.6	11.1	42.1	96.2	368.0	394.8	467.9	541.1	411.6	152.7	23.2	3.6	2,526.8 mm *4)
雨季/乾季	乾季			雨季					乾季				

出典： *1) Basic Statistics of the Lao P.D.R.
 *2) ADB, Asian Development Outlook 2001
 *3) CIA, The World Fact Book 2000
 *4) ナムグム第一水力発電所観測記録 (1972年～2000年)
 無印：国別協力情報 (JICA)

資料4 当該国の社会 経済事情 (2/2)

国名	ラオス人民民主共和国
	Lao People's Democratic Republic

(2/2)

我が国におけるODAの実績 (支出純額、単位：億円)				
項目	1996	1997	1998	1999
技術協力	3,641.48	3,655.45	3,688.35	3,643.84
無償資金協力	2,606.79	2,441.75	2,848.64	2,665.28
政府貸付等	3,025.02	1,904.03	4,786.05	5,647.83
総額	9,093.29	8,001.23	11,323.04	11,956.94

当該国に対する我が国ODAの実績 (資金協力は交換公文ベース、単位：億円)				
項目	1996	1997	1998	1999
技術協力	16.21	18.27	29.84	31.56
無償資金協力	54.47	91.24	74.77	80.13
有償資金協力	39.03	0.00	0.00	0.00
総額	109.71	109.51	104.61	111.69

OECD諸国の経済協力実績 (1998年) (支出純額、単位：百万ドル)					
	贈与 (技術協力・ 無償資金協力) (1)	有償資金協力 (2)	政府開発援助 (ODA) (1)+(2)=(3)	その他政府資金 及び民間資金 (4)	経済協力総額 (5)=(3)+(4)
二国間援助 (主要供与国)	163.0	2.7	165.7	4.4	170.1
1. 日本	82.5	3.1	85.6	-2.4	83.2
2. ドイツ	18.4	0.0	18.4	0.0	18.4
3. スウェーデン	12.0	0.0	12.0	0.2	12.2
4. フランス	12.0	-0.3	11.7	3.0	14.7
多国間援助 (主要援助機関)	23.0	92.7	115.7	1.1	116.8
1. ADB			63.5	0.0	63.5
2. IDA			23.7	0.0	23.7
その他					
合計	186.0	95.4	281.4	5.5	286.9

出典：国別協力情報 (JICA)

MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY ON THE PROJECT FOR
THE NAM NGUM NO. 1 HYDROPOWER STATION REHABILITATION
IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

In response to a request from the Government of the Lao People's Democratic Republic (hereinafter referred to as "the Lao P.D.R."), the Government of Japan decided to conduct a Basic Design Study on the Project for the Nam Ngum No. 1 Hydropower Station Rehabilitation (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Lao P.D.R. the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Mr. Kazuo Nakagawa, Managing Director, Office of Technical Coordination and Examination, Grant Aid Managing Department, JICA, and is scheduled to stay in the country from January 23 to February 24, 2001.

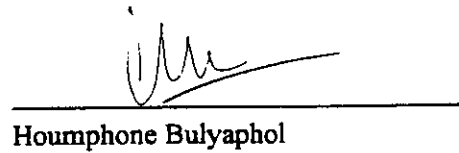
The Team held discussions with the officials concerned of the Government of the Lao P.D.R. and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Vientiane, January 31, 2001



Kazuo Nakagawa
Leader
Basic Design Study Team
Japan International Cooperation Agency



Houmphone Bulyaphol
Director
Electricity Department
Ministry of Industry and Handicrafts



Viraphonh Viravong
General Manager
Electricité du Laos

ATTACHMENT

1. Objective

The objective of the Project is to rehabilitate the existing plant, which have been deteriorated seriously and/or have lost their proper performances and functions on the existing Units No. 1 and No. 2 and their associated common equipment at the Nam Ngum No. 1 Hydropower Station.

2. Project Site

The site of the Project is the Nam Ngum No. 1 Hydropower Station located at about 90 km north from Vientiane, the capital of the Lao P.D.R., as shown in Annex - 1.

3. Responsible and Implementing Agency

The Responsible Agency is the Ministry of Industry and Handicrafts.

The Implementing Agency is Electricité du Laos.

4. Items Requested by the Government of the Lao P.D.R.

After discussion with the Team, the equipment, the facilities and the systems described in Annex - 2 were finally requested by the Lao side. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5. Japan's Grant Aid Scheme

The Lao side understands the Japan's Grant Aid Scheme explained by the Team, as described in Annex - 3.

