| ID: | | Name: Kuwil-Kawangkoan | Dam Type: Random Rock with Central core Dam Hight: 67,0 m | |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 16-Nov-22 | |
| | 2 | Project phase in which risks were recognized | Impounding | |
| | 3 | Location (Structure/Area) | Dam / diversion tunnel. | |
| | 4 | Contents of risk | There is seepage in the dam spillway tunnel | |
| | 5 | Risk factors | Internal erosion in dam structures due to water flow. | |
| | 6 | Events in which risks were recognized | Seepage can increase due to pressure from the reservoir's water head after the reservoir is impounded | |
| | 7 | Condition/Situation for risk realization | When there is pressure from the water in the dam after it is flooded. | |
| | 8 | Impact if the risk realize | Potential structural damage to the diversion tunnel. | |
| Perspectives on Risk Classification | 9 | Where risk exists | Geology, Hydrogeology, Construction method | |
| | 10 | Character | ☐ | Mainly caused by external forces |
| | | | ☑ | Mainly due to technical factors |
| | | | ☐ | Factors other than the above |
| | 11 | Phase of Realization | ☑ | Project Implementation |
| | | | ☐ | Operation |
| | | | ☐ | Due to large-scale external force action |
| | | | ☐ | Due to long-term use |
| | | | ☐ | Others |
| | 12 | Impact if the risk realize | ☑ | Affects dam safety |
| | | | ☑ | Affects dam function |
| | | | ☐ | Affect the schedule and costs of the projects |
| | 13 | Corresponding to risks | ☐ | Basically risk avoidance |
| | | | ☑ | Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ | Risk retention under certain conditions |

**Overview of Causal Relationships**

Seepage was observed at tunnel before impounding is conduced → During inpection for impouding permit, some seepage occur at the divertion tunnel → impounding cause water level and water pressure → Erosion of tunnel concrete, water flow at tunnel, tunnel moisturation condition → Structur demage, constraints of maintenance

Hydrogeology indentification => Regrouting, crytal plugging → Risk reduction

**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

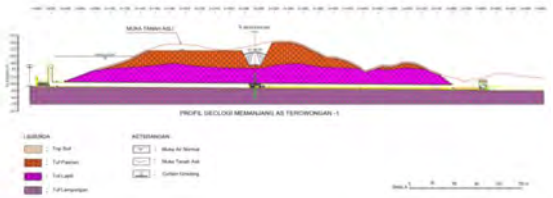


Figure-1 Geological profile of tunnel-1 at Kuwil Dam shows that tunnel located at lithology boundary (potential of weakzone / water path)


Photo-1 Photograph of tunnel condition before imponding, some seepage occur at contact joint and casting delay (gap) of concrete

| ID: #REF! | Name: Kuwil-Kawangkoan | Dam Type: Random Rock with Central core | Dam Hight: 67,0 m |
|---|---|---|---|
| History | Recognition or not in the past | Recognized | |
| | When the risk was recognized | Project Phase: Construction | Date: #REF! |
| | Status of corresponding | - | |
| Project Phase | History of correspond to risks | | |
| Plan | - | | |
| Design | - | | |
| Construction | Beberapa rembesan terjadi di tunnel bendungan sebelum dilakukan impounding. terdapat pula rembesan yang sudah mengering. | | |

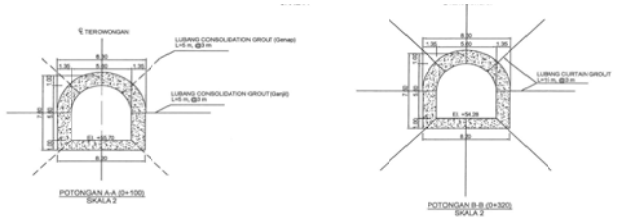


Figure-1 Typical design of tunnel (source: asbuild drawing of PT.WIKA-DTM, KSO)

| | | | |
|---|---|---|---|
| Impounding | - | | |
| Operation/ maintenance | - | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | | Reduction |
| | Measures | How to deal with | additional chemical grouting |
| | | Basis for decision | Tunnel condition, Dam safety |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | | - |
| | Availability and method of information sharing | | - |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | 1) Technical issues | | |
| | It should be noted that seepage can increase due to pressure from the reservoir's water head after the reservoir is impounded. Before handling seepage, the location of the seepage should first be ascertained. If seepage occurs at the contraction joint, it should be ensured that the handling method used will not interfere with the function of the contraction joint as a controller for concrete swelling and shrinkage. | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| Keywords. | Tunnel, seepage, Chemical grouting | | |
| References | Meeting Minutes: | | Sindang pleno pembahasan konstruksi dan kesiapan pengisian awal waduk, 16 November 2022 |
| | Meeting Materials: | | Paparan Sidang Pleno Persiapan Pengisian Awal Waduk Proyek Pembangunan Bendungan Kuwil Kawangkoan |
| | Other: | | As Built Drawing Paket 1 |

**ID:** **Name:** Kuwil-Kawangkoan **Dam Type:** Random Rock with Central core **Dam Hight:** 67,0 **m**

| | | | |
|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 2022 |
| | 2 | Project phase in which risks were recognized | Construction |
| | 3 | Location (Structure/Area) | Dam Body |
| | 4 | Contents of risk | Dam stability, embankment material |
| | 5 | Risk factors | Miss interpretation of material parameter |
| | 6 | Events in which risks were recognized | After insitu direct shear test had been conducted |
| | 7 | Condition/Situation for risk realization | Impouding |
| | 8 | Impact if the risk realize | Dam break, flooding |
| Perspectives on Risk Classification | 9 | Where risk exists | Dam material |
| | 10 | Character | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | Phase of Realization | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | Impact if the risk realize | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | Corresponding to risks | ☐ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☑ Risk retention under certain conditions |

**Overview of Causal Relationships**

Considetation the parameter of random material ⇒ After Insitu direct shear test => Random result parameter (various result) ⇒ Miss interpretation for material ⇒ worse material => impounding => instabel dam ⇒ Dam break, flooding

Additional MASW investigation ⇒ Risk reduction

**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

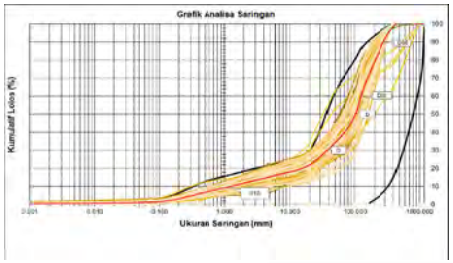



Figure-1 material gradation of random zone (zone 4) of Kuwil Kawangkoan Dam

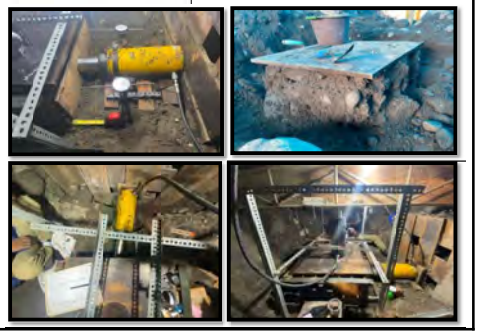


Photo-1 Documentation of In-situ Direct Shear Implementation in Zone 4 ( Random Rock)



**ID:** #REF! **Name:** Kuwil-Kawangkoan **Dam Type:** Random Rock with Central core **Dam Hight:** 67,0 **m**

| | | | |
|---|---|---|---|
| History | Recognition or not in the past | Unrecognized | |
| | When the risk was recognized | Project Phase: | Date: 2022 |
| | Status of corresponding | Additional MASW investigation | |
| Project Phase | History of correspond to risks | | |
| Plan | - | | |
| Design | - | | |
| Construction | During dam construction insitu direct shear test was conducted to recognized the parameter of random embankment (rock random), but the result of test is very vary to determinated the most appropriate parameter. MASW investigation was conducted to ensure the material parameter. From 6 locations test resulting the Phi value of 30-48 degree. | | |
| Impounding | - | | |
| Operation/ maintenance | - | | |
| Investigation /analysis | Investigation/analysis to identify factors, etc. | | MASW Investigation |
| | Research/analysis, etc. to assess impact | | - |
| | Analysis, etc. to determine the need for and methods of response | | Using 39 degree for internal friction angle |
| How to respond to risk | Contents of measures (avoidance, reduction, transfer) or retention | | Reduction |
| | Measures | How to deal with | Additional investigation to ensure parameter |
| | | Basis for decision | Dam stability |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | | Dam body instrumentation (piezometer, inclinometer) |
| | Availability and method of information sharing | | - |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | 1) technical issues | | |
| | a. Mapping of locations in random embankment zones, which have poor embankment quality<br>b. The need for routine monitoring should be included in the Operation and Maintenance Manual.<br>c. The results of the MASW and its evaluation should be presented in the embankment quality evaluation report. | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| Keywords. | Dam Body, material parameter, MASW investigation | | |
| References | Meeting Minutes: | | Sindang pleno pembahasan konstruksi dan kesiapan pengisian awal waduk, 16 November 2022 |
| | Meeting Materials: | | Paparan Sidang Pleno Persiapan Pengisian Awal Waduk Proyek Pembangunan Bendungan Kuwil Kawangkoan |
| | Other: | | |

