



**Republic of Indonesia, Ministry of Public Works
Directorate General of Water Resources**

**Indonesia
Expert Dispatch Scheme
Dam Design and Construction
Advisory Services**

**Completion Report
Main Report**

February 2025



Japan International Cooperation Agency



**CTI Engineering International Co., Ltd.
CTI Engineering Co., Ltd.**

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List of Abbreviations

ADB	: Asian Development Bank
BAPPENAS	: Badan Perencanaan National Development Planning Agency
BBWS	: Balai Besar Wilaya Sungai (Large River Basin Authority)
BIG	: Badan Information Geospatial (National Geospatial Information Agency)
BMKG	: Badan Meteorologi , Klimatologi , dan Geofisika (Agency for Meteorology, Climatology and Geophysics)
BNPB	: Badan National Penanggulangan Bencana (National Disaster Management Agency)
BPBDMore	: Badan Penanggulangan Bencana Daerah (Regional Disaster Management Agency)
BTB_	: Balai Teknik Bendungan (Dam Engineering Department, Ministry of Public Works and Housing)
BWS	: Balai Wilaya Sungai (River Basin Authority)
C/Ps	: Counterpart
C/S	: Construction Supervision
CSGMore	: Cemented Sand and Gravel (Construction method for concrete structures such as dams)
DBD	: Direct Trading Bendungan dan Danau (Department of Dams and Lakes, Ministry of Public Works and Housing)
D/D	: Detail Design
DGWRMore	: Directorate General of Water Resources (Directorate General of Water Resources, Ministry of Public Works and Housing)
DOISP	: Dam Operational Improvement and Safety Project World Bank investment. Currently Phase II (DOISP-2)
DSC	: Dam Safety Commission
DSUs	: Dam Safety Unit
F/S	: Feasibility Study
HATHI	: Himpunan Ahli Teknik Hidraulik Indonesia (Indonesian Society of Hydraulic Engineering)
INACOLD	: Indonesian National Committee on Large Dams
JICA	: Japan International Cooperation Agency
MCM	: Million Cubic Meter (1 million m ³)
MLIT	: Ministry of Land, Infrastructure, Transport and Tourism, Japan
M/P	: Master Plan
NETIS	: New Technology Information System (Ministry of Land, Infrastructure, Transport and Tourism)
NWL	: Normal Water Level
OCAJI	: The Overseas Construction Association of Japan, Inc.
O/D	: Outline Design
ODA	: Official Development Assistance
PDAM	Perusahaan Daerah Air Minum (Water Supply Authority)
PLNMore	: Perusahaan Listrik Negara (National Power Company)
POLA	: (UK) Water Resources Management Strategic Plan
PU / former PUPR	: Pekerjaan Umum (Ministry of Public Works) Pekerjaan Umum dan Perumahan Rakyat (Ministry of Public Works and National Housing)
PUSAIR	: Puslitabang Sumber Daya Air (Water Resources Research Institute)
RENCANA	: (UK) Water Resources Management Implementation Plan _
RPJM	: (UK) National Medium-Term Development Plan
SDA	: Direktorat Jendal Sumber Daya Air (Indonesian abbreviation for Directorate General of Water Resources, DGWR)
SNI	: (UK) Indonesian National Standard
WB	: World Bank

Preface

Indonesia is a country habitually suffered with water-related disasters due to its fragile volcanic geology and frequent floods caused by torrential rain, like Japan. In particular, considering the impact of climate change in the future, the Indonesian government has analyzed that capacity development for design, construction, and operation of multipurpose dams, as well as geological surveys, is indispensable.

Under these circumstances, for the future promotion of the construction project of multipurpose dams by PU, there are problems in the technical accumulation of PU regarding geological surveys and dam design and construction supervision at these dam construction sites, and it is necessary to improve them.

In the dam advisory services, for the future promotion of the construction of dams by PU, the technical problems regarding geological surveys, design and construction supervision at the ongoing dam projects are extracted, and the technical problems regarding these problems have been advised/suggested with the aim of improving them. And for future plan, we proposed to establish a "Dam Risk Management System in Design and Construction" to promote the capability of Indonesian dam engineers.

We sincerely hope that our output will be utilized effectively and contribute to the improvement of dam technology in Indonesia and also we wish that PU (BENDA, DSC, DSU, BTB) will continue to discuss to improve the dam construction skill and to develop a system.

This Completion Report is consists of following documents:

- (1) Completion Report: Main Report
- (2) Supporting Report 1: Summary of Regulations, Laws and Guidelines on Dam
- (3) Supporting Report 2: Study of Dam Related Issues on Ongoing 61 Dams
- (4) Supporting Report 3: Establishment of Risks Management System in Dam Construction
- (5) Data Book : Site Inspection Reports, Minutes of Discussion, Presentation Materials in Seminar

Finally, we would like to express our deep gratitude to the Government of Indonesia provided us with great support in carrying out this service, in particular, to Dr. Adenan, Director of Dams and Lakes Department, Dr. Malindo, former head of Dam Technical Center, Dr. Slamet, Head of Dam Technical Center, Ms. Anissa Mayangsari and Mr. Tri Hartanto, Section Chief, Dam Technical Center; Dr. Bambang Hargono, Dr. Aries Firman, Director, Dam Safety Commission and all staff of Balai Teknik Bangunan. We would also like to thank all the BTB staff who worked with us on site and in the meetings, as well as Mr. Rosihan and Ms. Diana for their continued support during our activities in Indonesia.

February 2025

Hiroshi SHIMIZU

Theam Leader:
Dam Design & Construction Advisor

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Location of Objective 61 Dams

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Supporting Reports and Databook

- Supporting Report 1: Summary of Regulations, Laws and Guidelines on Dam Safety and Construction in Indonesia
- Supporting Report 2: Report of 61 Indonesia Dams
- Supporting Report 3: Establishment of Risks Management System in Dam Construction
- Databook:
1. Inspection Reports
 2. Minutes of Meeting
 3. Presentation Materials in Seminars

PART 1 The Project

1. Project Overview

1.1 Project Overview, Purpose, and Scope of Work

The outline, objectives and scope of the works are as shown in Table 1-1.

Table 1-1 Overview, Objectives and Scope of the Work

Overview	(1) Target	<ul style="list-style-type: none"> ♦ To secure a quality of dam design and construction in Indonesia for reducing flood risk. ♦ To establish an effective organization for Dam design/plan and construction in PU
	(2) Output:	<p>[Output 1.] An effective organizational structure necessary for geological survey, design and construction supervision of the dam projects is established in PU.</p> <p>[Output 2.] Capacity for dam design, construction supervision and geological survey is developed for PU.</p>
	(3) Target area:	All over the Indonesia
	(4) Executing agency:	Ministry of Public Works, Directorate General of Water Resources (DGWR/PU)
Related major projects by GOJ	<ul style="list-style-type: none"> ♦ “Flood countermeasure master plan project for pre-investment in disaster prevention” JICA (ongoing) ♦ “Advisor for Integrated Water Resources Management Policy” JICA (ongoing) ♦ “Sutami Dam Restoration Project in the Brantas River Basin” JICA (ongoing) ♦ “Information Collection and Confirmation Survey on Flood Control for the Jeneberang River” JICA, 2023 ♦ "Collecting Basic Information and Examining the Possibility of Cooperation on Overseas Disaster Prevention and Water Infrastructure" MLIT, Japan, 2017-2019 ♦ “The Preparatory Study of Flood Risk Mapping Project for the Kapuas River Basin in Kalimantan Barat, Indonesia” MLIT (ongoing) ♦ “The Preparatory Survey for Integrated Urban Flood Management Project in JABODETABEK” JICA (ongoing) 	
Objectives	Through the activities, such as confirm and extract PU's dam project implementation system, current problems, and issues that occur at the site, propose countermeasures, provide expected results.	
Activities	The services will provide advices to PU on these issues and aim to improve the capabilities of PU in terms of geological survey, design and construction supervision necessary for the effective implementation of dam construction project.	

2. Project Description

Indonesia is a country habitually suffered with water-related disasters due to its fragile volcanic geology and frequent floods caused by torrential rain, like Japan. In addition to the fact that many people live in areas with high flood risk, there is a concern that damage losses may increase as the country develops. As part of integrated water resources management, PU has proposed a plan to construct a new multipurpose dam for water utilization and flood control. In particular, considering the impact of climate change in the future, the Indonesian government has analyzed that capacity development for design, construction, and operation of multipurpose dams, as well as geological surveys, is indispensable.

Under these circumstances, for the future promotion of the construction project of multipurpose dams by PU, there are problems in the technical accumulation of PU regarding geological surveys and dam design and construction supervision at these dam construction sites, and it is necessary to improve them.

In this service, for the future promotion of the construction project of multipurpose dams by PU, the technical problems of PU regarding geological surveys and dam design and construction supervision at the dam construction sites under implementation are extracted, and the technical problems of PU regarding these problems are advised and advised with the aim of improving them. Based on these, the aim is to improve the capacity of PU regarding geological surveys, design and construction supervision necessary for the dam construction project.

3. Policy on Work

Many dams have been constructed in Indonesia in cooperation with Japan and Western countries. Our country has been cooperating in dam construction since the 1960s. In recent years, most dams have been constructed by its own power after Jatibarang dam construction completed in 2014 (In recent years, China has supported the construction of the Jatigede and Jenelata Dams, and the Republic of Korea has supported the construction of the Kalian Dam). Dam engineers in Indonesia have accumulated experience in these cooperative projects and have inherited their skills. However, in the recent rush of dam construction, there is a shortage of experienced engineers and there is a problem that they cannot adequately cope with many risks that occur in the field.

This Advisory Services aims to improve the capacity of PU in geological surveys, design and construction management necessary for dam construction projects by providing advice and advice based on the technical development and knowledge and experience of Japanese dams. In addition, in order to cope with the above problems, we discussed with the PU how to effectively share information among the dam related parties in Indonesia, and we aimed to implement this measure.

In order to achieve this goal, it is necessary for dam engineers in Indonesia to recognize that dams are highly uncertain structures constructed against nature, and there are many visible and potential risks.

The work contents and schedule of the field work originally planned are as follows.

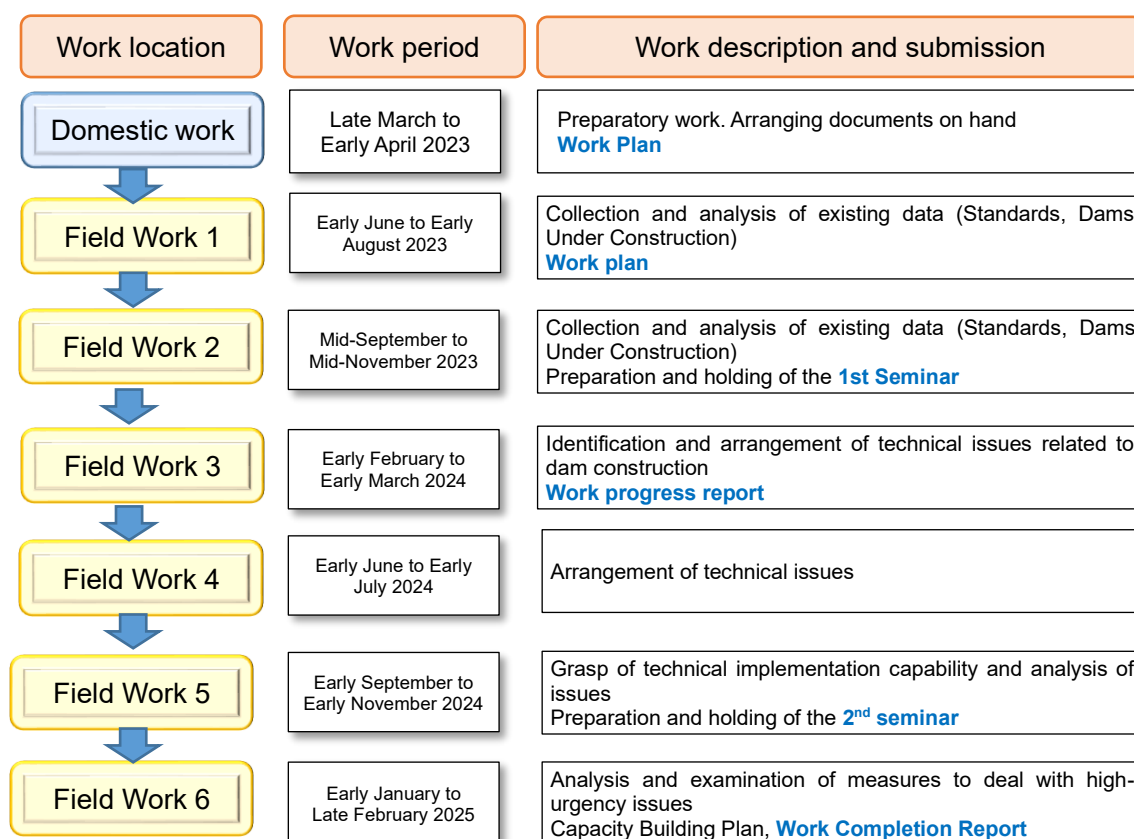


Figure 1-1 Work Schedule and Contents

3.1 Dispatch Period (Actual)

The dispatch period of the experts' field work was as follows: Of the two-year work period, the dam design, construction management expert provided technical advice on-site for 10 months (ultimately for 11.5 months), and the dam geology expert provided technical advice on-site for five months.