6. Undertakings by the Lao Side

The Lao side will take all the necessary measures, as described in Annex - 4, for smooth implementation of the Project, as a condition for the Japan's Grant Aid to be implemented. Especially important items are described as follows;

- (1) The Lao side shall exempt Japanese juridical and physical nationals engaged in the Project from custom duties, internal taxes including VAT, and other fiscal levies which may be imposed in the Lao P.D.R. regarding the Project under the verified contracts (according to the standard practice of the Japan's Grant Aid).
- (2) The Lao side shall shut down the Units No. 1 and No. 2 at the Nam Ngum No.1 Hydropower Station in accordance with the Project implementation schedule.
- (3) The Lao side shall make necessary coordination with EGAT for shutdown of the Units for execution of the Project at predetermined times and for an agreed period.
- (4) The Lao side shall allocate the necessary budget and personnel for the implementation of the Project.
- (5) The Lao side shall provide information related to the Project in timely manner, which may be raised after completion of the Basic Design Study.



- (6) The Lao side shall secure the spaces necessary for the execution of the Project and storage of the equipment and the materials required.
- (7) The Lao side shall provide necessary permissions, licenses and other authorizations for smooth and convenient implementation of the Project, if necessary.
- (8) The Lao side shall assign exclusive counterpart engineers and technicians for the Project.
- (9) The Lao side shall execute all the necessary operation of the Units, the switchgear and the powerhouse crane during implementation of the Project.
- (10) The Lao side shall take a share in site rehabilitation works of the turbines and the generators. The details of the works to be shared by the Lao side will be suggested in the draft final report and will be discussed at the meeting on the draft final report.
- (11) The Lao side shall undertake necessary modification works of the civil and building structures.
- (12) The Lao side shall be responsible for suitable treatment and disposal of the unnecessary existing equipment and/or materials that will be removed.

7. Schedule of the Study

- (1) The consultants will proceed to further field studies in the Lao P.D.R. until February 24, 2001.
- (2) JICA will prepare the draft final report in English and dispatch a mission in order to explain its contents around the middle of May, 2001.
- (3) In case that the contents of the draft final report is accepted in principle by the Government of the Lao P.D.R., JICA will complete the final report and send it to the Government of the Lao P.D.R. by August, 2001.