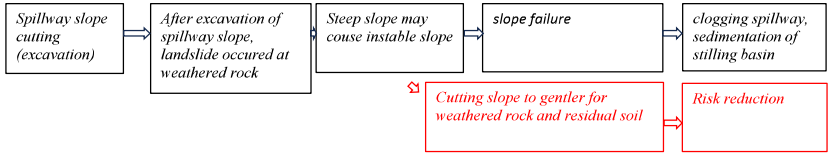
| ID: | Name: landongi | | Dam Type: zona rockfill with vertical core | Dam Hight: 66,0 m |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 11-Oct-23 | |
| | 2 | Project phase in which risks were recognized | Impounding | |
| | 3 | Location (Structure/Area) | Left slope excavation of Spillway | |
| | 4 | Contents of risk | Spillway demage, spillway clogging, Dam failure | |
| | 5 | Risk factors | Potentially unstable slope conditions. | |
| | 6 | Events in which risks were recognized | Landslide on the left side of the spillway dam, requires documentation, evaluation, | |
| | 7 | Condition/Situation for risk realization | The left slope is still at risk of landslides, similar to what happened during construction | |
| | 8 | Impact if the risk realize | Potential Structural Damage Landslides can cause damage to spillway structures, | |
| Perspectives on Risk Classification | 9 | Where risk exists | | |
| | 10 | Character | ☐ Mainly caused by external forces | |
| | | | ☑ Mainly due to technical factors | |
| | | | ☐ Factors other than the above | |
| | 11 | Phase of Realization | ☐ Project Implementation | |
| | | | ☑ Operation | |
| | | | ☐ Due to large-scale external force action | |
| | | | ☐ Due to long-term use | |
| | | | ☐ Others | |
| | 12 | Impact if the risk realize | ☑ Affects dam safety | |
| | | | ☑ Affects dam function | |
| | | | ☐ Affect the schedule and costs of the projects | |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance | |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. | |
| | | | ☐ Risk retention under certain conditions | |
| Overview of Causal Relationships | Slope failure at left hills of spillway ⇨ During Inspection observed slope failure and potentially become larger ⇨ Rain, earthquake trigger for landslide => special study is not ⇨ spillway demage, spillway clogging, dam failure (if ⇨ spillway function, disturbed of dam left abutment | | | |
| | Slope reinsforcement => Addational monitoring instrumentation (extenso etc) ⇨ Risk reduction | | | |
| Explanatory Diagram (Schematic Diagram/ Photos, etc.) |  | | | |
| | Photo-1 Slope failure location (yellow circle) at Ladongi Dam | | | |



| ID: #REF! | Name: landongi | | Dam Type: zona rockfill with vertical core | Dam Hight: 66,0 m |
|---|---|---|---|---|
| History | Recognition or not in the past | Unrecognized | | |
| | When the risk was recognized | Project Phase: Impounding | Date: #REF! | |
| | Status of corresponding | Considering countermeasures | | |
| Project Phase | History of correspond to risks | | | |
| Plan | - | | | |
| Design | - | | | |
| Construction | - | | | |
| Impounding | Landslide occor at left side of spillway hills | | | |
| Operation/ maintenance | - | | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | - | | |
| | Measures | How to deal with | - | |
| | | Basis for decision | - | |
| | Retention (no measures) | Reason | - | |
| | | Expected impact | - | |
| | Availability and method of monitoring | - | | |
| | Availability and method of information sharing | - | | |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | | |
| | 1) Technical issues | | | |
| | Considering that the landslide that occurred on the left slope of the spillway excavation during construction was quite large during the operation phase, it is necessary to carry out more careful monitoring of the results of the repair of the landslide and of the surrounding area, which has potential for landslides. Monitoring is carried out visually and using an inclinometer instrument; for this reason, it is recommended to install 2 inclinometer points, and this monitoring program is explained in the OP guidelines. | | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | | |
| Keywords. | Spillway slope, landslide, intrument monitoring | | | |
| References | Meeting Minutes: | Risalah Sidang Teknis Evaluasi Pelaksanaan Pengisian Waduk Dan Kesiapan Operasi Bendungan Ladongi, 11 Oktober 2023 | | |
| | Meeting Materials: | Monitoring Progress Persiapan Izin Operasi, 11 Okt 2022 | | |
| | Other: | Laporan Akhir, 2015, PT. Wecon Dan Cv. Trijaya (Kso): Tambahan Study Geologi Teknik Dan Penyempurnaan Detail Desain Serta Model Test | | |

| ID: | | Name: Pamukulu | Dam Type: Concreate Face rock-filled dams | Dam Hight: 65,5 m |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 19-Jul-23 | |
| | 2 | Project phase in which risks were recognized | Construction | |
| | 3 | Location (Structure/Area) | Spillway Slope | |
| | 4 | Contents of risk | slope failure | |
| | 5 | Risk factors | Weathering rock / cutting slope | |
| | 6 | Events in which risks were recognized | Weathering rock is observed during excavation of spillway slope | |
| | 7 | Condition/Situation for risk realization | Rain, runoff water | |
| | 8 | Impact if the risk realize | | |
| Perspectives on Risk Classification | 9 | Where risk exists | | |
| | 10 | Character | ☐ Mainly caused by external forces | |
| | | | ☐ Mainly due to technical factors | |
| | | | ☐ Factors other than the above | |
| | 11 | Phase of Realization | ☐ Project Implementation | |
| | | | ☐ Operation | |
| | | | ☐ Due to large-scale external force action | |
| | | | ☐ Due to long-term use | |
| | | | ☐ Others | |
| | 12 | Impact if the risk realize | ☐ Affects dam safety | |
| | | | ☐ Affects dam function | |
| | | | ☐ Affect the schedule and costs of the projects | |
| | 13 | Corresponding to risks | ☐ Basically risk avoidance | |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. | |
| | | | ☐ Risk retention under certain conditions | |

**Overview of Causal Relationships**




**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

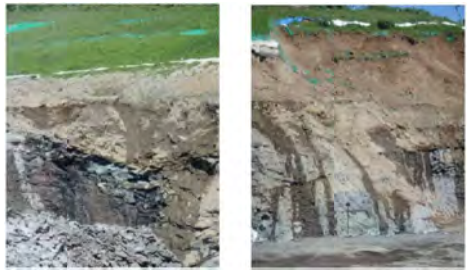


Photo-1 Weathered Basalt on Cut Slope and Collapse in the Soil Layer



| ID: | | Name: Pamukulu | Dam Type: Concreate Face rock-filled dams | Dam Hight: 65,5 m |
|---|---|---|---|---|
| History | Recognition or not in the past | Unrecognized | | |
| | When the risk was recognized | Project Phase: Pamukkulu | Date: 19-Jul-23 | |
| | Status of corresponding | Considering re-sloping | | |
| Project Phase | History of correspond to risks | | | |
| Plan | - | | | |
| Design | - | | | |
| Construction | During construction, spillway slope was excavated same as the rock lithology. landslide occur after it. | | | |
| Impounding | - | | | |
| Operation/ maintenance | - | | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | Reduction | | |
| | Measures | How to deal with | Re-sloping to be gentler | |
| | | Basis for decision | Slope stability | |
| | Retention (no measures) | Reason | - | |
| | | Expected impact | - | |
| | Availability and method of monitoring | - | | |
| | Availability and method of information sharing | - | | |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | | |
| | 1) Technical issue | | | |
| | The cut slope composed of residual soil of weathered rocks has collapsed on a small scale. In order to protect this slope, it is necessary to remake the cutting slope gentler or to provide slope protection works other than sodding or Geo-net which is proposed by site office because sliding occurred in the soil layer, not slope surface erosion. | | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | | |
| Keywords. | | | | |
| References | Meeting Minutes: | Risalah diskusi teknis Pembahasan pelaksanaan konstruksi bendungan pamukkulu, 19 Oktober 2022 | | |
| | Meeting Materials: | Rencana Tindak Darurat dan Potensi Longsoran Area Hulu dan Waduk, Juli 2023<br>Penulangan Beton Membran (Face Slab Concrete) | | |
| | Other: | Laporan Akhir, Desember 2016, PT. Mettana : Sertifikasi Desain Bendungan Pamukkulu | | |