Table 1-2 1

in Charge	Name	Dispatch Period	
Project Manager/ Dam Design and Construction Supervision	Hiroshi Shimizu	1 st : 2023/5/22 ~ 2023/8/13 (7/5-7/16, 12 days of temporary return to Japan)	72 days
		2 nd : 2023/9/27 - 2023/12/12	77 days
		3 rd : 2024/1/25 ~ 2024/2/27	34th
		4 th : 2024/6/12 ~ 2024/8/2	52 days
		5 th : 2024/9/16~ 2024/11/21 (11/9~13 5 days, Bereavement leave)	62 days
		6 th : 2024/1/9 ~ 2024/2/23	46 days
		Total (Actual/Schedule)	343/300days
Dam Geology	Naoya Mizuno	1 st : 2023/5/22 - 2023/8/2	31days
		2 nd : 2023/10 /2 - 2023/ 11 /30 2023/12/7 – 2023/12/19 (for 1st Seminar)	63 days
		4 th : 2024/6/12 ~ 2024/7/11	31days
		5 th : 2024/9/16 ~ 2024/11/21 2024/11/15 ~ 2024/11/17 (for 2 nd Seminar)	34 days
		Total (Actual/Schedule)	159/150days

PART 2 Activities

1. Policy of Activity

At present, Indonesia has constructed all 59 dams except 2 dams, Jenelata and Karian, using its own technology. Although many technical issues have arisen in proportion to the number of dams being constructed, the fact that Indonesia is aware of these issues and is responding to them suggests the high level of technical capability in dam construction in Indonesia. In addition, the knowledge and experience of the experts in the DSC and DSU, who conduct the technical review of the project, concerning dam construction are already outstanding, and it can be judged from this that Indonesia's dam technical capability is approaching a certain level. On the other hand, the fact that the knowledge and experience of experts and organizations have not been widely disseminated within the PU organization and to the consultant and contractor engineers is a major issue to be solved in the future.

Dam technology covers a wide range of areas, and it is necessary to make a judgment based on understanding all of them. Even if dam engineers in Indonesia have partial knowledge, they tend to turn a blind eye to non-specialized areas. Their ability to judge how to deal with issues that arise during dam design and construction is required with minimum knowledge in a wide range of fields in addition to specialized fields.

The first step is for dam engineers to systematically recognize the risks (Dam function, construction period, construction cost, safety during construction and after construction, impact on surrounding environment, etc.) associated with dam construction, and for those in charge to recognize the risks (prior to the DSC certification process) in the implementation of the project, in order to improve the level of dam technology in Indonesia by carrying out the purpose of this work, "Extraction and analysis of issues and improvement of technical capabilities of dam technology in Indonesia." This is consistent with the DSC's concept of dam safety.

From the above, the basic policy of the project implementation was established on the viewpoint of "Through the risk management related to the dam project in Indonesia, we propose the establishment of a system that recognizes the risks at each stage of the project and implements measures to minimize the risks at the most appropriate time."

2. Expected Output

The outputs originally planned include:

Output 1 : Effective Organizational Structure Necessary for Dam Projects

- 1-1 Collect information on policies, plans, laws and technical standards for dam design, construction supervision and geological surveys.
- 1-2 Collect and organize information such as the specifications of the ongoing 61 dams, basic data accumulated during surveys, design and construction supervision, and the progress of the project.
- 1-3 Identify and sort out technical issues related to dam design/construction supervision and geological survey.
- 1-4 Organize how to deal with technical issues related to dam design, construction supervision and geological survey.
- 1-5 Analyze and study methods to deal with technical issues related to dam design, construction supervision and geological survey from the viewpoint of urgency and priority.

Output 2 : Capacity Development of PUPR Dam Engineers

- 2-1 Confirmation of technical implementation capacity and analysis of issues
- 2-2 Capacity building plan

2-3 Seminar/Workshop

- ♦ 1st Seminar/Workshop
- ♦ 2nd Seminar/Workshop

3. Results of Each Output

The contents of the activities and the results are described below.

3.1 Output 1: Establishment of Effective Organizational Structure Necessary for Geological Survey, Design and Construction Supervision of the Dam Projects

3.1.1 Output 1-1: Collection of Information on Policies, Plans, Laws, and Technical Standards

Policy, plans, laws, and technical standards related to dam construction are listed in the "Dam Safety Concept and Regulation 2008 (Revised 2025)" compiled by DSC for project implementers, and we obtained the latest version based on this. Especially in recent years, standards such as fill dam design standards, dam earthquake-resistance standards, and standards related to design flow rate of spillway have been frequently revised in Indonesia's National Standards (SNI). Therefore, we tried to obtain the latest information held by BTB and DSU, and confirmed technical changes.

The collected data are as shown in Table 21. The technical guidelines cover almost all areas related to dam construction projects and technologies. Especially in Indonesia, technical guidelines on fill dams are substantial because the construction of fill dams is active. Indonesia also pays close attention to ensuring safety in dam construction, and a dam construction permit and approval system has been established by law.

These are summarized in "Supporting Report 1: Summary of Regulations, Laws and Guidelines on Dam Safety and Construction in Indonesia."

Table 2-1 Indonesian Dam-Related Laws and Regulations

I. Technical Standard/Regulation of Dams	1. Technical Standard/Regulation of Dams (Continue)
1. Hazard Classification of Dams	22. Technical Guideline: Book 1 Very Complexed Bent of Concrete
2. Emergency Action Plan	23. Technical Guideline: Book 2 Very Complexed Bent of Concrete
3. Regulation: Procedure for Process of Dam Safety Commission	24. Guideline: Bend on Concrete Membrane of Rockfill Dam (CFRD).
4. Regulation: Procedure for Approval -Dam Construction & Demolition	25. Attachment A. Guideline for Design & Construction of Concrete Facing Rockfill Dam
5. Guideline: Impounding Reservoir	26. Attachment B. Guideline for Design & Construction of Concrete Facing Rockfill Dam
6. Guideline: Dam Safety Inspection & Evaluation	27. Technical Guidelines: Dam Risk Assessment
7. Guideline: Dam Safety Assessment	28. TECHNICAL GUIDELINES. DAM RISK ASSESSMENT LAMP
8. Guideline: Seepage Control in Filltype Dam	29. Guideline: Planning & Construction of Tunnel for Dam
9. Guideline: Dam Operation & Maintenance _ Vol. 1 - 5	30. Attachment: Guideline for Planning & Construction for Dam
10. Guideline: Sedimentation Management	2. Government/Minister Regulation
11. Guideline: Tailing Dam for Mining	1. Government Regulation of the Republic of Indonesia Number 37, 2010. Regarding Dam
12. Guideline: Implementation of Fill-type Dam Construction	2. 2. Minister Order of The PUPR regarding Dam Number 27/PRT/M/2015
13. Manual for Visual Inspection of Fill Type Dam	3. 3. Amendment of Minister Order of The PUPR related to Dam, No.6 2020
14. Guideline: General Design Criteria for Fill-Type Dam	3. Others
15. Guideline: Grouting of Dam	1. Standard for Fill-Type Dam Planning
16. Guideline: Construction of Cut-Off Wall of Fill-type Dam	2. Vol 1. Survey & Investigation
17. Guideline: Dam on Soft Soil Foundation	3. Vol 2. Hydrological Analysis
18. Guideline: Dynamic Analysis of Fill-Type Dam	4. Vol 3. Dam Foundation & Dam body
19. Guideline: Dynamic Analysis of Gravity Concrete Dam	5. Vol 4. Design of Dam Appurtenant Structures
20. Guideline: Survey & Monitoring of Reservoir Sedimentation	6. Vol 5. Hydromechanics, Instrumentation & Complementary Works
21. Technical Guideline: Dam Hazard Classification	7. 6. Indonesian Earthquake & Hazard Map, 2017

(1) Technical Guidelines

These Indonesian dam technical standards are basically based on the technical standards of Japan, European countries, Australia and the United States, and are compiled in a way that meets the current situation in Indonesia. In addition, it can be judged that there are no discrepancies in the basic contents of dam construction projects in accordance with these standards and guidelines.

(2) Laws and Regulations on Dam Safety Management

In addition to the technical standards and guidelines, laws and regulations and ministerial regulations concerning dam safety management have also been established (In the Ministerial Decree of the Ministry of Public Works and Housing of the Republic of Indonesia on Dams 27/PRT/M/2015 "PERATURAN MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT, REPUBLIK INDONESIA, NOMOR 27/PRT/M/2015, TENTANG BENDUNGAN DENGAN RAHMAT TUHAN YANG MAHA ESA MENTERI PEKERJAAN UMUM DAN PERUMAHAN RAKYAT REPUBLIK INDONESIA," the requirements for dam construction and the system for approval of construction are described.).

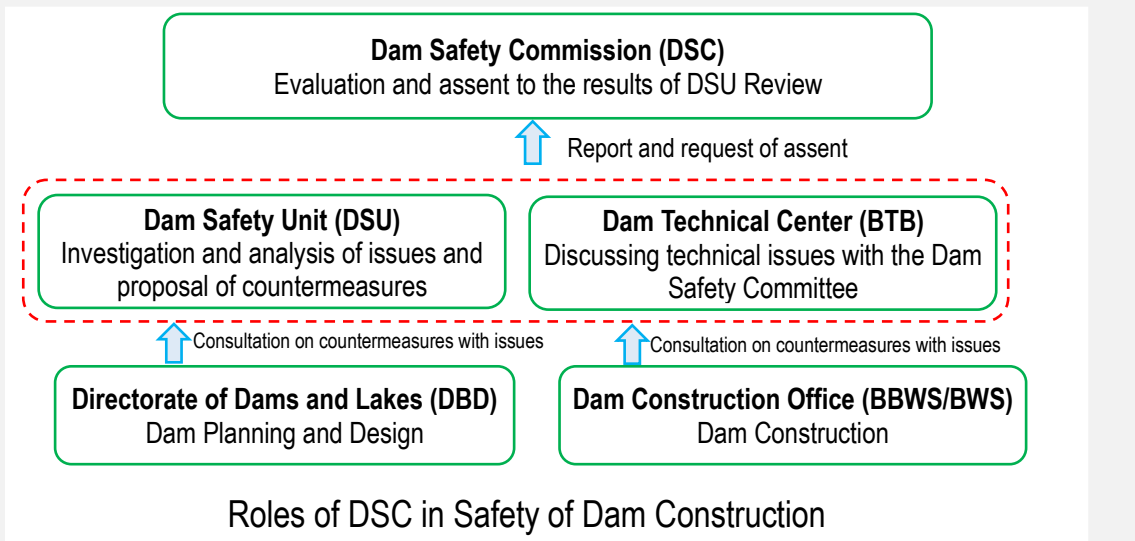
Safety management for dam construction in Indonesia was introduced in the "Dam Safety Guidelines (Dam Safety Guideline; SNI No. 1731-1989-F)" published in 1989. The guidelines describe the establishment of a committee responsible for approving dam safety assessments, including technical assessments for design, construction, operation and dam removal. In 1997, the Ministry of Public Works issued Ministerial Regulation 72/PRT/1997 on dam safety. The Dam Safety Regulation states that the Dam Safety Commission (DSC) and Dam Safety Unit (DSU) must conduct technical assessments to minimize dam damage at each stage of dam development (Design, construction, flooding, operation, rehabilitation, removal of dams) and obtain approval from the Minister (Fig. 21). In addition, regulations on dams in the Water Resources Act No. 7 of 2004 and Government Regulation No. 37 of 2010 on Dams were issued. This regulation clearly states the requirement to obtain a license at every stage of dam development and dam management. In addition, the need for an Emergency Action Plan is described as part of the Dam Safety Concept.

Dam Safety Committee (Ministerial Regulation 72/PRT/1997 on

The Dam Safety Committee (DSC), which is stipulated in the Act, has a system to confirm the safety of dam construction in the three stages of dam construction: (1) design, (2) flooding, and (3) operation. It carries out the following activities.

- The DSU collects data, analyzes analysis results, prepares technical proposals, and conducts on-site inspections.
- Based on the results of the DSU, the DSC conducts technical inspections.
- The DSC issues certificates indicating that the inspection of dam safety has been completed at each stage.
- BTB, the DSU, and the DSC provide technical advice on issues that occur at dam construction sites nationwide.