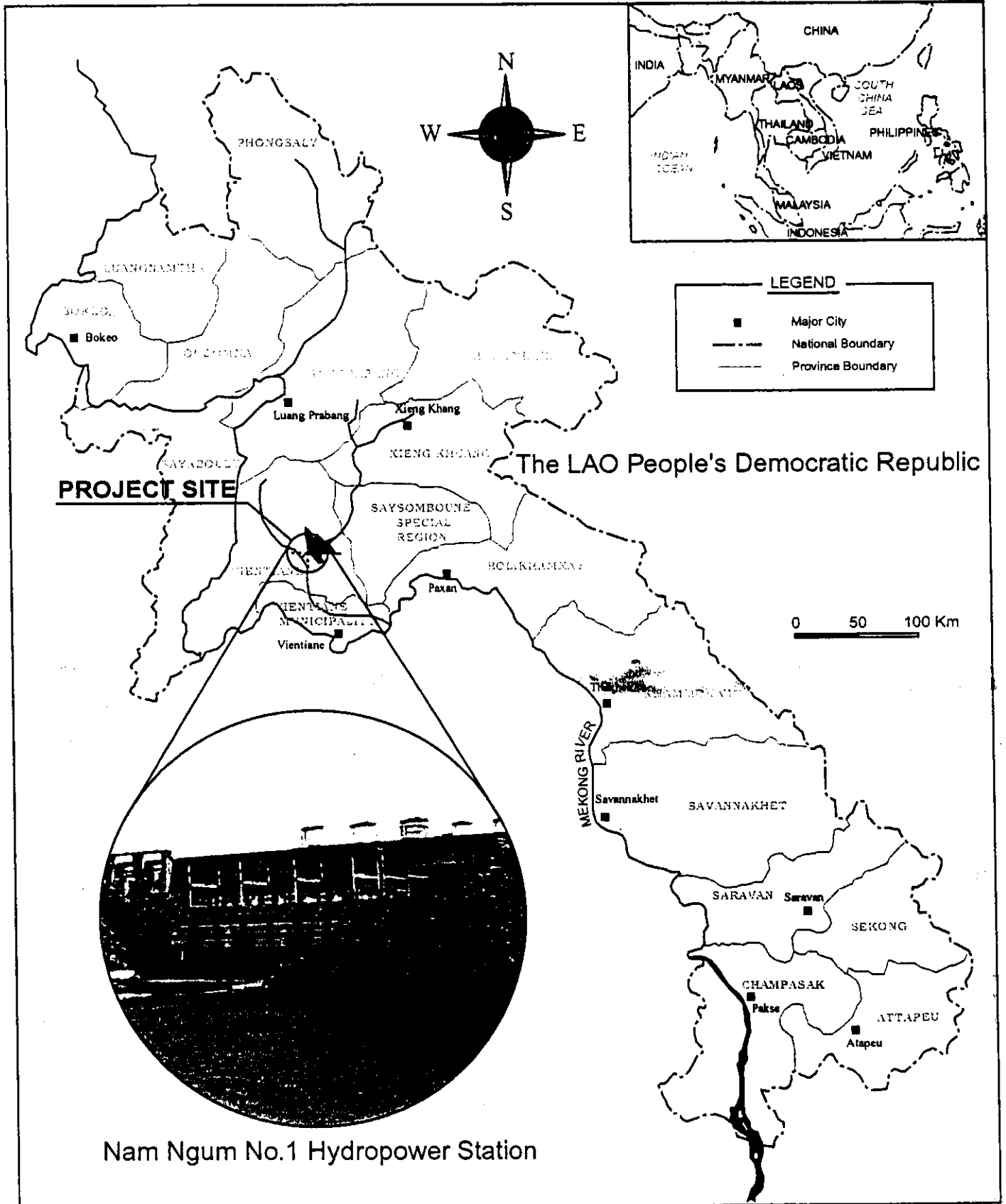
8. Other Relevant Issues

- (1) The Lao side has agreed to provide necessary number of counterpart personnel to the Team during the period of their field studies.
- (2) It was confirmed by the Lao side that there is no plan to privatize Electricité du Laos.
- (3) The Lao side shall submit answers to the questionnaire, which the Team had sent to the Lao side, by February 15, 2001.
- (4) The Lao side has agreed to shut down the existing Units No. 1 and No. 2 at the Nam Ngum No. 1 Hydropower Station according to the request by the Team for the interior inspection during the Basic Design Study.
- (5) The Lao side has agreed that defect liability by the Japan side shall be applied only to the equipment, materials and/or their parts that will be supplied and worked under the Project. The Lao side has also agreed that total performance of the Units No. 1 and No. 2 shall not be guaranteed by the Japan Side.
- (6) Both sides agreed that the Project Title shall be changed to "the Nam Ngum I Hydropower Station Rehabilitation".

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Annex - 1: Location Map



Nam Ngum No.1 Hydropower Station

LOCATION MAP

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ANNEX - 2

ITEMS REQUESTED BY THE GOVERNMENT OF THE LAO P.D.R.

No.	Description	Extent of Rehabilitation
1	Water turbines	Units No. 1 and No. 2
2	AC generators	Units No. 1 and No. 2
3	Intake gates and control panels	Units No. 1 and No. 2
4	Electrical protective relays	Units No. 1 and No. 2 and Common
5	Governor and oil pressure systems	Units No. 1 and No. 2
6	Compressed air systems	Units No. 1 and No. 2
7	Water supply and drainage systems	Units No. 1 and No. 2 and Common
8	Overhead travelling crane	Units No. 1 and No. 2
9	Main transformers	Units No. 1 and No. 2
10	Fire fighting equipment for main transformer	Units No. 1 and No. 2
11	11kV switchgear cubicles	Units No. 1 and No. 2
12	110 V batteries, battery chargers and DC distribution panels	Units No. 1 and No. 2
13	115 kV switchyard equipment and busbars	Units No. 1 and No. 2
14	Permanent magnetic generators (PMG)	Units No. 1 and No. 2
15	Station-service transformers	Common
16	Local-service transformer	Common
17	Control boards	Units No. 1 and No. 2 and Common
18	Gantry crane for intake gate stop logs	Common
19	Gantry crane for draft tube gate	Common
20	Emergency diesel engine generator set	Common
21	Telephone system for internal communication	Common

NOTE : "Common" means the station common equipment that is essential to operation of the Units No.1 and No. 2.

ANNEX-3

JAPAN'S GRANT AID SCHEME

1. Grant Aid Procedures

1) The Japan's Grant Aid Program is executed through the following procedures.

- Application (Request made by the recipient country)
- Study (Basic Design Study conducted by Japan International Cooperation Agency (JICA))
- Appraisal & Approval (Appraisal by the Government of Japan and Approval by the Cabinet)
- Determination of the Implementation (The Note exchanged between the Governments of Japan and recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study) using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for the Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the study

The aim of the Basic Design Study (hereafter referred to as "the Study") conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows :

- a) Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
- b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.
- c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- d) Preparation of a basic design of the Project.

e) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The selected firm(s) carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA. The consultant firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

1) Japan's Grant Aid

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

The Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely, consulting, constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

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5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the following:

- (1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
- (2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.
- (3) To secure buildings prior to the procurement in case the installation of the equipment.
- (4) To ensure all the expenses and prompt excursion for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.
- (5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

9) Banking Arrangements (B/A)

- a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.
- b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

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ANNEX - 4

MAJOR UNDERTAKINGS TO BE TAKEN BY EACH GOVERNMENT

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
2	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
3	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
4	To exempt Japanese nationals from customs duties, internal taxes including VAT and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		●
5	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
6	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the transportation and installation of the equipment		●

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MINUTES OF DISCUSSIONS
ON THE BASIC DESIGN STUDY
ON THE PROJECT FOR
THE NAM NGUM I HYDROPOWER STATION REHABILITATION
IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
(EXPLANATION ON DRAFT REPORT)

In January 2001, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on the Project for Nam Ngum I Hydropower Station Rehabilitation (hereinafter referred to as "the Project") to the Lao People's Democratic Republic (hereinafter referred to as "the Lao P.D.R."), and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the Study.