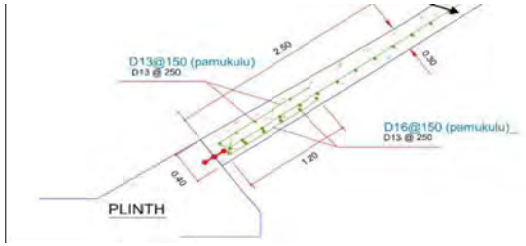
| ID: | | Name: Pamukulu | Dam Type: Concreate Face rock-filled dams Dam Hight: 65,5 m |
|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 19-Oct-22 |
| | 2 | Project phase in which risks were recognized | Construction |
| | 3 | Location (Structure/Area) | Dam body / slab concrete |
| | 4 | Contents of risk | Thermal cracking of concrete slab |
| | 5 | Risk factors | Concrete setting time / heat of concrete |
| | 6 | Events in which risks were recognized | Technical discussion of dam safety commission |
| | 7 | Condition/Situation for risk realization | Dam leakage / dam stability / piping |
| | 8 | Impact if the risk realize | Dam break / flooding |
| Perspectives on Risk Classification | 9 | Where risk exists | Dam material / slab reinforcement |
| | 10 | Character | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | Phase of Realization | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | Impact if the risk realize | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |
| Overview of Causal Relationships | Crack of concrete slab ⇒ the design of dam is considered has cracking potential at the slab concrete ⇒ Setting time of concrete result a head may couses crack ⇒ Crack occur at slab concrete ⇒ dam leakage / dam break | | |
| | additional anti-spaling reinformecent => ⇒ Risk reduction | | |
| Explanatory Diagram (Schematic Diagram/ Photos, etc.) |   | | |

Figure - 1 Standard Spalling Reinforcement (black) and For Pamukulu dam (blue)



| ID: | Name: Pamukulu | Dam Type: Concreate Face rock-filled dams Dam Hight: 65,5 m | |
|---|---|---|---|
| History | Recognition or not in the past | Unrecognized | |
| | When the risk was recognized | Project Phase: Construction | Date: 19-Oct-22 |
| | Status of corresponding | Additional spalling reinforcement | |
| Project Phase | History of correspond to risks | | |
| Plan | - | | |
| Design | - | | |
| Construction | During construction there posibility of thermal crack at slab concrete of Pamukkulu dam. a rekomendation is using double reinforcement ( at plint and slab core) to antisipate thermal cracking and scalling | | |
| Impounding | | | |
| Operation/ maintenance | | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | reduction | |
| | Measures | How to deal with | additional spalling reinforcement |
| | | Basis for decision | Dam safety / construction time / cost |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | - | |
| | Availability and method of information sharing | - | |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | 1) Technical issues | | |
| | It should be noted that the reinforcement aims to anticipate the occurrence of cracks due to thermal cracking and scaling.<br>The Campos Novos Dam uses a reinforcement ratio of 0.3 – 0.6%, additional reinforcement to prevent scaling at the pressure (compressive stress).<br>Concrete structure that are experiencing compressive stress (compression), it is necessary to add two layers of reinforcement. | | |
| Applicable standards | ICOLD, November 2004, partie 2 chapter 6, page 6-11 | | |
| Keywords. | Concrete slab, dam body, spalling reinforcement | | |
| References | Meeting Minutes: | Risalah diskusi teknis Pembahasan pelaksanaan konstruksi bendungan pamukkulu, 19 Oktober 2022 | |
| | Meeting Materials: | Rencana Tindak Darurat dan Potensi Longsoran Area Hulu dan Waduk, Juli 2023<br>Penulangan Beton Membran (Face Slab Concrete) | |
| | Other: | Laporan Akhir, Desember 2016, PT. Mettana : Sertifikasi Desain Bendungan Pamukkulu | |

**ID:** 34 **Name:** Bulango Ulu Dam **Dam Type:** Rock Fill Dam with Cental Core **Dam Hight:** 75,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | Jan-2024 |
| | 2 | ***Project phase in which risks were recognized*** | Design |
| | 3 | ***Location (Structure/Area)*** | Dam foundation |
| | 4 | ***Contents of risk*** | Foundation strength, piping |
| | 5 | ***Risk factors*** | Fault zone at the foundation |
| | 6 | ***Events in which risks were recognized*** | Design and construction |
| | 7 | ***Condition/Situation for risk realization*** | Impounding |
| | 8 | ***Impact if the risk realize*** | Material leaching (piping), dam break |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, dam material |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☐ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Fault recognized at dam foundation* ⇨ *design stage estimate fault at dam foundation => Fault confirmed during construction* ⇨ *water may flow under embankment and couse piping* ⇨ *piping of foundation, foundation deformation* ⇨ *dam break, flooding*

*additional grouting, fault zone excavation, filter backfill* ⇨ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***


Figure-1 Fault estimation was observed during design stage (PT. Suwanda karya Mandiri KSO, 2018)

Photo-1 Fault apperence at Bulango Ulu dam foundation



**ID:** 34 **Name:** Bulango Ulu Dam **Dam Type:** Rock Fill Dam with Cental Core **Dam Hight:** 75,0 **m**

| | | | |
|---|---|---|---|
| ***History*** | ***Recognition or not in the past*** | Recognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Design | ***Date:*** Jan-2024 |
| | ***Status of corresponding*** | Additional graoting and fault zone excavation | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | Fault at dam foundation was observed during dsign stage | | |
| ***Construction*** | During construction, fault is comfirmed and form several frackture zone with wheatered crack and partially become clay material | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |

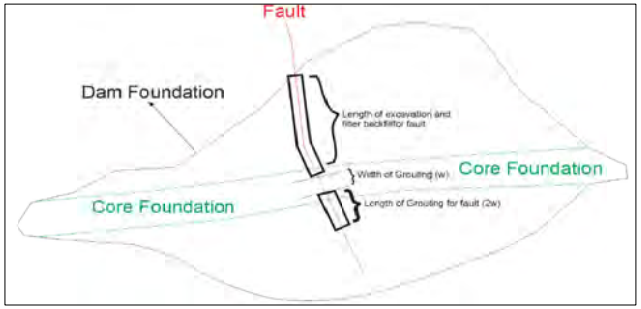



Figure-1 Sketch for Fault Treatment of Dam foundation

| | | | |
|---|---|---|---|
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Additional grouting and fault zone excavation |
| | | ***Basis for decision*** | Dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical Issue | | |
| | 8) For the handling of faults crossing the core material foundation, excavation should be carried out at the downstream of the core material along the foundation fault zone to remove the weathered material (waek zone), then backfilled with graded filter material from fine at the bottom and increasingly coarse at the top to match the rockfill. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Foundation, Fault, Grouting, | | |
| *References* | ***Meeting Minutes:*** | | - |
| | ***Meeting Materials:*** | | Kondisi Geologi - Geoteknik Bendungan Bulango Ulu Kab. Bone Bolango - Prop. Gorontalo Februari 2024 |
| | ***Other:*** | | Laporan akhir: DD DAN SERTIFIKASI DESAIN BENDUNGAN BULANGO ULU (MYC) 2018 |

**ID:** 34 **Name:** Bulango Ulu Dam **Dam Type:** Rock Fill Dam with Cental Core **Dam Hight:** 75,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | Feb 2024 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Left Abutment / Spillway inlet |
| | 4 | ***Contents of risk*** | Side seepage, water leakage, piping |
| | 5 | ***Risk factors*** | Fault near to spillway inlet |
| | 6 | ***Events in which risks were recognized*** | Construction |
| | 7 | ***Condition/Situation for risk realization*** | Impoounding |
| | 8 | ***Impact if the risk realize*** | landslide, uncontrol seepage |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, foundation |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☐ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Fault was observed near to spillway* ⇒ *Excavation of spillway (tunnel spillway)=> Fault observation* ⇒ *Rim grouting didn't reach to the fault=> side seepage potential* ⇒ *Side seepage may cause piping and lanslide* ⇒ *slope failure, uncontrol seepage*