DSC members: Ministry of Public Works and National Housing (Directorate General of Water Resources, Department of Dams and Lakes DBD, Department of Dam Technology BTB, Institute of Water Resources PUSAIR), Ministry of Energy and Mineral Resources (Directorate General of Geology, Directorate General of Electric Power and Energy Utilization), Public Power Corporation (PLN), Ministry of Environment, Health and Forest, Indonesian Great Dams Conference (INACOLD), Indonesian Hydrological Society (HATHI)



Roles of DSC in Safety of Dam Construction

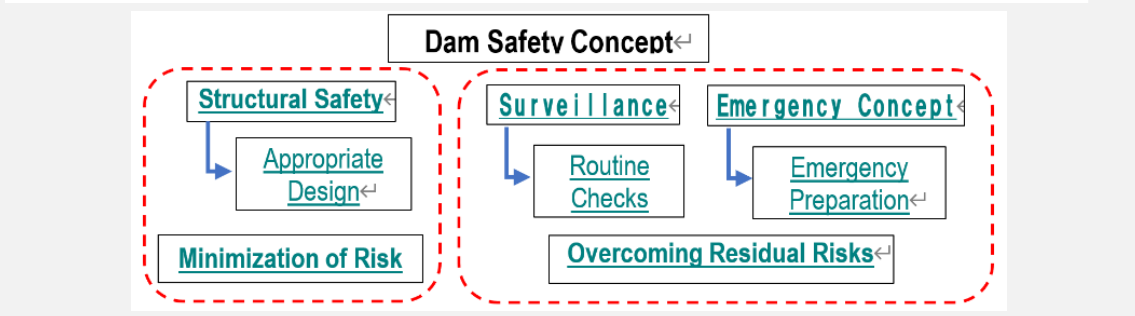


Figure 2-1 Concept of Dam Safety System in Indonesia

Note : Regarding this dam safety committee, it was revised in 2015 and a new Ministerial Decree No. 1234 (KEPMEN PUPR NOMOR 1234 TAHUN 2023 TTG KOMISI KEAMANAN BENDUNGAN) was issued.

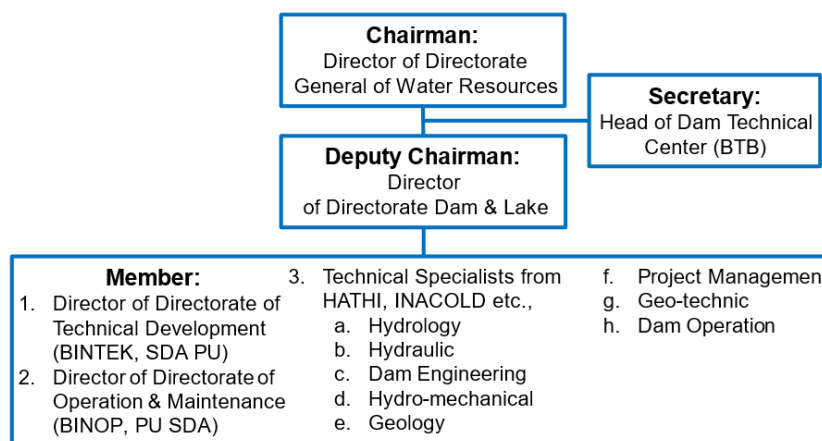


Figure 2-2 Organization Chart of Dam Safety Commission

As described above, the concept of dam safety in Indonesia is not limited to technical aspects of safety before construction, but also considers maintenance and management after construction and responses to unexpected situations.

The details of dam safety management are summarized in Supporting Report 3: Establishment of Risks Management System in Dam Construction.

3.1.2 Output 1-2: Collecting and Organizing Information on Ongoing 61 Dams

(1) Collecting Information on Ongoing Dams

Ongoing dams' information on 61 dams described in the “Rencana Strategies 2020-2024” were collected and organized (design documents, construction management reports, completion reports, dam behavior monitoring reports, etc.). They are under construction or scheduled to begin construction between 2020 and 2024, and dams scheduled to begin operation by 2024.

Such information is submitted to the DSU when applying for approval for each dam construction and is digitized and stored on the BTB server once the technical review by the DSU and the confirmed with the DSC are completed. So that, dam information had been mainly collected from the BTB.

The obtained information is shown in Table 2-2. In organizing this information, we prepared a form to extract issues that need to be investigated (Table 2-3). In addition, we prepared basic data to create a database of problems and responses in dam projects under construction to be able to utilize as examples in the future (Refer to Supporting Report 3 Establishment of Risks Management System in Dam Construction).

Table 2-2 List of Collected Ongoing Dam Data

No	Dam Name	Design Reports	Presentation Materials	Drawings	Minutes of Discussion	Remarks
1	AMERORO	0	0		0	
2	BAGONG		0		0	
3	BAJULMATI	0		0		
4	BENDO	0	0	0	0	
5	BENER	0	0		0	
6	BERINGIN SILA	0	0			
7	Bintan Bano	0	0	0	0	
8	BUDONG-BUDONG	0			0	
9	BULANGO ULU	0				
10	CIAWI		0		0	
11	CIPANAS	0	0	0	0	
12	GONDANG	0	0			PPT/ Paper
13	GONGSENG	0	0	0	0	
14	JATIGEDE	0	0		0	
15	JLANTAH		0		0	
16	JRAGUNG		0			
17	KARALLOE	0	0	0		PPT/Paper
18	KARIAN	0	0	0	0	
19	KEUREUTO		0	0		
20	KUNINGAN	0	0	0	0	
21	KUWIL KAWANGKOANG	0	0	0	0	
22	LADONGI	0	0	0		PPT/Paper
23	LAUSIMEME	0	0			
24	LEUWIKERIS		0			
25	LOGUNG		0		0	
26	LOLAK	0	0			
27	MANIKIN	0	0		0	
28	MARANGKAYU		0		0	
29	MARGATIG	0	0	0	0	
30	MENINTING	0	0			
31	MILA		0		0	
32	NAPUNGETE		0		0	
33	NIPAP		0			PPT/Paper
34	PAMUKKULU	0	0	0		
35	PASELLORENG	0	0			PPT/Paper
36	PAYA SEUNARA	0		0		
37	PIDEKSO	0	0	0	0	
38	RAJUI	0		0		
39	RAKNAMO	0			0	
40	RANDUGUNTING		0		0	
41	ROTIKLOT		0	0	0	
42	RUKOH		0		0	
43	SADAWARNA	0	0	0	0	
44	SEI GONG		0			
45	SEMANTOK	0	0	0		
46	SEPAKU SEMOI	0	0	0	0	
47	SIDAN	0	0			PPT/Paper
48	SINDANG HEULA		0			PPT/Paper
49	SUKAMAHI	0	0	0	0	
50	TAMBLANG	0	0	0	0	
51	TANJU		0		0	
52	TAPIN		0		0	
53	TEMEF	0	0	0	0	
54	TERITIP		0			PPT/Paper
55	TIGA DIHAJI		0		0	
56	TITAB		0			PPT/Paper
57	TIU SUNTUK	0	0	0		
58	TUGU	0	0	0	0	
59	TUKUL		0			
60	WAY APU		0			
61	WAY SEKAMPUNG		0		0	

Note) : ✓ is indicated in the available data. Different types of data are available depending on the dam.

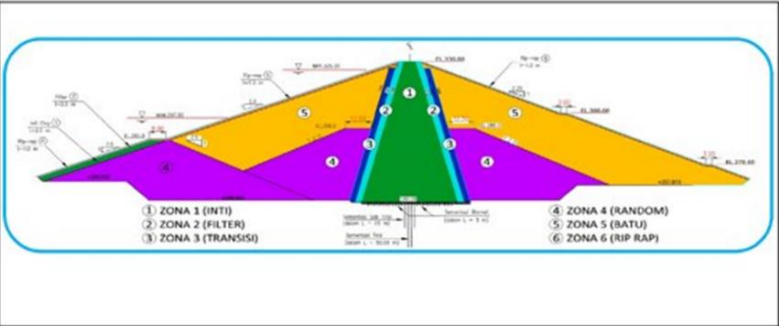
(2) Organization of basic information on dams

Basic information on each dam was organized as “Dam Technical Data” shown in Table 2.3. Information on the 61 target dams is summarized in Supporting Report 2 Study of Dam Related Issues.

on

Ongoing 61 Dams

Table 2-3 Dam Technical Data Input Form

<table style="width: 100%; border: none;"> <tr><td style="border: none;">Dam Name</td><td style="border: none;">: Bagong</td></tr> <tr><td style="border: none;">Province</td><td style="border: none;">: Jawa Timur</td></tr> <tr><td style="border: none;">Regency</td><td style="border: none;">: Trenggalek</td></tr> <tr><td style="border: none;">Coordinate</td><td style="border: none;">: 7° 59'51.63" S 111° 41'33.45" E</td></tr> </table>	Dam Name	: Bagong	Province	: Jawa Timur	Regency	: Trenggalek	Coordinate	: 7° 59'51.63" S 111° 41'33.45" E																																
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3.1.3 Output 1-3: Identifying and Sorting Technical Issues Concerning Dam Construction in Indonesia

Site Inspections and Technical Meetings of On going Dams

In response to requests from DBD and BTB, we accompanied DSC on site inspections of dams where issues were occurring, made comments at meetings, and compiled the contents of the inspections into a "Site Inspection Report" that was shared with DSC, BTB, and the dam site office.

Issues that are difficult to solve at the site are brought to BTB, considered by DSU, and then DSC proposed a solution. Therefore, there is a time delay in dealing with problems at the site. In the dam design and construction review process, a technical session is held with the consultant of dam design and construction supervision. The consultant and the owner explain the design concept and construction method, and then the contents are discussed. The matters that were resolved during the discussion and outstanding issues are recorded in the minutes as comments of DSC. Since this technical session is an important source of information for the ongoing dam project, I participated in the meeting as much as possible and proposed countermeasures to the problems presented.

Table 24 shows the site inspection and technical meetings that I participated in during the dispatch period. In addition, the Site Inspection Report and the minutes of the meeting are summarized in Supporting Report 4 Activity Reports.

Table 2-4 Participated Dam Site Inspections with DSC and Technical Sessions

Date	Name of Da	Activity	R emarks
Site Inspection			
Jun. 13, 2023	J lagung	Site Inspection	With DSC/BTB
Jun. 22, 2023	K eureuto	Site Inspection	With DSC/BTB
Jun. 23, 2023	R ukoh	Site Inspection	With DGSDA/DBD/BTB/DSC
Jul. 18, 2023	Singt an	Technical Discussion	On Kapuas River, West K alimantan
Jul. 19, 2023	P amkkulu	Site Inspection	With DSC/BTB
Jul. 20, 2023	A meroro	Site Inspection	With DSC/BTB
Jul. 25, 2023	J ragung	Site Inspection	With BBWS Pumali -Juana
Jul. 27, 2023	T emef	Site Inspection	With BTB
Jul. 28, 2023	M anikin	Site Inspection	With BTB
Aug. 8, 2023	L euwikeris	Site Inspection	With DSC/BTB
Oct. 5, 20 23	Temef /Manikin	Site Inspection	With DSC/BTB
Oct. 13, 2023	Bagong	Site Inspection	With BTB
Nov. 30, 2023	Ciawi / Sukamahi	Site Inspection	With BBWS CiliCis
Oct. 5, 20 23	Temef /Manikin	Site Inspection	With DSC/BTB
Oct. 13, 2023	Bagong	Site Inspection	With BTB
Nov. 30, 2023	Ciawi / Sukamahi	Site Inspection	With BBWS CiliCis
Jul. 2, 2024	Malang Kayu	Site Inspection	With DSC/BTB
Jul. 3, 2024	Speak Semoi	Site Inspection	With DSC/BTB
Jul. 18, 202 4	Sidang	Site Inspection	With DSC/ BTB
Jul. 19, 2024	Tamblang / Titab	Site inspection	With DSC/BTB
Jul. 30, 2024	Jenelata	Site Inspection	With DSC/BTB
Nov. 4, 2024	Ombo	Information gathering	With JICA Expert
Nov. 5, 2024	Jragung	Site Inspection	With JICA expert
Technical Session/Meeting			
Jul. 18, 2023	Singt an	Technical Discussion	On Kapuas River, West Kalimantan
Oct. 16, 2023	Sintang	Technical Discussion	BINTEK, MLIT Team On Kapuas River, West Kalimantan
Oct. 27, 2023	Ameroro	Technical Meeting for Impounding	DSC (Sidang Teknik)
Oct. 7, 2023	Muria Juroi	Technical Meeting for Impounding	With DSC
Oct. 8, 2023	Ameroro	Technical Meeting for Impounding	With DSC
Nov. 15, 2023	Bintang Sila	Technical Meeting for OM	With DSC
Nov. 16, 2023	Bintang Bino	Technical Meeting for OM	With DSC
Nov. 17, 2023	Temef	Technical Meeting for Impounding	With DSC
Nov. 23, 2023	Sai Harapan/ Lady	Technical Meeting for Impounding	With DSC/BTB
Oct. 16, 2023	Sintang	Technical Discussion	BINTEK, MLIT Team On Kapuas River, West Kalimantan
Oct. 27, 2023	Ameroro	Technical Meeting for Impounding	DSC (Sidang Teknik)
Oct. 7, 2023	Muria Juroi	Technical Meeting for Impounding	With DSC
Oct. 8, 2023	Ameroro	Technical Meeting for Impounding	With DSC
Nov. 15, 2023	Bintang Sila	Technical Meeting for OM	With DSC
Nov. 16, 2023	Bintang Bino	Technical Meeting for OM	With DSC
Nov. 17, 2023	Temef	Technical Meeting for Impounding	With DSC
Nov. 23, 2023	Sai Harapan/ Lady	Technical Meeting for Impounding	With DSC/BTB
Jun. 2 6, 202 4	Speak Semoi	Technical Meeting	W ith BINTEK, DSC, BTB, Cipta Karya, K-Water on Water Supply System to IKN (New Capital)
Jul. 4, 2024	Koto Panjang	Technical Meeting	With OM, Dam Operation Improvement Plan
Jul. 5,2024	Koto Panjang	Coordination Meeting	With OM, DBD, PLN
Jul. 9, 2024	Rukoh	Technical Meeting for Impounding	With DSC

Jul. 10, 2024	Cibeet	Technical Meeting for Design	With DSC , BTB, BBWS Citarum
Jul. 15, 2024	Wonogiri	Technical Meeting	With JICA, NK
Jul. 16, 2024	Benar	Technical Meeting	With DSC /BTB
Sep. 17, 2024	Lausimeme	Technical Meeting	With DSC/BTB
Sep. 24, 2024	Rukoh	Technical Meeting	With DSC/BTB
Sep. 26,2024	Menting	Technical Meeting	With DSC/BTB
Sep. 27, 2024	Tamblang	Technical Meeting	With DSC/BTB
Oct. 9, 2024	Sidan	Technical Meeting	With DSC/BTB

In addition, the trends of the locations and causes of problems and accidents that occurred at the site were examined from the viewpoint of risks as described in the next section.