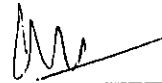
In order to explain and to consult the Government of the Lao P.D.R. on the components of the draft report, JICA sent to the Lao P.D.R. the Draft Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Uegaki, Deputy Director, Office of Technical Coordination and Examination, Grant Aid Management Department, JICA, from May 10th to May 24th, 2001.

As a result of discussions, both sides confirmed and mutually agreed the main items described on the attached sheets.

Vientiane, May 23, 2001



Motoyuki Uegaki
Leader
Draft Report Explanation Team
Japan International Cooperation Agency



Houmphone Bulyaphol
Director
Electricity Department
Ministry of Industry and Handicrafts



Viraphonh Viravong
General Manager
Electricite Du Laos

ATTACHMENT

1. Components of the Draft Report

The Government of the Lao P.D.R. agreed and accepted in principle the components of the draft report explained by the Team.

2. Japan's Grant Aid Scheme

The Lao side understands the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of the Lao P.D.R. as explained by the Basic Design Study Team and described in Annex-3 and Annex-4 of the Minutes of Discussions signed by both sides on January 31st, 2001.


3. Schedule of the Study

JICA will complete the final report in accordance with the items confirmed by both sides and send it to the Government of the Lao P.D.R. by August, 2001.

4. Other Relevant Issues

- (1) The Lao side shall undertake the works which are described in the Minutes of Discussions signed by both sides on January 31st, 2001. As a result of detailed discussion on this issue, Chapter 3 "Obligations of Recipient Country" of the draft report was revised as shown in Annex-1.
- (2) In accordance with the practice of the Japan's Grant Aid, the Lao side shall ensure the tax exemption including VAT, referring to Annex-4 of the Minutes of Discussion on January 31st, 2001.
- (3) The Lao side shall shut down the No.1 and No.2 Units according to the Project implementation schedule. The Lao side shall make necessary coordination with Electricity Generating Authority of Thailand (EGAT) for the shutdown related to the Project.
- (4) The Lao side shall allocate the budget, which is estimated by the Team, to cover the Lao side's undertakings, according to the Project implementation schedule.
- (5) The Lao side shall complete the necessary preparation work of the storage area, for the waste equipment/materials, by the time that new equipment/materials arrive at the Project site.
- (6) The Lao side pointed out the necessity of replacing the air compressor of the diesel engine generator because of deterioration. The Team suggested that this item should be undertaken by the Lao side as soon as possible prior to the implementation of the Project.
- (7) The Team handed one copy of the draft detailed specifications of the equipment to the Lao side. Both sides agreed that these draft specifications are confidential and should not be duplicated nor released to any outside party.
- (8) All the goods procured under the Project shall be maintained as state property by the Lao side, and shall be neither leased nor transferred to other sites.

- (9) For the sake of the technology transfer on sustainable operation and maintenance, the Lao side pointed out the need for technical training of the EDL's staff(s) in Japan. They also understood that another official request on technical cooperation should be submitted through diplomatic channel such as the JICA Laos Office.

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CHAPTER 3 OBLIGATIONS OF RECIPIENT COUNTRY

3.1 Works to be Executed by Lao Side

In the implementation of this Project, the Lao side is requested to execute the following works in addition to the services and works listed in Annex-3 and Annex-4 of the Minutes of Discussions on January 31, 2001 as the obligations of the recipient country.

(1) Participation in Rehabilitation Works of Turbines and Generators

The site rehabilitation works of the turbines and generators shall be carried out in active collaboration with the Lao side.

The Lao side shall provide at least ten (10) personnel of the maintenance crews of the Nam Ngum I Power Station to participate directly in the site rehabilitation works of the turbines and the generators during the period of the site rehabilitation works. These personnel is requested not only to be actively engaged in the rehabilitation works but also to improve and master a practical technique for dismantling and re-assembling the turbines and the generators in close collaboration with Japanese technicians.

(2) Proper Storage and Disposal of Unnecessary and Waste Equipment/Materials

The Lao side shall be responsible for proper storage and disposal of all unnecessary and waste equipment/materials including removal of them to the outside of the power station.

However, removal of the existing main transformers will be included in the scope of work for a Japanese contractor on condition that the existing main transformer should be relocated to the EDL's stockyard, which is about 600 m distant from the powerhouse.

The following works shall also be borne by the Lao side.