*Extending the rim grouting* ⇒ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

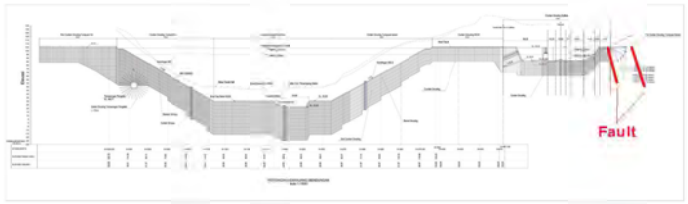



Figure-1 Grouting layout of Bulango Ulu dam foundation

Photo-1 Fault near to spillway at Bulango Ulu dam



**ID:** 34 **Name:** Bulango Ulu Dam **Dam Type:** Rock Fill Dam with Cental Core **Dam Hight:** 75,0 **m**

| | | | |
|---|---|---|---|
| ***History*** | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Construction | ***Date:*** Feb 2024 |
| | ***Status of corresponding*** | Extending the rim grouting | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |


Figure-1 Grouting plan surrounding spillway during design stage

***Construction***


Photo-2 estimation of extending grouting

| | | | |
|---|---|---|---|
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Extending rim grouting |
| | | ***Basis for decision*** | dam safety, dam fungtion |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | Near to spillway building there are two fault. Fault is weak zone that water can be through. Rim grouting need to be extending until cover both of fault | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | | | |
| ***References*** | ***Meeting Minutes:*** | - | |
| | ***Meeting Materials:*** | Kondisi Geologi - Geoteknik Bendungan Bulango Ulu Kab. Bone Bolango - Prop. Gorontalo Februari 2024 | |
| | ***Other:*** | Laporan akhir: DD DAN SERTIFIKASI DESAIN BENDUNGAN BULANGO ULU (MYC) 2018 | |

**ID:** 34 **Name:** Bulango Ulu Dam **Dam Type:** Rock Fill Dam with Cental Core **Dam Hight:** 75,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 26-Jan-24 |
| | 2 | ***Project phase in which risks were recognized*** | Design |
| | 3 | ***Location (Structure/Area)*** | Dam body / dam material |
| | 4 | ***Contents of risk*** | High settlement, material density, piping |
| | 5 | ***Risk factors*** | High persentage of fine material for dam core |
| | 6 | ***Events in which risks were recognized*** | design investigation and trial embankment |
| | 7 | ***Condition/Situation for risk realization*** | Impounding, during construction |
| | 8 | ***Impact if the risk realize*** | Dam failure, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | core material, dam body, |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*HIgh presentage of fine material for dam core* ⇒ *during investigation proposed core material has much fine grained (more than 60%)* ⇒ *During contraction and impounding settlement high settlement may occur and cause crack of core* ⇒ *settlement / piping => Crack of dam core, water leakage* ⇒ *Dam failure, flooding*

*Modified core material by mixing / deeper excavation* ⇒ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

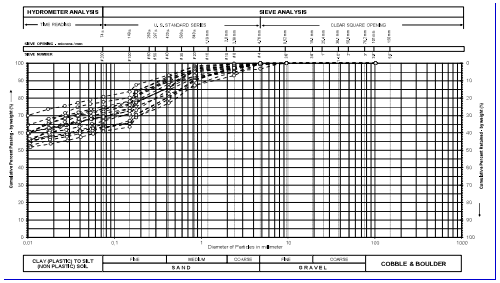



Figure-1 Core material gradation of borrow area at Bulango Ulu dam

Photo-1 Material condition during trial embankment



**ID:** 34 **Name:** Bulango Ulu Dam **Dam Type:** Rock Fill Dam with Cental Core **Dam Hight:** 75,0 **m**

| | | | |
|---|---|---|---|
| ***History*** | ***Recognition or not in the past*** | Recognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Design | ***Date:*** 26-Jan-24 |
| | ***Status of corresponding*** | Modified the excavation method / trial embankment | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | During investigation, proposed core material has high persentage of fine grain material | | |
| ***Construction*** |   Photo-1 Testpit at borrow area of Bulango Ulu dam. (A) soil condition at upper part with high persentage of fine material (silt-clay). (B). soil condition of lower part with less persentage of fine material (sandy silt dominant). | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |
| ***Investigation /analysis*** | ***Investigation/analysis to identify factors, etc.*** | | Tespit |
| | ***Research/analysis, etc. to assess impact*** | | - |
| | ***Analysis, etc. to determine the need for and methods of response*** | | - |
| ***How to respond to risk*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Mixing material |
| | | ***Basis for decision*** | Material properties, dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues, | | |
| | the core material is wheatering product of granodiorit (igneous rock). Persentage soil (fine material) will be less at the bottom so it can be mixed with the upper part (more fine material). | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | | | |
| ***References*** | ***Meeting Minutes:*** | - | |
| | ***Meeting Materials:*** | Kondisi Geologi - Geoteknik Bendungan Bulango Ulu Kab. Bone Bolango - Prop. Gorontalo Februari 2024 | |
| | ***Other:*** | Laporan akhir: DD DAN SERTIFIKASI DESAIN BENDUNGAN BULANGO ULU (MYC) 2018 | |

**ID:** 35 **Name:** Budong-Budong **Dam Type:** Zonal earth - filled Dam **Dam Hight:** 44,0 *m*

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2018 |
| | 2 | ***Project phase in which risks were recognized*** | Design |
| | 3 | ***Location (Structure/Area)*** | Dam foundation / foundation strengh |
| | 4 | ***Contents of risk*** | Foundation seepage, liquefaction |
| | 5 | ***Risk factors*** | Alluvium foundation |
| | 6 | ***Events in which risks were recognized*** | Drilling investigation for DED observed thick alluvium at dam foundation |
| | 7 | ***Condition/Situation for risk realization*** | Construction, impounding |
| | 8 | ***Impact if the risk realize*** | Dam stability, dam break |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Alluvial at dam foundation* ⇨ *thick alluvial depoosit was found during design investigation* ⇨ *Using alluvial as foundation => foundation seepage and strengh* ⇨ *piping, liquefaction* ⇨ *Dam failure, flooding, over seepage*

*Using alluvial as foundation => foundation seepage and strengh* ↘ *Redesign without using alluvial as foundation* ⇨ *Risk Avoidance*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

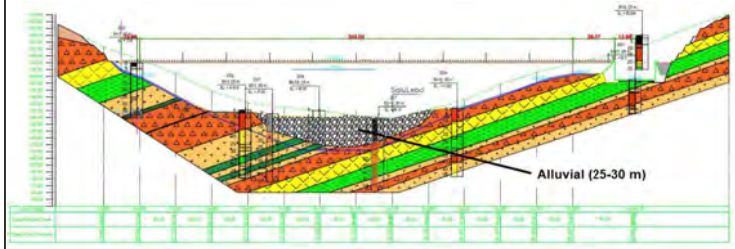



Figure-1 Geological profile of Budong budong dam axial with coluvium thickness upto 25 m

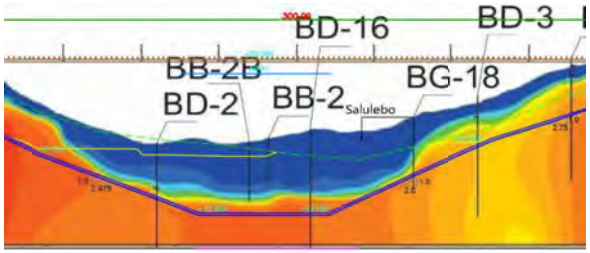



Figure-2 MASW profile of dam axial of Budong Budong Dam



**ID:** 35 **Name:** Budong-Budong **Dam Type:** Zonal earth - filled Dam **Dam Hight:** 44,0 *m*

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Recognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Design | ***Date:*** 2018 |
| | ***Status of corresponding*** | Using alluvial as dam foundation | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | | | |
| *Design* | | | |