3.1.4 Output 1-4: Identification and Organization of Technical Issues Related to Dam Construction in Indonesia

In the dam project, it is necessary for the parties concerned to correctly recognize the influence of uncertainty related to the dam, that is, the risks related to the dam project, and to appropriately deal with them in conception, planning, investigation, design, construction, and maintenance. In order to ensure the efficient execution and safety of the dam project, it is necessary to clarify the handling of the risks related to the dam project and the countermeasures as much as possible, and to appropriately evaluate the risks and make the best countermeasures.

Among the above risk management, it is considered important to recognize the existence of risks and to share them among the parties concerned in this work, and for 61 dams, problems that occurred in the site were regarded as risks from the DSC meeting records and the results of the site inspection, and risk cases were extracted, and the types, locations, causes, and countermeasures of the risks were arranged and analyzed. These details are summarized in "Supporting Report 3 Establishment of Risks Management System in Dam Construction".

(1) Definition of Dam Risk

In this study, dam risk was defined as below:

"Situation or condition which raised or recognized during the investigation, design, and construction of a dam and may have a serious undesirable impacts on a dam project".

It differs from the definition applied in ICOLD and USBR/US Army, which is "risk of dam collapse or malfunction or adverse effects of the project on stakeholders that may occur after the dam construction."

Reference: ICOLD's Approach to Risk Assessment

Since the middle of 1990, ICOLD has been discussing dam risk assessment in view of factors such as the aging of dams, the application of risk analysis in the nuclear and aircraft industries, and the response to climate change. However, most of the papers focus on the risk related to safety assessment of existing dams, not on the design and construction risks. In 2003, ICOLD published "ICOLD BULLETIN Risk Assessment in Dam Safety Management."

In this ICOLD Bulletin, dam risk is defined as follows.

"The probability and degree of importance of an adverse effect on human life, health, property, or the environment. In general, risk is estimated by scenario, probability of occurrence, and outcome. In particular cases, the average risk is estimated by the mathematical expectation of the outcome of an undesirable event that occurs (the product of the probability of occurrence and the outcome combined across all scenarios)."

As mentioned earlier, in Indonesia, besides the construction approval system, there is an organization called KKB to ensure the safety of dams, and it is obligatory to consider RTD (Rencana Tindakan Darurat Bendungan) based on ICOLD Bulletin before construction.

These are very different from the definition of dam risk proposed in this paper, but they contribute to the improvement of the quality of dam construction and are in line with the concept of dam safety. This is not to change the Indonesian system, but to add measures to recognize and respond to the risks arising in dam construction into the existing dam safety system.

The dam risk management here, therefore, aims to identify risks before construction starts, and provide measures to prevent accidents, delays, and cost increases during construction while also ensuring safety of dam after construction. It can be defined as "Dam Risk Management in Dam Design & Construction". Furthermore, it can be applied not only to risk management during construction but also to future maintenance and operation of dam.

(2) Identifying Risk Cases

Based on the dam design report and technical session data submitted to the Dam Safety Committee (DSC), 100 risk cases were extracted and analyzed for 61 dams across Indonesia. To extract risks, the background of risk recognition, risk factors, risk assessment, risk response, etc. were arranged in the causal relationship diagram shown in Fig. 22, and risks were extracted and specified.

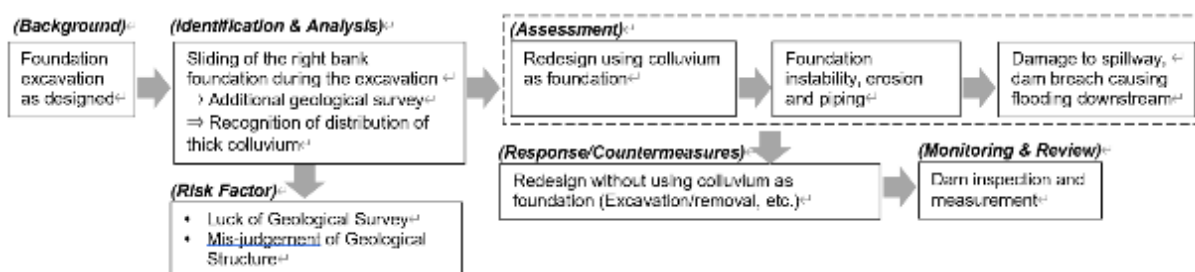


Figure 2-3 Diagram of Risk Identification

Note : In this case, during foundation excavation, it was found that the inundated soil was distributed with much thicker thickness than the assumption at the time of design. Therefore, insufficient strength of dam and spillway foundation and leakage/piping through the inundated soil were concerned.

(3) Collection and Organization of Cases

(a) Dam Risk Input Form

In organizing the 100 extracted risk cases, the input form shown in Table 25 was created for each extracted risk. The following 3 main items are organized in this form. The causal relationship chart shown in Fig. 22 is also a part of this input form.

- a. Background and circumstances of risk occurrence (location, occurrence)
- b. Risk factors and analysis
- c. Countermeasures and remaining issues

These results will be valuable information (database) on risk identification and countermeasures for dam construction projects in Indonesia. However, the use of case studies should be reviewed by engineers at each dam construction site who are familiar with how problems occurred and how they were resolved.

For reference, an example of the completed form is shown in Table 26. The completed form created in this survey is presented in Supporting Report 3, Establishment of Risks Management System in Dam Construction.

Table 2-5 Dam Risk Input Form

Table-1

When the risk was identified/observed	21 Dec 2022
Project phase in which risks were recognized	Construction
Location (Structure, Area)	Tunnel / top of tunnel
Context of risk	Clarity of tunnel, visibility
Risk factors	visibility appearance using variable dam
Events in which risks were recognized	material collapse from top of tunnel during tunneling
Condition/Situation for risk realization	verticality, vibration
Impact of the risk realizer	tunnel collapse, dam foundation disturbance
Where risk exists	geology, rock mass, permeability, foundation
Characteristics	273
Phase of Realization	<input checked="" type="checkbox"/> Operation <input checked="" type="checkbox"/> Due to large-scale external force action <input checked="" type="checkbox"/> Due to long-term use <input type="checkbox"/> Others
Impact of the risk realizer	<input checked="" type="checkbox"/> Affects dam safety <input checked="" type="checkbox"/> Affects dam function <input type="checkbox"/> Affects the schedule and costs of the projects <input type="checkbox"/> Avoidance is difficult.

Risk factors, categories, etc.

Risk realization process and response

Overview of Causal Relationships

Tunnel collapse → tunnel excavation and loose material collapse from above → sinkhole → additional survey for distribution → replaced with concrete + additional steel rib

machine vibration along concrete core → tunnel collapse, sinkhole for dam foundation → unstable dam foundation, dam break

ignoring sinkhole with concrete additional steel rib for tunnel → sinkhole

Aspiration

Risk Situation

Figure-1 Sinkhole location during tunneling




Figure-2 loose material collapse from tunnel

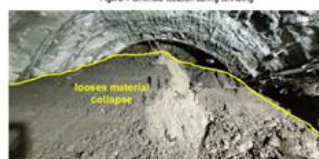


Table-2

Recognition or not in the past	Unrecognized
When the risk was recognized	Project Phase: Construction Date: 21 Dec 2022
Status of corresponding	Expanding to concrete
Project Phase	History of corresponding to risks
Plan	
Design	Using steel ribs for Tunnel reinforcement
Construction	Using canopy shields for tunnel reinforcement
Operation/maintenance	
Investigation/analysis	Investigation/analysis to identify factors, etc.
Research/analysis	Research analysis, etc. to assess impact
Measures	Allow to deal with Plans for decision Mitigation (see measures) Availability and method of monitoring
Special Notes	1) Challenges 2) Technical issues, 3) Constraints in project implementation requirements (Construction time, cost, etc.), 4) Constraints in dam operation, 5) Issues due to human and organizing (Cause for improvement of risk management etc.) 1) Technical issue 2) construction time and cost
Keyword	should be considered that for the downstream based segment of the Dam axis that passes through the loose sand layer, a drainage pipe equipped with a permeable should be installed so that the saturation level of the sand layer before the downstream slope can be reduced to minimize the seepage risk.
References	1) Technical issues related to geological study, dam design, and construction design 2) Tunnel construction 3) Tunnel construction 4) Tunnel construction

Risk response history

Illustration Steel Rib Canopy

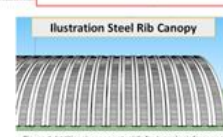


Figure-1 Additional canopy shields for tunnel reinforcement




Figure-2 concrete replacement to sinkholes

Special Notes

References

Table 2-6 Dam Risk Input Form - Example of Filling Out

ID:	Name: Bagoong	Dam Type: Rock-fill dam with central core	Dam Height: 82.0 m	Unrecognized	Date: 7-Jul-22
Contents of Risk	1 When the risk was identified (date)	7-Jul-22			
	2 Project phase in which risks were recognized	Construction			
	3 Location (Structure/Area)	Dam: Foundation, Spillway / Foundation			
Perspectives on Risk Classification	4 Contents of risk	Instability of the foundation, Piping of the foundation			
	5 Risk factors	Sliding of colluvium (rock mass sliding) used as foundation, Unequal settlement			
	6 Events in which risks were recognized	Sliding of the right bank cut slope occurred during the foundation excavation.			
	7 Conditions/Situation for risk realization	Foundation deterioration over time, Impounding, Heavy rains, Earthquakes			
	8 Impact if the risk realize	Dam breach causing flooding downstream, Damage to spillway			
Overview of Causal Relationships	9 Where risk exists	Geology / Strength, Permeability, Design / Foundation treatment			
	10 Character*1	B: Mainly due to technical factors			
	11 Phase of Realization*2	II: Operation, III: Due to large-scale external force action, IV: Due to long-term use			
Explanatory Diagram (Schematic Diagram/ Photos, etc.)	12 Impact if the risk realize*3	S: Affects dam safety / F: Affects dam function			
	13 Corresponding to risks*4	or Basically risk avoidance			
	Foundation excavation as designed	Sliding of the right bank cut slope occurred => Additional geological survey => Recognition of the distribution of thick colluvium	Redesign using colluvium as foundation	Instability of the foundation, Piping of the foundation	Dam breach causing flooding downstream, Damage to spillway