(a) Emptying and re-filling work for insulating oil of the existing main transformers

(b) Foundation work for the relocated existing main transformers

Appropriate foundations are required to place the existing main transformers at the EDL's stockyard. The design and preparation of these foundations shall be carried out by the Lao side.

The foundation works shall be completed one month before the new main transformers arrive at the site.

(c) Storage of old oils

This Project is planning to change all lubricating oils (4,800 liters) and pressure oils (7,600 liters) for the Units No. 1 and No. 2. In case the old oils are to be stored in oil drums, necessary number of the oil drums shall be arranged by the Lao side in close coordination with the contractor.

Re-conditioning of these oils shall also be made by the Lao side, if necessary.

(d) Disposal of existing lead acid batteries

The waste lead acid batteries consisting of 104 cells shall be carefully disposed at a factory of car battery in Laos.

(e) Safekeeping of harmful electrical equipment

It is found that the existing excitation transformers, 11 kV voltage transformers and 11 kV capacitors use the insulating oils containing toxic chemicals. These items are requested to be removed from the 11 kV switchgear cubicles and stored securely at a specially designated place in the powerhouse for safekeeping.

The required space for safekeeping of these items are 2 m x 6 m and it shall be surrounded by a suitable oil fence with a height of at least 20 cm.

The preparation of this place for safekeeping of such harmful electrical equipment shall be completed prior to the commencement of the replacement work of the 11 kV switchgear cubicles.

(3) Floor Finishing Work

In relation to the removal of the existing equipment, floor finishing work will be required to repair the floor surfaces. Such finishing works shall be carried out by the Lao side as well as supply of necessary mortar cement and floor tiles.

(4) Cable Re-Connection Work for DC Supply to Units Nos. 3 to 5

When the DC distribution panels are rehabilitated, the DC power supply to the Units Nos. 3 to 5 needs to be secured by changing the cable connections so that the DC power can be supplied directly from the battery charger.

For this purpose, the existing power cables for the DC power supply to Units Nos. 3 to 5 is required to be disconnected from the existing DC distribution panel and to be re-connected to the battery charger.

This cable re-connection work shall be carried out by the Lao side.

(5) Temporary Connection for House-Service Power Supply

When the 115 kV busbars are rehabilitated, the house-service power supply needs to be secured by receiving power from the 22 kV distribution line. Necessary preparation and temporary connection works for this purpose shall be carried out by the Lao side.

(6) Removal and Re-Installation of Terminal Boxes in the AC/DC Distribution Panels

The existing terminal boxes, which were additionally installed in the existing AC/DC distribution panels, are required to be removed before the replacement of AC/DC distribution panels are carried out by the contractor and to be re-installed in the new AC/DC distribution panels after completion of the contractor's replacement work.

Such removal and re-installation works for the terminal boxes shall be carried out by the Lao side including their cable connections.

(7) Remake of Foundations for Fire Extinguishing System for Main Transformers

At the replacement of the main transformers, a part of the water pipes for the fire extinguishing system will be disassembled by the contractor including removal of the foundations for their supports. (b)

The foundations removed are required to be remade after completion of the replacement of the main transformers.

Such remaking of the foundations shall be carried out by the Lao Side.

(8) Replacement of Air Compressor for Emergency Diesel Engine Generator

The existing air compressor, which is essential to starting-up of the diesel engine, has seriously deteriorated in its operating function. Therefore, the replacement of the air compressor is urgently required to ensure successful operation of the diesel engine generator at any time to secure the house-service power supply.

The replacement of the air compressor shall be undertaken by the Lao side as soon as possible prior to the implementation of the Project.

3.2 Project Cost Estimation

In order to execute all the above mentioned works as undertaking obligations by the Lao side, the cost to be borne by the Lao side is estimated as follows:

(a) Personnel expense	<u>Kip. 70,000,000</u>
(b) Civil and building works	<u>US\$ 2,000</u>
i) Temporary foundations for existing main transformers	US\$ 1,200
ii) Oil fence around storage area of harmful equipment	US\$ 50
iii) Floor finishing work	US\$ 300
iv) Remake of foundations for fire extinguishing system	US\$ 50
v) Others	US\$ 400
(c) Air compressor for diesel engine generator	<u>US\$ 6,250</u>

To smoothly implement this Project, the Lao side should have the necessary cost ready in advance.