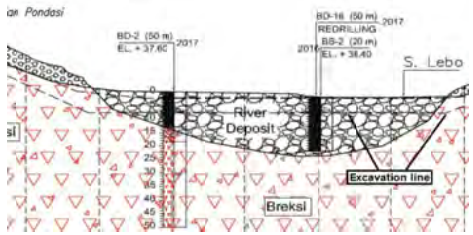



Figure-1 Excavation line of budong budong dam (PT. Mettana, 2017)

| | | | |
|---|---|---|---|
| *Construction* | | | |

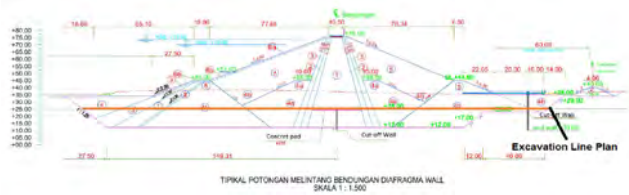



Figure-2 Planning of Excavation line of budong budong dam for construction

| | | | |
|---|---|---|---|
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *Investigation /analysis* | ***Investigation/analysis to identify factors, etc.*** | | Drilling investigation, MASW investigation |
| | ***Research/analysis, etc. to assess impact*** | | Alluvial thickness and bearing capasity confirmation |
| | ***Analysis, etc. to determine the need for and methods of response*** | | - |
| *How to respond to risk* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Avoidance |
| | ***Measures*** | ***How to deal with*** | using alluvial as foundation |
| | | ***Basis for decision*** | Contruction time, |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues,<br>2) Constraints in project implementation requirements | | |
| | The river deposit material needs to be confirmed in terms of size and type, matrix and so on to ensure that cut-off can be carried out with the right tools.<br>Due to alluvium is tend to permeable, dewatering system may be required during construction | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Dam foundation, alluvium foundation | | |
| *References* | ***Meeting Minutes:*** | | Perubahan desain galian dan perbaikan pondasi tubuh bendungan |
| | ***Meeting Materials:*** | | Risalah sidang pleno pembahasan desain bendungan budong-budong. 4 desember 2019 |
| | ***Other:*** | | Laporan Akhir (PT. Mettana,2017) DD Bendungan Budong-Budong |

**ID:** 35 **Name:** Budong-Budong **Dam Type:** Zonal earth - filled Dam **Dam Hight:** 44,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | *When the risk was identified (date)* | 25-Jun-24 |
| | 2 | *Project phase in which risks were recognized* | Construction |
| | 3 | *Location (Structure/Area)* | Dam body, dam material |
| | 4 | *Contents of risk* | Ddam stability, Dam erotion |
| | 5 | *Risk factors* | Dam material properties, dam surface protection |
| | 6 | *Events in which risks were recognized* | During technical discussion of dam construction |
| | 7 | *Condition/Situation for risk realization* | Impounding, run off water, rain |
| | 8 | *Impact if the risk realize* | dam break, flooding |
| *Perspectives on Risk Classification* | 9 | *Where risk exists* | Dam material, dam body, |
| | 10 | *Character* | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | *Phase of Realization* | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | *Impact if the risk realize* | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | *Corresponding to risks* | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

*Overview of Causal Relationships*

*Design of Budong Budong Dam* ⇒ *Technical discussion of construction => consultant changing the dam design due to avability of material* ⇒ *Zone 4 is random material (hanging rock zone at upper part* ⇒ *Dam stability, erosion* ⇒ *dam failure, flooding*

*Changing design to lengthen the rock zone until foundation* ⇒ *Risk reduction*

*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*

The rock zone at Budong Budong Dam is lay on random zone. It ia afraid that rock zone will not protect the rondom zone but become additional overburden

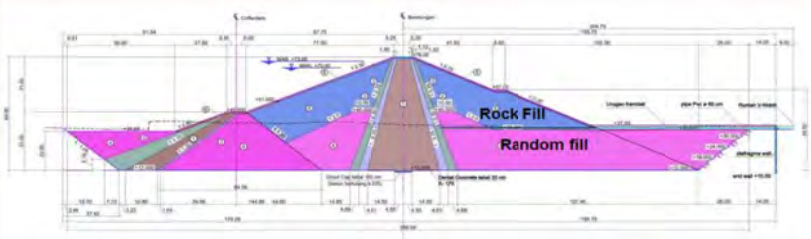
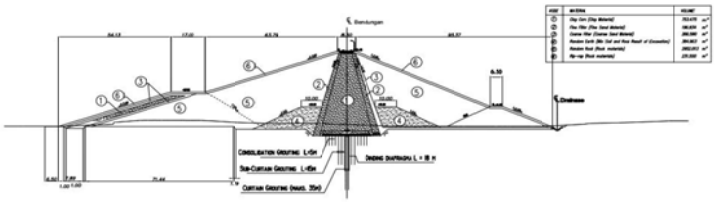
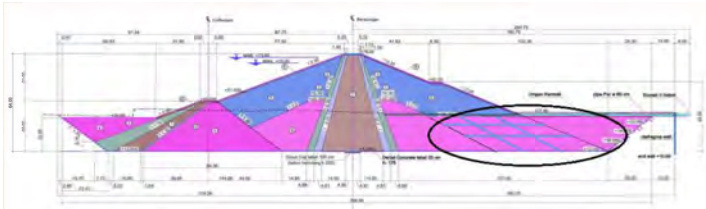



Figure-1 Typical design of Budong Budong Dam



**ID:** 35 **Name:** Budong-Budong **Dam Type:** Zonal earth - filled Dam **Dam Hight:** 44,0 **m**

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | | |
| | *When the risk was recognized* | *Project Phase:* | *Date:* #REF! |
| | *Status of corresponding* | | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | | | |
| *Design* |  Figure-1 Typical of dam design of Budong Budong (Design stage of PT. Mettana, 2017) | | |
| *Construction* |  Figure-2 Recommendation to lengthen the rock-fill zone | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Reduction |
| | *Measures* | *How to deal with* | Changing the dam design |
| | | *Basis for decision* | Dam safety, material availability |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | | - |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical issues, | | |
| | for Design of embankment dam, the low strenght material should be cover with stonger materil fully. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Dan desing, dam material, redesign | | |
| *References* | *Meeting Minutes:* | | Perubahan desain galian dan perbaikan pondasi tubuh bendungan |
| | *Meeting Materials:* | | Risalah sidang pleno pembahasan desain bendungan budong-budong. 4 desember 2019<br>Disksusi teknik konstruksi bendungan Budonng Budong, 25 Juni 2024 |
| | *Other:* | | Laporan Akhir (PT. Mettana,2017) DD Bendungan Budong-Budong |

**ID:** 36 **Name:** Ameroro Dam **Dam Type:** Rock-fill dam with central core **Dam Hight:** 82,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 17-May-22 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Dam Foundation, slope cutting |
| | 4 | ***Contents of risk*** | differential settlement, core cracking |
| | 5 | ***Risk factors*** | The steep slope of the foundation excavation |
| | 6 | ***Events in which risks were recognized*** | Observation of the steep slope in the foundation excavation profile. |
| | 7 | ***Condition/Situation for risk realization*** | Embankment consolidation, overburden |
| | 8 | ***Impact if the risk realize*** | Dam failure, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | foundation excavation, dam material |
| | 10 | ***Character*** | ☑ Mainly caused by external forces |
| | | | ☐ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Differential settlement potential* ⇨ *The excavation profile of dam foundation show there are steep slope excavation => arching settlement* ⇨ *consolidation of core material => The higher overburden equal to higher settlement* ⇨ *settlement, cracking,* ⇨ *dam leakage, dam failure, flooding*

*Re-sloping using dental concrete* ⇨ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

The excavation profile of the dam foundation site shows a relatively steep slope and it has potential to cause “arching” cracks in the embankment.