History	Recognition or not When the risk was recognized	Unrecognized	Project Phase	Construction	Date: 7-Jul-22
Plan	Status of corresponding	Countermeasure construction is under consideration			
	History of correspond to risks	The design was to use bedrock as the foundation.			
Construction	Investigation analysis	Investigation analysis to identify factors, etc.			
	Research/analysis, etc. to assess impact	Analysis, etc. to determine the need for and methods of response			
How to respond to risk	Measures	Foundation Treatment=> Spillway: Pile foundation-Scant Pile Dam: Scant Pile			
	Reason	Ground conditions, Construction cost			
Special Notes	Applicable standards	JIS S 5021, JIS S 5022, JIS S 5023, JIS S 5024, JIS S 5025, JIS S 5026, JIS S 5027, JIS S 5028, JIS S 5029, JIS S 5030, JIS S 5031, JIS S 5032, JIS S 5033, JIS S 5034, JIS S 5035, JIS S 5036, JIS S 5037, JIS S 5038, JIS S 5039, JIS S 5040, JIS S 5041, JIS S 5042, JIS S 5043, JIS S 5044, JIS S 5045, JIS S 5046, JIS S 5047, JIS S 5048, JIS S 5049, JIS S 5050, JIS S 5051, JIS S 5052, JIS S 5053, JIS S 5054, JIS S 5055, JIS S 5056, JIS S 5057, JIS S 5058, JIS S 5059, JIS S 5060, JIS S 5061, JIS S 5062, JIS S 5063, JIS S 5064, JIS S 5065, JIS S 5066, JIS S 5067, JIS S 5068, JIS S 5069, JIS S 5070, JIS S 5071, JIS S 5072, JIS S 5073, JIS S 5074, JIS S 5075, JIS S 5076, JIS S 5077, JIS S 5078, JIS S 5079, JIS S 5080, JIS S 5081, JIS S 5082, JIS S 5083, JIS S 5084, JIS S 5085, JIS S 5086, JIS S 5087, JIS S 5088, JIS S 5089, JIS S 5090, JIS S 5091, JIS S 5092, JIS S 5093, JIS S 5094, JIS S 5095, JIS S 5096, JIS S 5097, JIS S 5098, JIS S 5099, JIS S 5100			
	Keywords	Colluvium, Weathering, Creep			
References	Meeting Minutes:	2023.09.21 RDT Spillway Bagoong (Z-AF) - CL (rev), Cap 226-SKR Laporan Inspeksi dim rangka Pelaksanaan Konstruksi B. Bagoong			
	Meeting Materials:	Papanan BTB-Slinitua			
Other:	LAPORAN AKHIR STUDY NEOTEKNIK, Laporan Progress Pegebobana hasil MASW				

Figure-1	Photo-1 Before the cut slope sliding (July 3, 2022)	Photo-2 After the cut slope sliding (July 7, 2022)	Figure-2	Geological cross section of the dam axis (Site plan after additional investigation)
Figure-1				<p>Figure-2: Geological cross section of the dam axis (Site plan after additional investigation)</p>
	<p>Figure-1 Right bank geologic cross section based on additional survey results</p>			

3.1.5 Output 1-4: Organizing the Measures to Deal with Technical Issues

To organize the issue solutions in Indonesian dam projects, we analyzed/assessed the issues actually arose at each site, grasped the tendency, and then show the process of how to deal with issues.

(1) Risk Analysis

(a) Analysis Method

Collected risk cases were analyzed. Based on the summary table shown in the preceding paragraph, the number of cases was analyzed mainly from the following viewpoints and plotted as a pie chart.

- ✓ Risk factors: Factors that have the potential to materialize risks
- ✓ Risk locations: Locations of risk factors or structures affected by risk materialization
- ✓ Risk types: Classification of risk content (Leaks, deformations, landslides, etc.)
- ✓ Risk triggers: Classification of triggers for risk materialization (Natural and man-made factors, etc.)
- ✓ Similarity of risks: Recognized at many sites, recognized under special conditions, etc.
- ✓ How to deal with risks: Avoidance, reduction, holding
- ✓ When to deal with risks: Planning, investigation, design, construction, operation

(b) Results of Analysis

As a result of this risk analysis, the following were proven as the trends of problems which occur in the dam site in Indonesia. These risk analysis results were reported in the second seminar.

- ✓ Geological risks accounted for more than 60% of the total. This suggests that appropriate geological surveys, improvement of the ability of geological engineers, and advice from experienced engineers are important to avoid risks at dam construction sites.
- ✓ Most of the risks were caused by human factors (Inadequate research, misinterpretation of geology, improper design, etc.), and many of them could be avoided at the time of investigation and design. Therefore, improving the knowledge and ability of dam engineers and receiving reviews from experienced engineers would lead to risk avoidance.
- ✓ About 60% of the risks were similar risks that occurred at other dams, and if we had easy access to past cases, we could take appropriate measures in each project stage by referring to those cases. It can be said that if we recognize risks early and know past cases, we can take appropriate countermeasures for many risks.
- ✓ 55% of the risks were recognized at the construction stage, and 44% were recognized after completion. More than 50% of the risks can be recognized at the investigation and design stage. If we recognize risks in advance at the planning and design stage, it may be possible to prevent more risks from materializing or to improve the efficiency of handling risks.

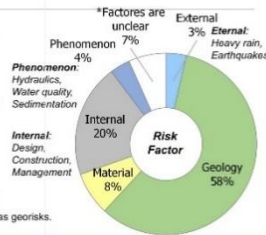
However, it is not possible to accurately and concretely judge the cause of the risk occurrence (especially whether it is man-made or not) from the data collected this time, as in the case of the evaluation in Japan, and it is undeniable that some aspects of the risk analysis were based on our evaluation criteria (For example, insufficient survey volume, insufficient technical skills, experience, and knowledge of the technician in charge, and inadequate management).

Dam Risk Analysis : 1 Risk Factor

- Risk factors are factors that have the potential to realize a risk.
- Approximately 60% of the identified risks are geological factors, and 20% are internal factors. Of the internal factors, approximately 70% are design-related.

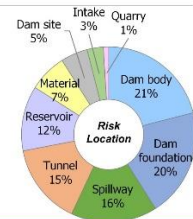
Geological study is very important !

Note: In this study, geological risk factors are referred to as georisks.



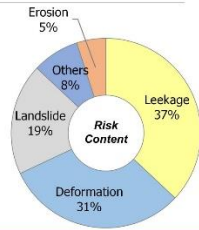
Dam Risk Analysis : 2. Location

- Risks observed in almost all areas of dam construction site, and the cause is largely related to geology.
- Approximately 50% of the risk factors are identified in the dam body, foundations and materials, with the rest in spillways, tunnels and reservoirs.



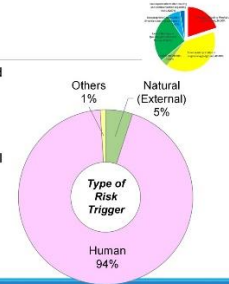
Dam Risk Analysis : 3. Type of Risk

- Water Leakage and Spring Water
 - from dam foundation, dam body, tunnel and other structures,
 - Deformation
 - foundation, dam body (in particular core zone), tunnels and other structures including sliding at structural foundation,
 - Landslides
 - collapse of natural slopes and cut slopes),
 - Erosion at waterway.
- Leakage, deformation and Landslide, account for 90%



Dam Risk Analysis : 4. Trigger

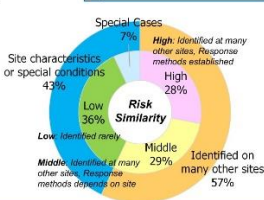
- The most of risks (classified as Human-related factor) can be avoided (94%) in case carrying out adequate survey and design.
- In each project stage, risk analysis and assessment, namely "RISK Management" should be conducted to recognize the potential risks and respond them.
- By accumulating experience and improving technical capabilities of Engineers, it is expected that risks can be avoided or reduced !



Risk Analysis : Similarity

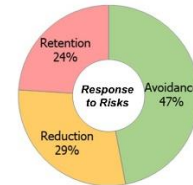
- 60% of the identified risks are similar to risks observed at other sites, so it is expected that risks will be respond efficiently based on similar risk cases.
- 40% of the identified risks are due to the characteristics of each site.
- In many cases, it is possible to efficiently respond to the risks by applying "Learned from Risk Analysis".

Categorization of Risk Similarities:
1. Risks that observed at many other sites
2. Risks that arise on special site conditions
Categorized depending on Response
a. High: Response methods are established,
b. Middle: Response methods are not established or vary from site to site
c. Low: Risks that be expected difficult
d. Special Cases



Risk Analysis: Results of Response to Risk

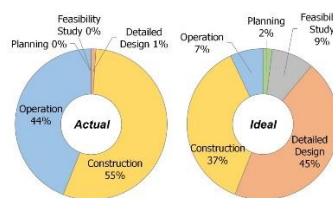
- Of the recognized risks, 47% are avoided, 29% are reduced, and 24% are retained.
- Avoidance refers to redesign and providing countermeasures,
 - Reduction refers to mainly repairs, and
 - Retention involves only monitoring.
- Even if these risks can be addressed after completion, it is essential that risks are eliminated before the dam is completed.



Risk Analysis: Project Phase for Risk Response

- By identifying risks in an early phase and handling them at the appropriate phase, it is often possible to avoid increased costs !

To respond to risks at the appropriate phase, Risk information is carried over to the next phase through risk communication!



Risk Analysis Findings

- Geological Risks** : more than 60%
 - Importance of appropriate geological surveys, improvement of the capabilities of geological engineers and advice from experienced engineers.
- Most Risks are due to **Human Factors** (insufficient investigation, misinterpretation of geology, inappropriate design, etc.)
 - Improve the capabilities of dam engineers and have experienced engineers' review.
- Of the identified risks, approximately 60% were **Similar Risks** that were observed in other dams.
 - If risks are recognized earlier, measures can be taken .
- 55% of risks were **Recognized during Construction Stage** and 44% after completion.
 - More than 50% of risks can be recognized at the time of survey and design stage. Many risks can be prevented if risks are recognized.

Importance of Risk Recognition
in early stage of the Project (Planning/Survey/Design Stages)
Risk Management System
to recognize potential risks and propose response at an earlier stage

Figure 2-4 Results of Risk Analysis (Seminar 2)

(2) How to Deal with Technical Issues

As described in the previous section, most of the issues occurred at the ongoing 61 dam sites were caused by human factors, and it can be judged to be able to avoid or reduce the risk by recognizing the risk at the time of planning, survey and design. Therefore, it is considered that the important issue is how engineers recognize the potential risk and deal with the risk at the appropriate time.

Currently, in Indonesia, the commencement of dam construction is permitted after design review by DSU and confirmation by DSC (Technical Session). The reviewing/analyzing of DSC and DSU are conducted based on the results of detailed design, but they are only judgements based on the product, so there is a possibility that risks that should be considered in design stage or transferred to the construction stage may be overlooked.

For this reason, a systemized method for checking risks throughout the entire project and an operating system for it, in other words, dam risk management, is required to deal with technical issues.

Here, risk management is the process of extracting and identifying risks without missing them, and optimizing the handling of risks based on the results of appropriate risk analysis and evaluation, as shown in Fig. 2-4.

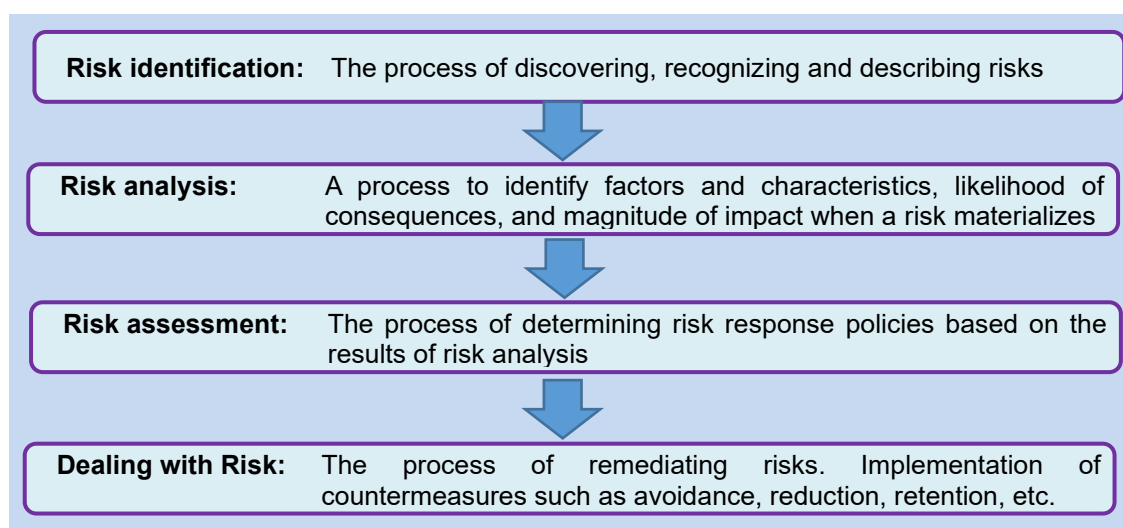


Figure 2-5 Approaches to Dealing with Risks

3.1.6 Output 1-5: Analysis and Examination of Coping Methods for High-Urgency Issues

Consultants and Contractors in Indonesia have technical skills, but they have a problem to grasp the whole project including site conditions from a bird's eye view and to recognize potential risks. And it is considered that introducing the "risk management system in dam design and construction" at working site is one of the effective measures to support the issues.

The frequent risk cases occurred at dam construction sites are spring water treatment, fault treatment, grout management, excavation slope failure, sedimentary rock slaking, and landslides. These are the high-urgency issues. Since most of the problems are related to geology and ground, the management of geology and ground risks is especially important in dam risk management. Therefore, the procedures and methods of risk management in dam projects were examined referring to "Guidelines for Geology and Ground Risk Management in Civil Engineering Projects" (March 2020).