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資料6 協力対象事業の概要

1. 協力対象事業名
ラオス人民民主共和国 ナムグム第一発電所補修計画
2. 我が国で援助することの必要性・妥当性
<p>(1) ラオス国は大メコン圏の中央に位置する内陸国であり、中央計画経済から市場経済への移行を推進しているが、我が国は、同国の開発がインドシナ半島全域の政治的安定と経済的繁栄にとって重要な役割を果たすとの認識の下、人造り、基礎生活分野、農林業、インフラ分野に重点を置いた援助を行っている。</p> <p>(2) ラオスの水力発電は、国内需要家への電力供給ばかりでなく、発電電力を近隣諸国に売電する主要な輸出産業であり、重要な外貨獲得源ともなっている。一方、99年時点の家庭電化率は全国で31.8%、ヴィエンチャン特別市及び周辺地域でも44.8%に過ぎない。これらを背景として、「水力発電開発」と「地方電化のための送配電網整備」がラオスの電力政策の二大重点課題となっている。</p> <p>(3) 当該国の社会・経済事情については資料4の「ラオスの社会・経済事情」参照。</p>
3. 協力対象事業の目的（プロジェクト目標）
1971年に建設されたナムグム第一水力発電所の1号機、2号機並びにそれらの運転に不可欠な所内共通設備の電氣的、機械的な性能及び使用上の信頼性・安全性を建設当時の状態まで回復させること。
4. 協力対象事業の内容
<p>(1) 対象地域 ヴィエンチャン県ケオウドン郡</p> <p>(2) アウトプット ナムグム第一水力発電所の1・2号機が機能回復される。</p> <p>(3) インプット ナムグム第一水力発電所 1・2号機に係わる水車、発電機、変圧器、開閉設備、制御盤、直流電源設備、ゲート設備等の補修及び更新</p> <p>(4) 総事業費 概算事業費 12.05 億円（日本側 12.03 億円、ラオス国側 0.02 億円）</p> <p>(5) スケジュール 2002年6月から2004年6月までの25ヶ月間を予定。</p> <p>(6) 実施体制 1) 主管官庁：工業手工芸省電力局 2) 実施・運営機関：ラオス電力公社（EDL）</p>

5. プロジェクトの成果

(1) プロジェクトにて裨益を受ける対象の範囲及び規模

ナムグム第一水力発電所

(2) 事業の目的（プロジェクト目標）を示す成果指標

1) 1・2号機の機能が回復される。

設備名	平均耐用年数	補修(2003年)時の余寿命	補修/更新後の期待寿命
1. 水車ランナ	26.7年	3.7年	20年
2. 水車调速機	26.7年	0年	25年
3. 発電機固定子巻線	28年	0年	28年
4. 油入変圧器	35年	3年	35年
5. 開閉機器	30年	0年	30年
6. 蓄電池	15年	0年～2年	15年

2) 1・2号機の故障発生率が低減する。

	故障発生件数 (1990～2000)	補修後10年間の 故障発生件数予測
1・2号機合計	25件	11.6件
・调速機	15件	2.0件
・圧油装置	4件	3.6件
・励磁装置	2件	2.0件
・その他	4件	4.0件

(3) その他の成果指標

1) 1・2号機の発電出力が増加する

	現在	補修後
1・2号機定格出力	15.0 MW x 2	17.5 MW x 2
発電所最大出力	150 MW	155 MW

6. 外部要因リスク

(1) 必要予算の確保

設備の期待寿命は、少なくとも各設備の消耗部品及び磨耗部品を保守・点検基準に基づいて適宜交換することが前提となる。ラオス電力公社が、そのための必要資金を遅滞なく確保する。

(2) 定期点検の実施

設備の性能維持、設備障害の早期発見、事故の未然防止を目的として、ラオス電力公社が分解点検を含む定期点検を実施する。

7. 今後の事後評価計画

(1) 事後評価に用いる成果指標

- 1) 1・2号機の故障発生件数
- 2) 基準落差（貯水池水位 EL. 205 m）以上における1・2号機の発電機出力
- 3) 1・2号機の発電電力量

資料7 収集資料リスト(1/2)