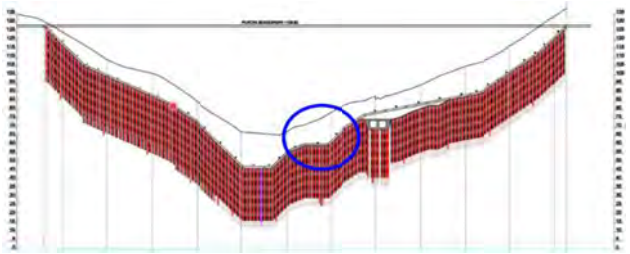
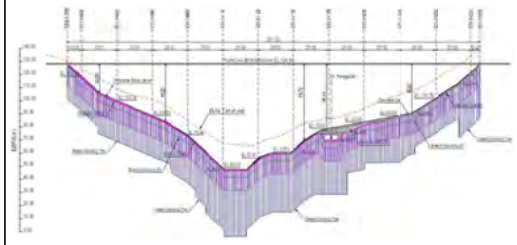
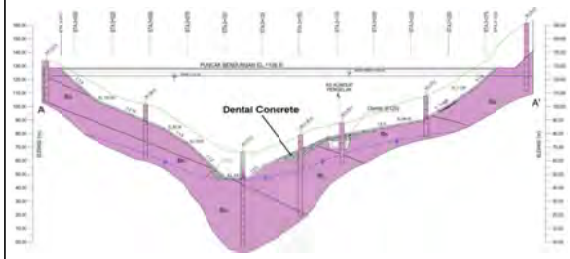


Figure-1 Geological Dam Profile of Ameroro dam with steep slope excavation (blue circle)



**ID:** 36 **Name:** Ameroro Dam **Dam Type:** Rock-fill dam with central core **Dam Hight:** 82,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Construction | ***Date:*** 17-May-22 |
| | ***Status of corresponding*** | Re-sloping using dental concrete | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** |  Figure-1 Geometric of foundation excavation ( sertification design of | | |
| ***Construction*** |   Figure-2 Foundation improvement// re-sloping using dental concrete for gentler slope | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Re-sloping steep cut using dental concrete |
| | | ***Basis for decision*** | Dam Safety, core settlement |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | The dam foundation should be formed to make it easy to fill and compact and not cause arching and/or differential settlement of the embankment above it.<br>Monitoring should be carried out for the possibility of cracks in the embankment around the bulge area or at the top of the dam area. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Dam Foundation, Diffential Settement, Cut Slope, Dental concrete | | |
| ***References*** | ***Meeting Minutes:*** | Risalah Diskusi Teknis Pembahasan Pelaksanaan Konstruksi Bendungan Ameroro Kabupaten Konawe, Provinsi Sulawesi Tenggara - 24 Februari 2023 | |
| | ***Meeting Materials:*** | Pelaksanaan Pembangunan Bendungan Ameroro Kab Konawe - Sd 19 Juli 2023 | |
| | ***Other:*** | Laporan Ringkasan (PT. Mettana, 2018) : Penyelidikan Geologi Detail dan Model Test Bendungan Ameroro | |

**ID:** 36 **Name:** Ameroro Dam **Dam Type:** Rock-fill dam with central core **Dam Hight:** 82,0 *m*

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 27-Oct-23 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Spillway, stilling basin chanel |
| | 4 | ***Contents of risk*** | Erosion, scouring |
| | 5 | ***Risk factors*** | Water fall from stilling basin |
| | 6 | ***Events in which risks were recognized*** | Dering technical discussion stilling basin design show erosion and scouring potential |
| | 7 | ***Condition/Situation for risk realization*** | Impounding, reservoir spill out |
| | 8 | ***Impact if the risk realize*** | Demage of spillway structure |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Spillway, hydrolic, |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Design of stilling basin* ⇨ *Stilling basin design show erosion and scouring potential due to water fall from stilling basin* ⇨ *stilling floor 2 meter higher than downstream channel* ⇨ *Erosion and scouring* ⇨ *Damage on spillway structure*

*Additional flow reducer structure/ system from stilling basin to chanel* ⇨ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

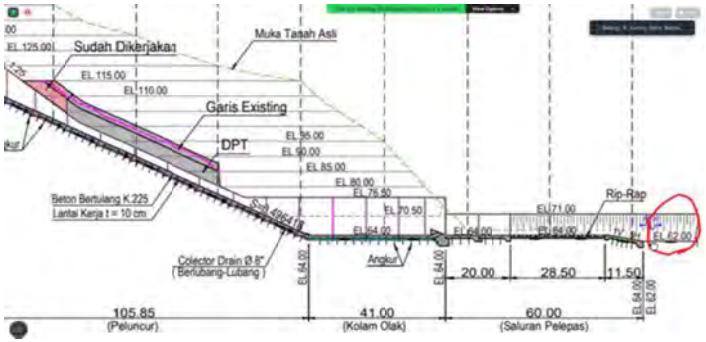
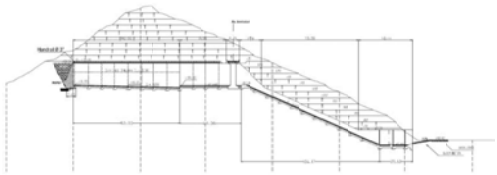



Figure-1 design of stilling basin of Ameroro Dam



**ID:** 36 **Name:** Ameroro Dam **Dam Type:** Rock-fill dam with central core **Dam Hight:** 82,0 *m*

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Unrecognized | |
| | *When the risk was recognized* | ***Project Phase:*** | ***Date:*** 27-Oct-23 |
| | *Status of corresponding* | Additional groundsill | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* |  Figure-1 Spillway section during design stage (PT. Mettana) | | |
| *Construction* |  Figure-2 Additional groundsil at downstream of stilling basin | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Reduction |
| | *Measures* | *How to deal with* | additional groundsill instalation for protection |
| | | *Basis for decision* | Water flow, spillway protection |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | | - |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | Groundsill must be integrated with the floor to be sturdy, it cannot just stick to it because it will not have a long life. Not only design issues but construction are also considered because some floors on the damper are already under construction. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Spillway, erossion, scouring, groundsill | | |
| *References* | *Meeting Minutes:* | | Risalah Diskusi Teknis Pembahasan Pelaksanaan Konstruksi Bendungan Ameroro Kabupaten Konawe, Provinsi Sulawesi Tenggara - 24 Februari 2023<br>Jawaban Risalah Diskusi Teknis KKB Pra Pleno |
| | *Meeting Materials:* | | Pelaksanaan Pembangunan Bendungan Ameroro Kab Konawe - Sd 19 Juli 2023 |
| | *Other:* | | Laporan Ringkasan (PT. Mettana, 2018) : Penyelidikan Geologi Detail dan Model Test Bendungan Ameroro |

**ID:** 37 **Name:** Sidan **Dam Type:** rock filled dam with vertical core **Dam Hight:** 68,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 9-Mar-23 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Tunnel Spillway |
| | 4 | ***Contents of risk*** | Structure stability |
| | 5 | ***Risk factors*** | Erossion, scouring |
| | 6 | ***Events in which risks were recognized*** | in the sky jump energy dissipator spillway structure. |
| | 7 | ***Condition/Situation for risk realization*** | Spill out of reservoir |
| | 8 | ***Impact if the risk realize*** | Structure demage |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Spillway, water hidrolic |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Design of Spillway* ⇨ *The 20 degree angle is difficult to work with the Road Header method. The slope that can use the Road Header machine is 15 degree.* ⇨ *Gentler design for chute spillway => Changing outlet spillway to skyjump* ⇨ *Erosion and scouring of plunge pool* ⇨ *Demage of plunge pool* => Foundation scouring

*Reinforcement plunge pool, addtional steel liner* ⇨ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

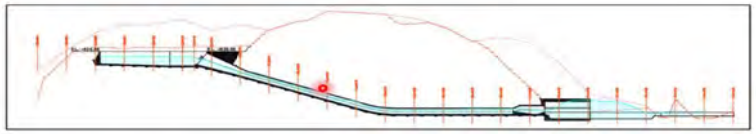


Figure 1. Initial design with a 20° angle.

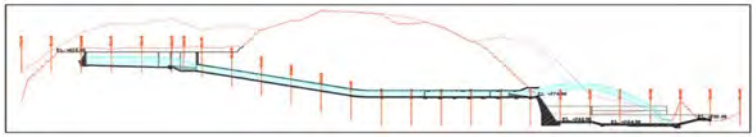
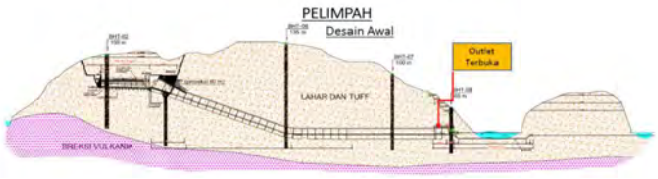
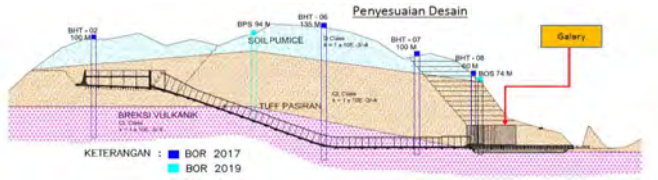


Figure 2. Design modification with a 12° angle.