By promoting the introduction and utilization of such a system, it is expected to prevent the occurrence of accidents due to the realization of risks, the delay of the project schedule and increase of the project cost due to the redesign and the implementation of countermeasures, etc., and to improve the safety of the constructed structure. In addition, it is expected to improve the technical ability of individual engineers by following the process of risk management.

(1) Risk Management Process

Risk management in a dam project is applied to various stages of the project and is continuously implemented throughout the project to optimize the handling of risks. Therefore, it is necessary to develop a clear policy and approach not only the risk assessment and the methods and procedures for handling risks, but also the operation of the management process such as risk management planning, communication and consultation, and continuous improvement of management. This content is explained in the first seminar. (See Data Book)

Risk management basically consists of the following five items, and the process consists of the relationship shown in Figure 24.

- (a) Communication and consultation
- (b) Risk Management Plan
- (c) risk assessment
- (d) Risk Response
- (e) Continuous improvement of risk management

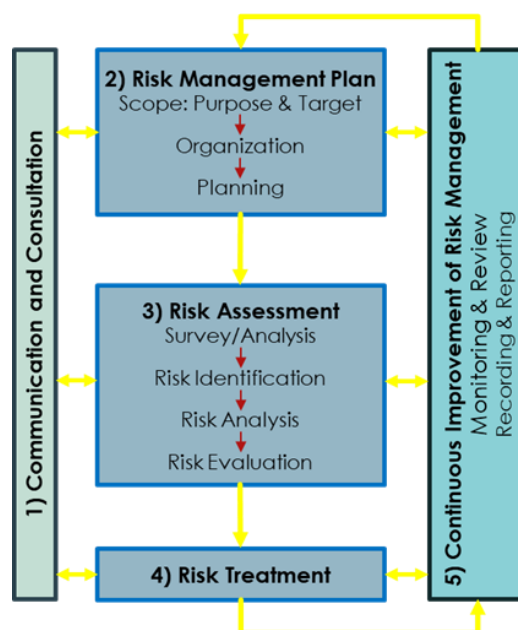


Figure 2-6 Risk Management Process

(a) Communication and consultation

Communication and consultation are the most important elements in the risk management framework and process. It is important to carry out communication and consultation continuously in the risk management process to constantly update the perception of risk and the way of thinking about responses. Such communication and consultation are necessary not only for risk assessment and risk response, but also for estimating the roles, capabilities, and functions of the people involved in building the system and organization, so they need to be carried out prior to the formulation of a risk management plan.

(i) Internal communications and consultations

Communication and consultation at the risk assessment and risk response stages must have the function of discussing information on the relationship and uncertainty of the foundation ground and material performance required for the design and construction of projects and structures and the performance of the foundation ground and materials estimated from surveys, tests, etc., and sharing an understanding of

risks. Although such consultation forums have traditionally been set up for the purpose of schedule adjustments and project execution, it is important to have communication and consultations with a clear purpose rather than simply sharing information.

For example, the information that each party has obtained can be compared with the information they need in order to prevent risks from being overlooked or misjudged, the extent to which a risk can be responded to at a given time can be clarified in order to consider the optimal timing for responding to the risk, and risk-related information can be shared in order to standardize the handling of risks in cases where multiple tasks or construction works are being carried out at the same time.

(ii) External communications and consultations

Communication and consultation are necessary not only within the business but also with external parties. Since the size and position of risks are affected by external circumstances such as the business objectives, demands and requirements for the business, and the environment in which the business is placed, communication and consultation with external parties is also necessary on an ongoing basis.

(b) Risk Management Plan

In dam risk management, it is desirable to determine in advance a management policy and management process that are common to all stages of the project. However, in reality, it is expected that management policies and processes will need to be considered for each stage of the project. For this reason, risk management plans at each stage must be made in accordance with the overall policy, taking into account the position and role of risk management at that stage in the overall project, and its relationship with other stages.

(c) Risk Assessment

Risk assessment is a process that provides materials for determining risk responses and their priorities. The estimated Introduction Management policies and processes common to all stages of the business should be established. The risk management plan at each stage should be in line with the overall policy, taking into account the position and role of risk management at that stage in the whole business and its relationship with other stages.

ted performance should be grasped based on the information available at that time, and it should be evaluated whether information on the performance required in the design and construction of the business and structures has been obtained, and how much uncertainty there is.

For example, it should be evaluated how the combination of the properties of foundation ground and materials, construction of the structure, external forces, etc., will produce the results, and how it will affect the business. It should also be clarified the prerequisites for information such as surveys and analyses, which are necessary materials for the judgment.

It should be noted that the surveys necessary for risk assessment are not necessarily carried out prior to risk identification and risk analysis, but they

should be comprehensively extracted at an early stage of the business and risk assessment should be carried out so as not to overlook risks with a large impact.

(d) Risk Response

Risk response is the process of correcting anticipated risks by avoiding, reducing, holding, etc. Risk response is the process of decision making of the response policy to select and implement the most appropriate response options based on the characteristics and magnitude of the impact of risks evaluated by risk assessment.

The content and magnitude of risks change depending on the accumulation of survey results due to the progress of business and the progress of the design and construction of structures. Therefore, risk response includes revision work such as detailed examination of the response measures selected in the previous stage and change of the response policy. Therefore, it is necessary to monitor the status of response to risks throughout each business stage.

(e) Continuous Improvement of Risk Management

Risk management needs to be continuously promoted throughout the entire business and each stage of the business. It is also necessary to review the organization and structure according to the progress. Therefore, it is necessary to monitor the progress of the business, changes in external conditions, changes in information regarding risks, and the current status of the structure and organization, and to review to determine whether appropriate response is possible. It is also necessary to prepare and report records to ensure that the information obtained through risk management and its results are shared and passed on.

(2) Timing of Conducting of the Risk Management

Risk management is a concept that can be applied at any stage of the business. On the other hand, since there are many options for dealing with uncertainties and risks associated with natural dams in the early stage of the project, it is desirable to start the project from the conception and planning stage from the viewpoint of economy and efficiency.

For example, in the dam project, if the risk can be recognized, the dam site with the risk can be avoided in the early stage, but when the project progresses, it becomes difficult to avoid it, and the possibility of spending a large amount of cost and construction time on countermeasures increases. In addition, even if the risk does not have a large impact, the project can proceed efficiently by identifying it early and responding strategically.

However, in the stage where information is scarce and there are many assumptions, even if the design is elaborated, it may result in overdesign due to excessively pessimistic assumptions, and in the worst case, excessively optimistic assumptions may cause accidents. Therefore, in the stage where information is not available, it is necessary to decide to suspend the determination of countermeasures.

(3) Risk Management Team

(a) Composition and roles of stakeholders

In building the risk management system, the business operator should involve persons with the necessary abilities and knowledge from both inside and outside, and clarify the coordination system of these parties, their functions, roles, and responsibilities. In addition, the parties concerned should confirm their respective roles and responsibilities in advance, and endeavor to ensure the necessary abilities and functions to fulfill their assigned roles.

In risk management, close cooperation with each other as well as their respective roles and responsibilities is important. Since geology and ground in particular are uncertain, unexpected situations often occur. In such cases, unplanned tasks are required. In such cases, gaps in roles and responsibilities, such as insufficient information transmission and insufficient sharing of risk information, often result in unfavorable results. Therefore, it is necessary to establish a system in which common recognition can be achieved by cooperating on a regular basis and sharing of risk information.

Table 28 shows an example of the composition of stakeholders in risk management, and Fig. 25 shows an example of the risk management system.

(b) Teams and their roles

Since dam risks span multiple areas of expertise, it is essential to respond by a team consisting of stakeholders according to the process. Examples of these response teams are shown below.

- ✓ Risk identification team: A team to identify and identify risks without missing them
- ✓ Risk analysis team: A team to analyze risks
- ✓ Risk assessment team: A team to evaluate risks
- ✓ Risk response review team: A team that devises and organizes risk response measures based on risk assessment results
- ✓ Construction risk response team: A team that deals with risks during construction

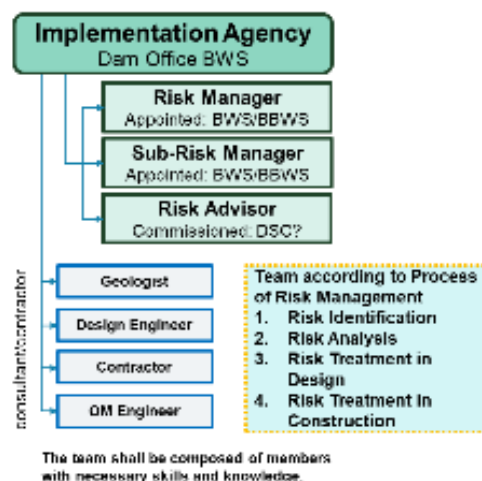


Figure 2-7 Composition of risk management team

Table 2-8 Proposed composition of the risk management teams

Member	Role
Implementing Agency (Dam Office / BWS)	A person who makes decisions of project implementation, planning and management of geological surveys, etc., and risk treatment.
Risk Manager (Appointed by IA)	A person in charge of overall dam engineering (structural/geological) risk management in/from the Implementing Agency.
Risk Sub-Manager (Appointed by IA)	A person who assists in the operation of risk management conducted by the risk manager.
Dam/geology Risk Advisors (Commissioned / DSC)	A dam and geology specialist who supports dam risk managers and risk management operations from a professional standpoint.
Dam Design Dineer (the Consultant/dam engineer)	A person who designs dam/structures, etc.
Geotechnical Engineer (the Consultant/geologist)	A person who conducts geological survey and analysis, etc.
Construction Engineer (the Contractor)	A person who constructs structures, etc. based on the design.
OM Engineer (if necessary) (the Consultant)	A person who conducts inspections in the maintenance and management of structures.

3.2 Output 2: Capacity Development of PU Dam Engineers

3.2.1 Proposal of Risk Management System for Dam Design and Construction

The fact that most of the dams under construction in Indonesia are constructed using the local technology suggests the high level of dam technology in Indonesia. On the other hand, the fact that the knowledge and experience of experts and organizations are not widely disseminated within PU organizations and to the engineers of consultants and contractors is a major issue to be solved in the future.

Especially, dam technology covers a wide range of areas, and it is necessary to make decisions based on understanding all of them. Even if dam engineers in Indonesia have partial knowledge, they tend to turn a blind eye to non-specialized areas. With minimum knowledge in a wide range of fields in addition to specialized fields, they are required to make decisions on how to deal with issues that arise during dam design and construction.

To solve this issue, we propose introducing the dam risk management discussed in the previous section into the review process of dam design and construction. By carrying out risk management at the time of investigation, design and construction, it is expected that the discussion in the field in the risk management team including the experts will be carried out, and it is expected that the capacity of not only the dam engineers of PU but also the consultant and contractor engineers will be enhanced, which will lead to the improvement of dam technology in Indonesia.

Therefore, this work proposed (1) construction of a database for risk management, (2) preparation of guidelines, and (3) introduction of a risk management system (construction of an implementation system) to BTB and DSU as a plan to strengthen the capacity of dam engineers of PU. In addition, in two technical seminars carried out by this work, the necessity of risk assessment and the proposed implementation system, examples of geological and geotechnical risks that occurred during dam design and construction, and geological considerations for risk management were presented and discussed.

(1) Preparation of Database

BTB, BENDA, and KKB confirmed on:

- a. understand the usefulness and necessity of the database
- b. commit to building the database, and
- c. confirm that it is essential to regularly update the database once it has been built.

Furthermore, more specific content is required for the areas of focus when creating the database. The objectives are:

- To use past events to guide actions against potential issues expected.
- To ensure transparency by disclosing and documenting dam damage, rather than concealing it.
- To develop a format for recording dam damage by categorizing it into spillway, geotechnical aspects, dam structures and works, etc.

Since basic information on existing and ongoing dams has already been accumulated in BTB, and 100 examples of how to compile the information have been provided in this project, such existing tools shall be utilized as much as possible. In the future, BTB will take the lead in proceeding with the work of creating a database of this information.

However, regarding the implementation method, there is a concern that if the work is relied on internal staff of BTB, it will overlap with other work and the work will not progress, so first, the development of the database system and the input of existing information will be outsourced to a consultant (PU side would like to ask JICA to create the TOR for this).

(a) Special Notes

- ✓ Classify the characteristics of each phase (investigation, design, construction, operation and maintenance) and extract keywords and best practices. In particular, referring to the results of risk assessment of 100 recent cases, the following points will be focused on:
 - a. Geological survey and analysis
 - b. Foundation treatment
 - c. Construction materials
 - d. Possibility of human error
- ✓ Database based on construction zones.
- ✓ BTB has accumulated information, so this information will be utilized to the maximum extent. Past experience, technical meetings, and opinions of the dam safety committee will be databased.
- ✓ A manual will be created to guide input into the database.
- ✓ The database will be designed in a structure that allows engineers to quickly access related past cases.
- ✓ The database should be practical and readily available for on-site reference.
- ✓ It should serve as a reference for dam safety assessment and decision-making.