番号	資料の名称	形態	版型	頁数	部数	収集先
1	Basic Statistics of the Lao P.D.R. 1975 to 2000	製本	A4	162	1	National Statistical Center
2	EDL Annual Report 1995	製本	A4	28	1	EDL
3	EDL Annual Report 1996	製本	A4	36	1	EDL
4	EDL Annual Report 1997	製本	A4	32	1	EDL
5	EDL Annual Report 1998 (Draft)	書類	A4	32	1	EDL(現地語)
6	EDL Finance Forecast 2000 - 2010	書類	A4	11	1	EDL
7	Energy Sales for Domestic and Export 1971 to 1999	書類	A4	1	1	EDL
8	Kip/US\$ Exchange Rate 1990 to 2000	書類	A4	1	1	EDL
9	Budget and Expenditures for Nam Ngum I Power Station 1996 to 2000	書類	A4	1	1	EDL
10	Electricity Law	書類	A4	13	1	EDL
11	Tax Law	書類	A4	66	1	EDL
12	Nam Ngum 1 Hydropower Station Extension Draft Feasibility and Preliminary Design Report	書類	A4	391	1	EDL
13	Nam Ngum 1 Hydropower Station Extension Feasibility and Engineering Study, Evaluation Report Upgrade of the Existing Units 1 & 2	書類	A4	118	1	EDL
14	Nam Ngum 1 Hydropower Station Operation Manual with Nam Son Diversion	書類	A4	93	1	EDL
15	Hydropower Development Strategy for Lao PDR Draft Final Report	書類	A4	94	1	EDL
16	Power Sector Strategy Study Draft Final Report	書類	A4	293	1	EDL
17	ナムグム発電所概要	書類	A4	5	1	JICA 専門家
18	ラオスの電力設備計画の概要	書類	A4	4	1	JICA 専門家
19	電化率データ(各県及び全国)	書類	A4	3	1	EDL
20	発電電力量、国内需要、電力輸出、電力輸入の推移(全国)	書類	A4	1	1	EDL
21	Daily Load Curve at Central-1 Region	書類	A4	5	1	EDL
22	Load Demand Forecast for Whole Country	書類	A4	1	1	EDL
23	Load Demand Forecast for Central-1 Region	書類	A4	4	1	EDL
24	Organization Chart of Nam Ngum HEPP	書類	A4	1	1	ナムグム発電所
25	Nam Ngum Switching Curve	書類	A4	1	1	ナムグム発電所
26	Nam Ngum Operation Pattern	書類	A4	1	1	ナムグム発電所
27	ナムソン転流ダムからの流入量	書類	A4	5	1	ナムグム発電所
28	ナムルック水力発電所からの流入量	書類	A4	1	1	ナムグム発電所
29	Maximum and Minimum Water Level 1981 to 2000	書類	A4	1	1	ナムグム発電所

資料7 収集資料リスト(2/2)

番号	資料の名称	形態	版型	頁数	部数	収集先
30	ナムグム第一水力発電所における雨量データ	書類	A4	1	1	ナムグム発電所
31	ナムグム第一水力発電所の月別発電電力量	書類	A4	6	1	ナムグム発電所
32	100/20/5 ton x 16.2 m、天井走行クレーン	図面	A3	1	1	ナムグム発電所
33	100/20 ton トロリー	図面	A3	1	1	ナムグム発電所
34	5 ton ウインチ、ロープトロリー用	図面	A3	1	1	ナムグム発電所
35	主要変圧器用消火配管ダイアグラム	図面	A3	1	1	ナムグム発電所
36	排水設備配管ダイアグラム	図面	A3	1	1	ナムグム発電所
37	水車1号機定期点検結果報告書(2000年)	書類	A4	27	1	ナムグム発電所
38	発電機1号機定期点検結果報告書(2000年)	書類	A4	30	1	ナムグム発電所
39	1号機定期試験記録	書類	B4	16	1	ナムグム発電所
40	2号機定期試験記録	書類	B4	16	1	ナムグム発電所
41	ナムグム第一水力発電所 通信システム	図面	A4	5	1	ナムグム発電所
42	制御盤正面図	図面	A3	4	1	ナムグム発電所
43	115 kV 屋外開閉所 平面図・断面図	図面	A3	6	1	ナムグム発電所

資料 8 参考資料（水車流量の回復による水車特性への影響）

基本方針

3・4・5号機と運用上の整合性を図って、1・2号機の水車の基準有効落差を現在の32mから3・4・5号機と同じ37mに変更し、水車流量を原設計流量まで回復させる。

1. 水車出力への影響

基準有効落差を高くすれば、水理的には水車流量を更に増やす事が可能となるため、次の案について検討を行なった。

基本案： 基準有効落差を37mに変更し、水車流量を原設計通り55.4 m³/sに回復させる。

代案： 基準有効落差を37mに変更し、水車流量を水理的に可能な58.7 m³/sまで増加する。

水車出力は有効落差と流量によって決定されるため、基準有効落差と水車流量を変更すれば、水車出力も変わる。有効落差、水車流量と出力の関係は下表の通りである。

	有効落差	水車流量	水車出力	発電機出力
原設計	32 m	55.4 m ³ /s	15.5 MW	15.0 MW
現在の運用	37 m	46.0 m ³ /s	15.5 MW	15.0 MW
基本案：原設計流量への回復	37 m	55.4 m ³ /s	18.3 MW	17.5 MW
代案：水力的に可能な流量	37 m	58.7 m ³ /s	19.2 MW	18.6 MW