**ID:** 37 **Name:** Sidan **Dam Type:** rock filled dam with vertical core **Dam Hight:** 68,0 **m**

| | | | |
|---|---|---|---|
| ***History*** | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Construction | ***Date:*** 9-Mar-23 |
| | ***Status of corresponding*** | - | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | | | |
| ***Design*** |   Figure 1. Initial design of sidan dam spillway tunnel | | |
| ***Construction*** |   Figure 1. Review design of sidan dam spillway tunnel | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |
| ***Investigation /analysis*** | ***Investigation/analysis to identify factors, etc.*** | | Drilling Investigation |
| | ***Research/analysis, etc. to assess impact*** | | Review the lithology condition |
| | ***Analysis, etc. to determine the need for and methods of response*** | | Rock soil properties |
| ***How to respond to risk*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Reinforcement / additional steel liner |
| | | ***Basis for decision*** | Structure design |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Techical issues | | |
| | -Remember that the plunge pool will receive a water waterfall with high speed and energy. It should be ensured that the plunge pool foundation is hard rock or, if necessary, equipped with concrete reinforcement as a result of a comprehensive technical analysis.<br>'-It should be noted that the required dimensions of the plunge pool are that the upstream boundary should use a Q2th flood design, and the water jump extension should use a Q1000th or QPMF flood design | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Tunnel Spillway, Road header tunnelling, skyjump | | |
| ***References*** | ***Meeting Minutes:*** | | Risalah diskusi teknis Pembahasan perubahan desain bangunan pelimpah, 9 Maret 2023 |
| | ***Meeting Materials:*** | | Review Design Pelimpah |
| | ***Other:*** | | |

**ID:** 38 **Name:** Tamblang **Dam Type:** ACCED **Dam Hight:** 70,0 m

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 3-Nov-22 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Dam / Geology / Fondatioun / Grouting |
| | 4 | ***Contents of risk*** | Uplift, Foundation leakage, piping |
| | 5 | ***Risk factors*** | Permeable foundation, |
| | 6 | ***Events in which risks were recognized*** | the supervising consultant modify the initial design without using curtain grouting at the riverbed |
| | 7 | ***Condition/Situation for risk realization*** | Impounding |
| | 8 | ***Impact if the risk realize*** | Dam failure, potential breaches, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, Foundation permeability |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☐ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☑ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Grouting for foundation* ⇒ *During design, lugeon value more than 15 obseved at the river bed of dam foundtion => curtain grouting was recomended for dam* ⇒ *Grouting for river bed is not conduted dering construction* ⇒ *foundation leakage, uplift, piping* ⇒ *water leakage, dam failure, flooding*

*Dam behavior monitoring* ⇒ *Risk retention*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

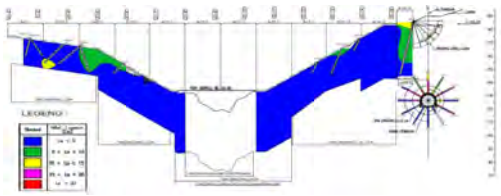
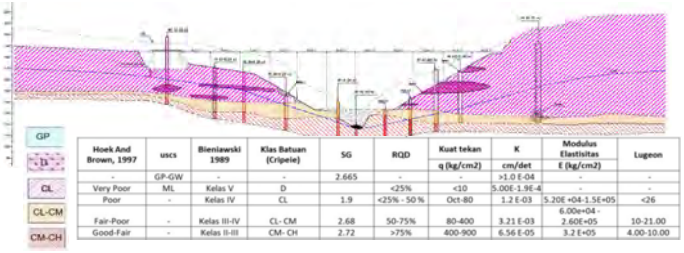


Figure 1 Lugeon profile of main dam with no grout at the river bed foundation (PT.




| Hoek And Brown, 1997 | uscs | Bieniawski 1989 | Klas Batuan (Cripele) | SG | RQD | Kuat tekan q (kg/cm2) | K cm/det | Modulus Elastisitas E (kg/cm2) | Lugeon |
|---|---|---|---|---|---|---|---|---|---|
| - | GP-GW | - | - | 2.665 | - | - | >1.0 E-04 | - | - |
| Very Poor | ML | Kelas V | D | | <25% | <10 | 5.00E-1.9E-4 | - | - |
| Poor | - | Kelas IV | CL | 1.9 | <25% - 50 % | Oct-80 | 1.2 E-03 | 5.20E +04-1.5E+05 | <26 |
| Fair-Poor | - | Kelas III-IV | CL- CM | 2.68 | 50-75% | 80-400 | 3.21 E-03 | 6.00e+04 - 2.60E+05 | 10-21.00 |
| Good-Fair | - | Kelas II-III | CM- CH | 2.72 | >75% | 400-900 | 6.56 E-05 | 3.2 E+05 | 4.00-10.00 |

Figure-2 Engineering Geology Profile of Tamblang Main Dam



**ID:** 38 **Name:** Tamblang **Dam Type:** ACCED **Dam Hight:** 70,0 m

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Recognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Design sage | ***Date:*** 2018 |
| | ***Status of corresponding*** | Retention | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | During design stage semi permeable foundation was observed at the river bed then grouting is recommended for foundation improvement. | | |

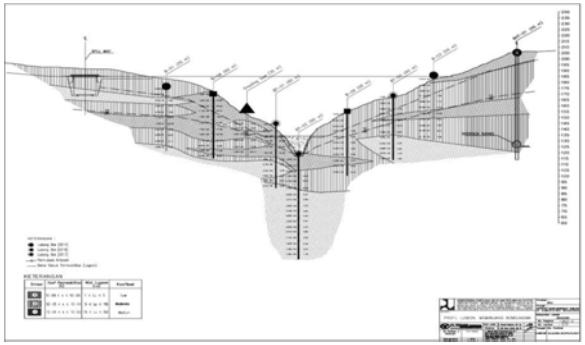


Figure-1 Lugeon Profile of Tamblang Dam axila during design (PT. Vitraha, 2018)

| | |
|---|---|
| ***Construction*** | The supervising consultant changed the initial design by not doing curtain grouting in the riverbed area because the foundation rock in the riverbed was andesite rock. Curtain grouting is still being carried out on the right and left abutments of the dam because the foundation is |
| ***Impounding*** | - |
| ***Operation/ maintenance*** | - |

| | | | |
|---|---|---|---|
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Retention |
| | ***Measures*** | ***How to deal with*** | - |
| | | ***Basis for decision*** | - |
| | ***Retention (no measures)*** | ***Reason*** | Lithology of foundation |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues<br><br>The technical justification for the initial design change regarding grouting should be detailed again, covering the condition of the andesite foundation, the results of trial grouting that has been carried out, the potential for uplift and seepage from the foundation, etc., to ensure that curtain grouting is not needed in the riverbed area and does not reduce the safety of the dam. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Dam foundation, permeable foundation, grouting | | |
| ***References*** | ***Meeting Minutes:*** | | Risalah Sidang Teknis Perubahan Desain, 3 November 2022 |
| | ***Meeting Materials:*** | | Evaluasi Pengisian Awal Waduk, 5 Mei 2023<br>Evaluasi Pengisian Awal Waduk-Grouting, 27 April 2023<br>Paparan Umum |
| | ***Other:*** | | Laporan Akhir, PT. Vitraha Consindotama, Nopember 2017 |

**ID:** 38 **Name:** Tamblang **Dam Type:** ACCED **Dam Hight:** 70,0 m

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | April 2023 |
| | 2 | ***Project phase in which risks were recognized*** | After Impounding |
| | 3 | ***Location (Structure/Area)*** | Dam body, dam material |
| | 4 | ***Contents of risk*** | Piping, water leakage, dam stability |
| | 5 | ***Risk factors*** | water leakage on dam body |
| | 6 | ***Events in which risks were recognized*** | Several leakage/ seepage on dam body was observed after initial impounding |
| | 7 | ***Condition/Situation for risk realization*** | Impouding, earthquake |
| | 8 | ***Impact if the risk realize*** | Dam failure, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Dam material, geotechnical, quality control |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Water leakage / seepage* ⇨ *During inpection after initial impounding several water leakage was observed on dam body* ⇨ *water leakage on elevation 168 to 170 m and dam toe => Covered with tarp => Monitoring* ⇨ *piping => material leaching* ⇨ *Dam failure, flood*

*Conducting grouting at dam surrounding* ⇨ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