(b) Action Plan

To develop a database for recording past dam risk cases, the following items will be carried out.

- ✓ Create the database structure
- ✓ Aim for the structure to be a complete set of measures to effectively reduce risk.

- ✓ The solutions are comprehensive and feasible.
- ✓ Create a classification system for risks by zone and phase (design, construction, operation, maintenance).
- ✓ Create TOR showing the structure and contents of the database
- ✓ Outsource the development of the database system and input of existing information to a consultant.

After the 1st Seminar, Database Creation Team was formed within BTB by PU staff, and they started to fill the dam risk input form, but the work was not continued. In response to this, this action plan was proposed by BTB/DSC.

It is hoped that in the future, input of risks for existing and new dams will be promoted, and discussions will be held on the construction of a database based on this input form and its utilization.

(2) Preparation of guidelines and establishment of implementation system

In parallel with building the database, it is necessary to create "Dam Risk Management Guidelines" that will serve as a guide for implementing risk management during design and construction on-site. Indonesia already has a "Dam Risk Management Guideline," so the system proposed here will be incorporated into this. Japan's "Guidelines for Geological and Ground Risk Management in Civil Engineering Projects" can be used as a reference for this.

The draft guidelines will be created by BTB with the cooperation of DSC, and then handed over to the PU SDA Technical Bureau (BINTEK) for revision and publication.

3.2.2 First seminar

The first seminar was held as part of a workshop organized by the Indonesia Dam Conference (INACOLD) from December 8 to 10, at the request of Indonesia.

In the presentation at the seminar, Mr. Aries, Director of Dam Safety Committee (DSC), gave a lecture on "Dam construction situation and problems in Indonesia," followed by Mr. Shimizu, who explained the outline of "Risk management (geology and foundation) in civil engineering project" guideline of Japan and proposed how to apply it to Indonesia, and then Mr. Mizuno, who explained geological survey analysis for risk management.

The presentation materials are attached to Supporting Report 5.

Figure 2-8 Program and presentations of the 1st seminar

Program of Seminar

SEM 1		SEM 2	
No.	Activity	No.	Activity
1	14:00 - 2:00pm Address "TOWARDS SAFETY and SUSTAINABILITY OF DAM CONSTRUCTION IN INDONESIA" Dr. Aries Firman, Dam Safety Commission	1	14:00 - 2:00pm Presentation "Dam Risk Management in Dam Design & Construction" Mr. Shimizu Hiroshi, JICA Dam Construction Advisor
2	2:00pm - 2:45pm Presentation "Dam Risk Management in Dam Design & Construction" Mr. Shimizu Hiroshi, JICA Dam Construction Advisor	2	2:45pm - 3:00pm Coffee Break
3	3:00pm - 3:45pm Case Study "Geological Study for Risk Management" Mr. Mizuno Naoya, JICA Dam Construction Advisor	3	3:00pm - 3:45pm Case Study "Geological Study for Risk Management" Mr. Mizuno Naoya, JICA Dam Construction Advisor
4	3:45pm - 4:45pm Question-and-answer session, Discussion	4	3:45pm - 4:45pm Question-and-answer session, Discussion

- Date: December 8, 2023
- Venue: Universitas Pelita Harapan, Tangerang.
- Rundown
 - 14:00pm - 2:00pm
Address "TOWARDS SAFETY and SUSTAINABILITY OF DAM CONSTRUCTION IN INDONESIA"
Dr. Aries Firman, Dam Safety Commission
 - 2:00pm - 2:45pm
Presentation "Dam Risk Management in Dam Design & Construction"
Mr. Shimizu Hiroshi, JICA Dam Construction Advisor
 - 2:45pm - 3:00pm
Coffee Break
 - 3:00pm - 3:45pm
Case Study "Geological Study for Risk Management"
Mr. Mizuno Naoya, JICA Dam Construction Advisor
 - 3:45pm - 4:45pm
Question-and-answer session, Discussion

プレゼンテーションの内容 1 "TOWARDS SAFETY and SUSTAINABILITY OF DAM CONSTRUCTION IN INDONESIA" Dr. Aries Firman, Dam Safety Commission

- "Construction"
 - a. Site activity focused?
 - b. What about planning & design?
 - c. Dams: multi disciplinary aspects
- Safety and Sustainability
 - a. ICOLD's World Declaration
- Design issues
 - a. Planning, Survey & Investigation
 - b. Land acquisition
 - c. Basic Design
 - d. Detail Engineering Design
 - e. Design approval process
- Implementation issues
 - a. Additional site investigation
 - b. Accessibility
 - c. Material availability
 - d. Method of statement
 - e. Unforeseeable conditions
- Moving forward
 - a. Sustainable dam construction specialists
 - b. A full life cycle approach for resilient dams
 - c. Maintain dam & public safety during operation stage

プレゼンテーションの内容 2 "Risk Management in Dam Design & Construction" Mr. Shimizu Hiroshi, JICA Dam Construction Advisor

1. Necessity of Risk Management in Dam Project
2. Effects of Risk Management
3. Initiatives in Japan
Guidelines for Geological & Ground Risk Management in Civil Engineering Projects
 - a. Basic Concept of Risk Management in Civil Engineering Projects
 - b. Basic Policy of Guidelines
 - c. Focus Points of the Guideline
 - d. Application of ISO31000 "Risk Management"
 - e. Composition of Guideline
 - f. How to Proceed Risk Management in projects
 - g. Timing of Risk Management
 - h. Establishment/ Organizing of Management
4. Application to Indonesia
 - a. Preliminary Survey for Risk Management
 - i. Utilization of the System
 - ii. Individual Event Summary Report
 - b. Establishment of Risk Management System in Indonesia
 - i. System in Each Project
 - ii. Utilization of the System
 - iii. Configuring the System in Other Countries

プレゼンテーションの内容 3 "Geological Study for Risk Management" Mr. Naoya Mizuno, JICA Dam Construction Advisor (Geology)

1. Importance of Geologic Study
2. Geological Survey
 - 2.1 Boring Survey by Grid
 - 2.2 Utilization of Seismic Exploration
3. Geological Analysis
 - 3.1 Purpose
 - 3.2 Role in Risk Management
 - 3.3 Procedure
 - (1) Topographic Interpretation
 - (2) Geologic Stratigraphy/Geologic Structure
 - (3) Geotechnical Evaluation
4. Consideration of Georisk in Design
 - 4.1 Georisk Category
 - (1) Discontinuity
 - (2) Volcanic Activity
 - (3) Weathering
 - (4) Swelling/Slaking
 - 4.2 Cutting Slope
 - (1) Stress Release Ratio
 - (2) Excavation Gradient
 - (3) Characteristic Geological Structures
 - (4) Protection of Cut Slope
 - 4.3 Tunnel
 - (1) Discontinuity
 - (2) Swelling

写真

Photos in Venue

Following the presentation, the following questions were asked:

Table 2-9 Main Questions and Answers at the First Seminar

Question	Answer
Q1: How can risk management guidelines be applied within budget and time constraints?	Dam construction is influenced by many factors, and it is impossible to predict all of them, so it is important to first organize and study various external cases. When building a dam while balancing costs and schedules, much needs to be learned from experience. Don't assume that data-driven design is perfect; learn from precedent.
Q2: Can we avoid risks and prepare for new technologies in dam construction?	Guidelines have already been put together for some topics. In the future, we plan to improve the process of building and operating dams. For this reason, we will continue to record the dam's construction and operation process, as well as data. I think it would be effective to create a database using a risk management system.
Q3: How should we think about treating groundwater, which was not mentioned in the presentation?	Treatment must be done while taking into consideration the overall balance. Not only must surface drainage be improved, but measures must also be taken to prevent and reduce weathering of the excavated surface.
Q4: What is your approach to limiting the number of survey holes when an increase in the number of survey holes is expected?	The placement of survey holes will follow existing guidelines, but where quantities are expected to be highly uniform, hole placement has been reviewed and quantities adjusted based on key requirements. Since there are limitations on the amount of survey data available and it is not possible to collect complete data on-site, empirical judgments are made from the data obtained and the data is output as quantitative data for design.
Q5: If the desired information is not obtained from the exploration hole, how should the additional drilling plan be decided?	

3.2.3 The 2nd seminar

The seminar on risk management in dam construction was conducted in the workshop organized by the Indonesia Commission on Large Dams (INACOLD) as a "National Seminar" from November 15 to 17, 2024.

First, Mr. Shimizu presented the results of analysis of risks during construction in Indonesia, followed by Mr. Mizuno, who presented specific examples of risks related to topography and geology, and suggested the points to be considered for risk management. And finally, Dr. Aries, Dam Safety Commission, presented the risk management of existing dams in Indonesia (see Data Book 4).

Table 2-10 Presentations at the 2nd Seminar



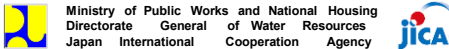
Risk Management in Dam Design & Construction

COMPOSING RISK MANAGEMENT SYSTEM IN INDONESIA

NOVEMBER 16, 2024
NATIONAL SEMINAR, INDONESIA COMMITTEE ON LARGE DAM (INACOLD)

BY JICA, DAM CONSTRUCTION ADVISORS

Contents of Presentation

Geological Considerations for Dam Risk Management.

November 16, 2024
National Seminar, Indonesia Committee on Large Dam (INACOLD)

By JICA, Dam Geological Advisors
Naoya Mizuno

Table of Contents

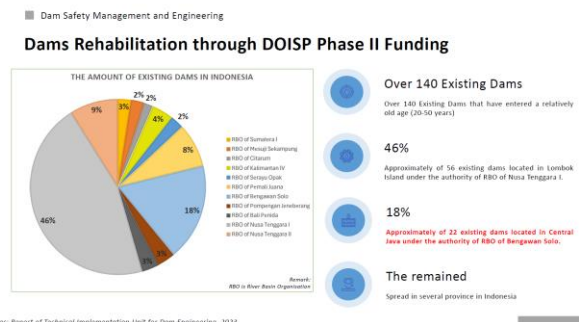
1. Introduction	
1.1 Define and Identify Risk	
1.2 Geological Risk Factor (Georisk Factor)	
2. Considerations for Each Phase	
2.1 Plan & Preliminary Design Phase	
(1) Active fault	
(2) Sedimentation	
(3) Landslides around Reservoir	
2.2 Detailed Design Phase	
(1) Dam Foundation (including Grouting)	
(2) Cut slope	
(3) Tunnel	
2.3 Construction Phase	
(1) Dam Foundation	
(2) Cut slope	
(3) Tunnel	
2.4 Operation Phase	
(1) Sedimentation	
(2) Landslides around Reservoir	
3. Engineering Sense for Geologists	
3.1 Perspective and Imagination	
3.2 Integrated Interpretation	



INACOLD
Indonesia Committee on Large Dam

Risk Assessment of Dams in Indonesia

2024 Annual Meeting & National Seminar
(presented at Workshop organized by JICA)



After the presentation, the following questions and answers were held:

Table 2-11 Main Questions and Answers at the 2nd Seminar

	Questions	Answers
1	Dam construction is expected to cause environmental and social problems (especially land acquisition). How should we deal with problems that are not covered by the database provided? (Fathih: BBWS Brantas)	This time, we focused on the technical issues of dam construction, and dealt with risk analysis and risk treatment in surveys, designs, and construction. In the future, it is hoped that information on various issues will be collected and a database will be built. We also believe that these issues will be resolved through discussions by the risk management team. (Shimizu)
2	How should we decide on a risk management method, since problems vary from dam to dam? (Faizal: ITB)	The first step in determining a risk management method is risk analysis, which identifies the anticipated risks at each site. The database can predict and identify various dam problems that may occur at each dam. In addition, risk management will be carried out within the team, with reference to past cases. This will also include inviting experts to the team, such as members of the DSC. (Shimizu)
3	What should we do if an active fault is found at a dam site during construction, which is an actual example? (Mr. Solar: Peso Energy)	If the presence of an active fault is confirmed at the site, the expert's opinion will probably be to "suggest moving to another location." We expect discussions based on risk management. (Mizuno)
4	What efforts are being made in Indonesia, based on past dam construction experience, to avoid the risk of dam collapse for dams currently under construction? (Shimizu)	In Japan, technical guidelines have been created that document measures according to the situation at each work stage of the project, but the geology is very complex, so they do not cover everything. When a problem occurs, it is often the case that each project will deal with it. In this case, too, it is necessary to predict risks in advance and respond to them by the risk management team when they occur. (Mizuno)
5	What efforts are being made in Indonesia, based on past dam construction experience, to avoid the risk of dam collapse for dams currently under construction? (Shimizu)	As an effort to complete the dam construction lifespan, the dam construction process to meet the design material parameters is important, and DSC focuses on this point. We also recognize the importance of water level and leakage management during test impoundment and operation, and respond to reports from the field. (Aries)
6	How are dam risk management assessments applied by companies and private companies in dam design planning? (Question from Dr. Aries to the audience)	Henny (Antan: Mining company) Antan has already created ISJ factor regulations created in-house with reference to ICOLD B-130 (Risk Assessment in Dam Safety Management - ICOLD Bulletin 130 A). All recorded risk figures are investigated, evaluated and ranked. Risk investigations include social, environmental, geological, etc. The results are taken into account in the design as dam safety figures, and consideration is given to minimizing damage in the event of a collapse. Sulitstiant (PLN: Electricity Company) Dam collapse risk analysis is carried out in the design approval process for dam construction, including the financial process as an evaluation in the business process of providing hydroelectric power. Risks in river management models are also evaluated in collaboration with the River Technology Agency.
7	How do we integrate research conducted by universities with data owned by government agencies? (Dr. Faizal, ITB Professor)	This research program has collaborated with university researchers as part of scientific renewal and for application to dam construction. (Aries) It is very important to integrate research data conducted by universities with government agencies. This can be achieved by holding meetings, discussions and seminars involving academics and relevant government agency personnel. (Yamamoto) We believe that addressing dam safety risks can be done through cooperation between institutions and communities to maintain the cleanliness and sustainability of reservoirs, such as through joint management of reservoirs with communities. (Bambang)



Scene from the venue



Shimizu presentation



Mizuno presentation



Comments by Mr. Yamamoto, JICA Expert



Presentation of memorabilia by Ali PU Counselor



Mizuno · Shimizu · Dr. Bambang · Dr. Aries ·
Wdi Director of River and Coastal Department

Photos in Venue

3.2.4 Participation in INACOLD Webinar

On July 31, 2024, I participated as a presenter in the Webinar on "Design and Construction of RCC Dam" organized by the Indonesia Large Dam Conference (INACOLD). This Webinar is a technical conference held to deepen understanding of RCC Dam in Indonesia for the construction of Cibet Dam, the first RCC Dam in PU.