原設計流量を流す基本案においては、水車出力は18.3 MWに増加し、発電機端での出力は17.5 MWになる。

2. 基準有効落差の変更による水車への影響

1・2号機の水車は、もともと有効落差が32mから45.5mまでの範囲で運転できるように設計されており、基準有効落差を37mに変更することは機械的に全く問題ない。

3. 水量増加による水車及び損失落差への影響

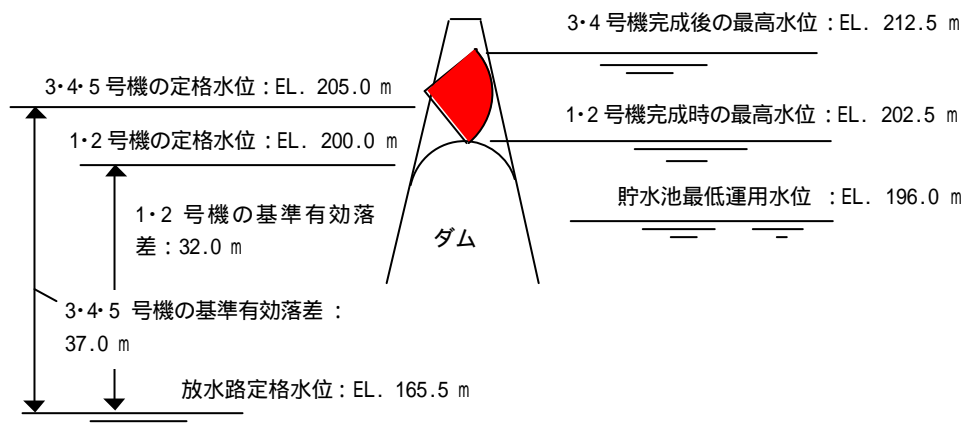
1・2号機の水車は、有効落差が32m以上であれば原設計流量の55.4 m³/sを流すことができる。また、有効落差が37m以上であれば58.7 m³/sを流すことも可能である。

他方、水圧鉄管は原設計流量の55.4 m³/sで設計されている。機械的にはそれ以上の流量を流すことは可能であるが、流量の増加分だけ水圧鉄管内の損失落差が大きくなる。

有効落差とは、総落差から損失落差を差し引いた落差であり、次式で表せる。

$$\text{有効落差} = \text{ダム水位} - \text{放水路水位} - \text{損失落差}$$

3・4・5号機の基準有効落差37mは下図の通り、ダム水位EL. 205.0mに対応したものである。1・2号機の損失落差を原設計以上に大きくした場合、基準有効落差37mを確保するためには、損失落差の分だけ、ダム水位を高く設定する必要があるが、これは3・4・5号機との整合性を図るという基本方針に反する。したがって、水車流量を原設計の55.4 m³/s以上とすることは受け入れられない。



4. 水車出力増加による水車特性への影響

水車出力が増加すれば水車特性が変わる。ここでは、水車特性のうち、代表的な次の3項目について検討した。

検討項目	定義	変更に対する考察 / 判定基準
最大水圧	水車発電機が運転中に突然系統から解列された場合に、调速機的作用によって水車の水口（ガイドベーン）が急閉し、水撃作用によって水圧鉄管及び水車の水圧が上昇するが、その最大値を最大水圧という。	既存の水車及び水圧鉄管の設計水圧に大きく関わるため、最大水圧を原設計以上に増加させることはできない。 (判定基準) 原設計の保証値と同じ 65.4 m 以下であること。
最大速度変動率	水車発電機が運転中に突然系統から解列された場合に、過渡的に水車入出力のバランスが崩れて回転速度が上昇するが、その回転速度変化分の最大値を最大速度変動率という。	原設計の保証値は 37 % であるが、水車及び発電機回転子は無拘束速度（定格速度の 118 % 増）に 1 分間耐えるように設計されているため、多少増加となっても問題はない。 フランス水車の最大速度変動率は最近でも 45 ~ 50% を採用することが一般的である。 (判定基準) 50% 以下とする。
吸出し高さの余裕	水車据付位置と水車出口側の放水路水位との差を吸出し高さという。水車据付位置は変更できないため、計算上の余裕をもって判断する。	吸出し高さは水車のキャビテーション（壊食）の発生に大きく影響するため、原設計以上の余裕が確保される必要がある。 (判定基準) 原設計の +1.12 m 以上の余裕があること。

以上の検討項目に対する計算結果を下表に示す。

項目	判定基準	基本案		代案	
		結果	判定	結果	判定
水車出力	-	18.3 MW	-	19.2 MW	-
水車比速度	-	259.5 m-kW	-	268.0 m-kW	-
損失落差	増加なし	増加なし		増加	×
最大水圧	65.4 m 以下	65.4 m		65.4 m	
最大速度上昇率	50 % 以下	44 %		52 %	×
吸出し高さ余裕	+ 1.12 m 以上	+ 1.93 m		+ 1.35 m	
総合					×

5. 結論

上記の検討結果により、水車流量を原設計流量よりも増加させる代案は、損失落差を増大させ、より高い速度上昇率を発生させるため、技術的に採用できない。

一方、水車流量を原設計流量に回復させる基本案は、水車特性に悪い影響を及ぼすことなく実現が可能である。したがって、基本方針が技術的に妥当であることが確認された。