As the participants were Indonesian engineers, I anticipated that there would be few experienced people, and I described the history of RCC Dam construction, features of RCC Dam, criteria for selection, and points to consider in design. I also explained the difference from RCD developed in Japan based on my experience in Japan (see Data Book).

KNIBB INACOLD **RPU** **SIKAP MEMBAKUN NEGARA**

WEBINAR

DESAIN DAN METODE PELAKSANAAN KONSTRUKSI ROLLED COMPACTED CONCRETE (RCC) DAMS

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Dr. Adnan Khayri, Country Director, KNI-IBB, INACOLD
Dr. Saiful M. Eng, President, RRCI, RRCI, RRCI, RRCI

Dr. Herman Prihadi, ST., IIR, IIR, IIR, IIR
Edward Flint, Head of Office, Director, Technical Department, PPTA
Shimizu Hiroshi, Supervisor, CCI Engineering & Infrastructure Company

Dr. Sanji G. Prasad, ST., M.Sc., Director, Technical Department, PPTA
Arnesia Mayangsari, Head, RRCI, RRCI, RRCI, RRCI

via zoom

Studi Kasus: Bendungan Cibeeet

Rabu, 31 Juli 2024
Pukul 15.00 - 18.00 WIB

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Ministry of Public Works and National Housing
Directorate General of Water Resources
Japan International Cooperation Agency

Design & Construction of RCC and RCD Dams

WEBINAR ON WEBINAR ON DESIGN AND CONSTRUCTION METHOD OF RCC
INACOLD & BBWS - CILIGIS
JULY 31, 2024

SHIMIZU Hiroshi
JICA Dam Construction Advisor
CCI Engineering International Co., Ltd.

Contents

1. History of RCC Dam Construction
2. Advantage of RCC
3. Disadvantages of RCC
4. RCC Dam and RCD Dam
5. RCC Innovation
6. Points to note regarding design and construction
 - a. Consideration of RCC/RCD adoption
 - b. Specific check items
 - i. Ensuring watertightness
 - ii. Design of
 - iii. Mix Design of RCC
 - iv. Quality Management
7. Conclusion

Figure 2-9 INACOLD Webinar Brochure and Presentation Material

After the presentation, many questions were received and answered. The main ones are as follows.

In addition, BTB and BBWS Citarum requested cooperation on RCC for the construction of Cibeeet dam.

Table 2-12 Questions and Answers at Main Seminars

Questions	Answers
<p>Q1. What challenges will be faced during the construction of the RCC and how will they be addressed?</p>	<ul style="list-style-type: none"> • In the construction of RCC dams, quality control of RCC concrete (compaction) and pouring surface treatment become issues. • Regarding pouring surface treatment, at RCD dams in Japan, standard pouring surface treatment such as green cutting and smooth spreading of mortar is carried out to ensure adhesion of pouring joints and prevent water leakage from the pouring surface. • In addition, temperature control during curing is also important.
<p>Q2. How to maintain water-cement ratio during RCC construction</p>	<ul style="list-style-type: none"> • The quality of unhardened RCC concrete is evaluated by its CV value. • In particular, the consistency of RCC concrete, as represented by the VC value, is greatly affected by the water-cement ratio, so the optimum water-cement ratio is set in advance using a trial mix. During construction, the VC value is checked periodically (setting of quality control standards).
<p>Q3. How do you ensure that the temperature of the constructed RCC is as specified?</p>	<ul style="list-style-type: none"> • In RCC/RCD dams, in order to take advantage of the rapid construction feature and because of the rolling compaction construction method, cooling pipes are generally not installed on the pouring surface. Since post-cooling cannot be expected, pre-cooling is thoroughly implemented. In addition to preventing the temperature rise of the aggregate, in Japan, aggregate is cooled with liquid nitrogen and cold water/ice are also used. • A thermometer will be installed inside the dam body. If the temperature rise is higher than the analytical value, the construction speed will be restricted and the pouring surface will be cured to prevent the occurrence of racking due to internal restraint. • In order to reduce the effects of temperature stress, measures such as limiting the width of horizontal joints, reducing the amount of cement used, and using Pozzolan (mainly Fly Ash) will be taken.
<p>Q4. I would like to know how to design the RCC mix, including how to think about aggregates.</p>	<ul style="list-style-type: none"> • There are standards in the US Army Engineers Manual and USBR, so it is best to follow those. • The use of Pozzolan and Additive (especially Fly Ash and AE water reducers) should also be confirmed during laboratory testing. • The main standards for aggregates that are discussed are the fine aggregate ratio and the actual volume ratio. In order to make High (Rich) Paste RCC, the amount of fine aggregate is sometimes increased slightly. • On-site testing is carried out prior to construction to check the number of compactions, strength, pouring surface treatment methods (including sides), etc. • During testing, large-scale BE-VE tests will be conducted to confirm the results using actual-size aggregate.

4. Activities with Japanese ODA Activities

4.1 Collaboration with JICA Integrated Water Resources Management Policy Advisor

In the activities as a dam advisor, information exchange with the "JICA Integrated Water Resources Management Policy Advisor" was very effective. We, the dam advisors worked based in BTB, but the Integrated Water Resources Management Policy Advisor shared information from the headquarter of PU, especially the Directorate Operation and Maintenance and Technical Bureau (BINTEK), which allowed us to expand the scope of my activities. Specifically, I received information on dam plans that BTB is not directly involved in, such as the proposal for the Kotopanjang Dam operation plan, the investigation of the water resource supply plan for the new capital (IKN), the investigation of the Kedung Ombo Dam Upgrade Plan in Central Java, and the Sintang Dam plan in Kalimantan.

On the other hand, the Integrated Water Resources Management Policy Advisor accompanied to technical meetings and site inspection of DSC, as well as the Dam Risk Management meeting proposed in this project, and provided with valuable advice.

4.2 Information Exchange with Japanese ODA Projects

In the course of the activities, we also exchanged information with other Japanese projects.

With "Flood Countermeasure Master Plan Project in Disaster Prevention for Pre-Investment (JICA)", we exchanged information on the operation of the three cascade dams on the Citarum River (results of the study of projects conducted by MLIT and the WB) and discussed the contents of the flood control and water resource development plan in Central Java (Semarang Integrated Water Resources and Flood Control Project (JICA)).

The flood-gates operation procedure of the Bili-Bili Dam proposed in the "Information Collection and Verification Study on Flood Control of the Jeneberang River (JICA)" was taken up by the BINTEK and the DOM in the discussion on improving the operation of the Kotopanjang Dam (with the participation of the Integrated Water Resources Management Policy Advisor and Dam Advisor), and it was decided to apply a similar operation method.

The operation of the dry-dams in the upstream of the Ciliwung River, which was related to the "The Preparatory Survey for

Integrated Urban Flood Management Project in JABODETABEK (JICA)", was also discussed within BTB, and technical advice was provided.

In addition to these ongoing projects, technical discussions were held with consultants and contractors regarding design reviews and construction method for the "Wonogiri Dam Sediment Control Project (JICA)" currently being carried out with a yen loan.

PART 3 Conclusions and Recommendations

1. Conclusion

1.1 Current Situation

Currently, in Indonesia, DSC/DSU conducts technical review at each stage of design, impounding and operation to ensure the safety of dams. Although this system works very effectively, through the inspection of dam construction sites in this service, we confirmed that relatively many risks in the site have been arose and some of them have been exposed, due to oversights in the investigation and design stage, insufficient geological survey, and incorrect geological interpretation. In addition, the analysis of risk cases extracted from ongoing 61 dams revealed that most of the risks were related to geology and construction materials, and that most of the risks could have been prevented from being occurred or the effects of risks could have been reduced by taking measures at the preliminary investigation and design stage.

1.2 Establishment and Use of Risk Management System in Dam Project

In dam construction, since the project is carried out against natural conditions such as topography, geology, and weather, there are risks due to many uncertain elements, and it is impossible to avoid them completely. However, according to the results of the risk analysis carried out in this work, many of the risks are caused by human factors. Therefore, it is proposed to organaize the coordinating team and establish a implementation methodology of the Dam Risk Management System, early on. It is expected that the risk management in planning, design, and construction will reduce the impact (Delays in project schedules and increased project costs) of issues that to be occurred during construction, ensure the safety of the constructed structure, and reduce the maintenance and management cost in the operation stage.

As an implementation system for this purpose, the following operations are important:

- ✧ In the early stages of planning and survey, risks are comprehensively extracted and evaluated, and risk response policies are examined. In addition, risk information should be kept as a management record.
- ✧ Risk assessment and risk response should be reviewed in the each project implementation stage. In addition, the risk management system also should be reviewed.
- ✧ Based on the results of the above review, the management system shall be improved, the risk management record be updated, the risk information be handed over between project stages, and the risk information be shared among related parties.

In the dam projects in Indonesia, technical review and confirmation are carried out by DSC/DSU at each project stage, and the safety of the ongoing and constructed dams is monitored. However, this process is discussed after the all design works are completed or issues are disclosed, and there are many cases where the timing of response is delayed due to reviews being carried out by DSC's limited human resources.

Therefore, by incorporating the above dam risk management system into the existing review system, it is expected that the procedures associated with the introduction of the new system will be reduced and that the review will be carried out more effectively.

1.3 Construction and Utilization of Database

1.3.1 Existing Risk Cases

Accumulating and compiling a database of issues (Potential risks identified, risks identified and their impact, etc.) that have occurred at completed dam sites, countermeasures, and response results, and utilizing it for risk management of dam projects under construction and new dams, will contribute to the prevention of missing risks and the efficiency and rationalization of risk responses.

In this service, risk cases were organized and analyzed for ongoing 61 dams, and the trend of dam risk in Indonesia was roughly grasped. Therefore, it is considered to be useful for the improvement of dam technology in Indonesia to organize and compile a database of risk cases not only for dam projects that will start in Indonesia but also for past dam projects. In addition, BTB stores information on issues discussed for all dams that have been examined, and the materials for database construction are already available.

1.3.2 Risk Management Records

When implementing risk management, recording risk information in a database system is expected to promote the transfer the risk information to the next project stages and to share the information among related parties. Furthermore, if this database is constructed so that it can be linked to the database of existing risk cases, new risk information can be accumulated in the database.

2. Recommendation

We proposed the implementation of dam risk management as one of the way to minimize risks during implementation of dam projects (infrastructure projects) and to contribute to the improvement of engineers' skills. In order to realize the implementation of this risk management, we propose the implementation of the following three items.

- ✧ Construction of Database: Utilization of past information stored in BTB and construction of risk management tool
- ✧ Preparation of dam risk management Guideline
- ✧ Construction of dam risk management system in each project

3. Conclusion Remarks

Dams are constructed by the maximum use of the nature such as regional geology, climate, and natural resources, so forced to face to various risks not only natural factors but also human factors in planning, investigation, design, and construction. In order to minimize these risks, it would be effective to introduce a risk management system into the current review system by the Dam Safety Committee. The introduction of such a system is expected to improve the capabilities of engineers involved in dam projects.

We sincerely hope that the results of this study will be effectively utilized and contribute to the improvement of dam technology in Indonesia, and we hope that PU (BENDA, DSC, DSU, BTB) will continue discussions to improve dam construction technology and develop the system.