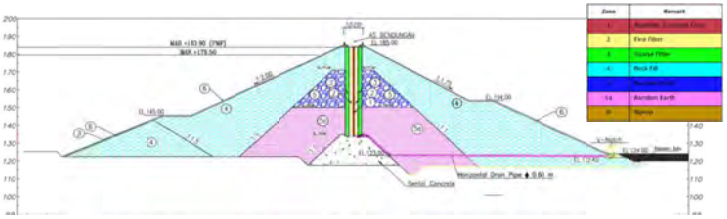


Figure-1 Typical design of Tamblang Dam

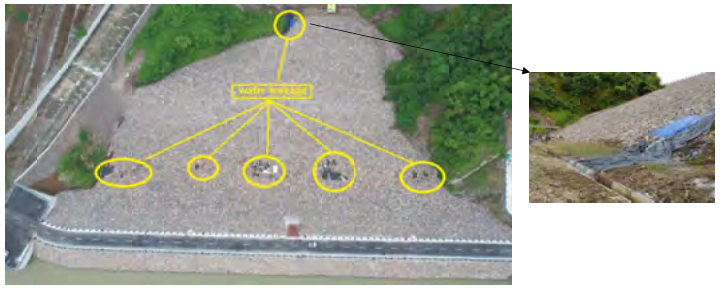


Photo-1 Water leakage location at Tamblang Dam



**ID:** 38 **Name:** Tamblang **Dam Type:** ACCED **Dam Hight:** 70,0 m

| | | | |
|---|---|---|---|
| ***History*** | ***Recognition or not in the past*** | | Unrecognized |
| | ***When the risk was recognized*** | ***Project Phase:*** Impouding | ***Date:*** April 2023 |
| | ***Status of corresponding*** | Grouting | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | The initial design of tamblang is clay core dam. Because of dificullity to look for clay core, supervise consultant recommended to change the design clay core to be asphalt core (ACCED). | | |
| ***Construction*** |   Photo-1 Dumentation during construction of main dam of Tamblang Dam | | |
| ***Impounding*** | After impounding, additional grouting is conducted at left and right abutment   Figure-1 Shop drawing of grouting location at left and right abutment | | |
| ***Operation/ maintenance*** | - | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Grouting for dam improvement |
| | | ***Basis for decision*** | Dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | Lowering reservoir for grouting to certain elevation | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Dam Body, water leakage / seepage, grouting | | |
| ***References*** | ***Meeting Minutes:*** | | Risalah Sidang Teknis Perubahan Desain, 3 November 2022 |
| | ***Meeting Materials:*** | | Evaluasi Pengisian Awal Waduk, 5 Mei 2023<br>Evaluasi Pengisian Awal Waduk-Grouting, 27 April 2023<br>Paparan Umum |
| | ***Other:*** | | Laporan Akhir, PT. Vitraha Consindotama, Nopember 2017 |

**ID:** 39 **Name:** Bintang Bano **Dam Type:** Rock - Filled dam with central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 7-Jul-22 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Dam / Spillway / Dam Crest |
| | 4 | ***Contents of risk*** | Piping, dam leakage |
| | 5 | ***Risk factors*** | Dam material, settlement / consolidation |
| | 6 | ***Events in which risks were recognized*** | When soil settlement occurs, indicated by cracks on the road at the top of the dam. |
| | 7 | ***Condition/Situation for risk realization*** | Impounding, settlement due to overburden |
| | 8 | ***Impact if the risk realize*** | Piping causes dam failure, flooding at downstream |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Dam material |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Crack on the dam crest* ⇒ *During inspection after impounding crack on the dam crest was observed* ⇒ *posibility continues crack to HWL elevation* ⇒ *Piping, water leakage through crack* ⇒ *Dam failute, flooding*

*Investigating the crack condition* ⇒ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

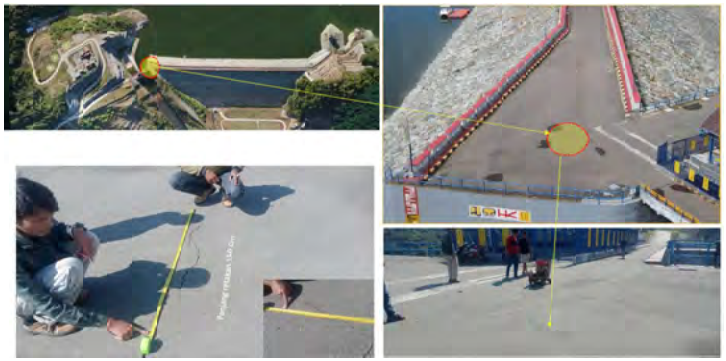
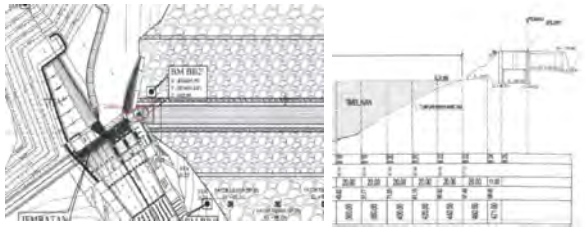


Photo-1 Location of crack at dam crest (near to spillway)



**ID:** 39 **Name:** Bintang Bano **Dam Type:** Rock - Filled dam with central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** 7-Jul-22 |
| | ***Status of corresponding*** | Investigating the crack condition | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** |  Figure-1 Layout at right abutment (Asbuilt drawing) | | |
| ***Impounding*** | Testpit on the crack was conduted to comfirm crack condition. The cracks are only on the asphalt surface and do not extend downward. Furthermore, no cracks were found on the core fill. Cracks on the asphalt surface are caused by the difference in the settlement of the concrete sloof of the stoplog house foundation with the settlement of the embankment soil. |  Photo-1 Testpit on the crack | |
| ***Operation/ maintenance*** | - | | |
| ***Investigation /analysis*** | ***Investigation/analysis to identify factors, etc.*** | | Testpit |
| | ***Research/analysis, etc. to assess impact*** | | Visual investigation |
| | ***Analysis, etc. to determine the need for and methods of response*** | | - |
| ***How to respond to risk*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | - |
| | | ***Basis for decision*** | - |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | Regarding the presence of these cracks, it should pay attention to the following things:<br>• Crack locations should be depicted on the dam layout.<br>• An analysis should be carried out regarding the causes of cracks related to dimensions, geometry, crack patterns, and existing instrumentation readings. Then, what is the repair solution, and predict what will happen if the crack is not treated immediately. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Crack on dam crest, piping, testpit | | |
| ***References*** | ***Meeting Minutes:*** | | Diskusi Teknis Pembahansan Pelaksanaan Pengisian Awal Waduk dan Kesiapan Operasi, 9 February 2023 |
| | ***Meeting Materials:*** | | Persiapan Operasi dan Pemiliharaan, February 2023 |
| | ***Other:*** | | Asbuilt drawing galian dan timbunan |

**ID:** 39 **Name:** Bintang Bano **Dam Type:** Rock - Filled dam with central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 7-Jul-22 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Dam body, dam material |
| | 4 | ***Contents of risk*** | Dam stability, sliding of embankment |
| | 5 | ***Risk factors*** | Riprap condition, erosion |
| | 6 | ***Events in which risks were recognized*** | Impounding |
| | 7 | ***Condition/Situation for risk realization*** | rain, water erosion |
| | 8 | ***Impact if the risk realize*** | Sliding on dam body |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Dam material, reservoir |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Riprap condition* ⇒ *During inspection after impounding, some ripraps are not interloced => riprap containing many small size of rock* ⇒ *Countinue rain may couse riprap eroded dan separated* ⇒ *Unprotected slope* ⇒ *sliding of dam slope*

*Changing riprap with the good one and interlock installation among the riprap* ⇒ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***


Figure-1 Location of non-interlocking riprap

Photo-1 Visual condition of the riprap



**ID:** 39 **Name:** Bintang Bano **Dam Type:** Rock - Filled dam with central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** 7-Jul-22 |
| | ***Status of corresponding*** | Considering changing the riprap | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** | The construction Bintang Bano Dam is already finished in 2021 | | |
| ***Impounding*** | After impouding some riprap is losing ites interlocking | | |
| ***Operation/ maintenance*** | - | | |
| *Investigation /analysis* | ***Investigation/analysis to identify factors, etc.*** | | Visual inspection |
| | ***Research/analysis, etc. to assess impact*** | | - |
| | ***Analysis, etc. to determine the need for and methods of response*** | | Repir the riprap |
| *How to respond to risk* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Avoidance |
| | ***Measures*** | ***How to deal with*** | Considering changing and repairing the riprap |
| | | ***Basis for decision*** | Dam safety, riprap condition |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | Rip-rap material that is too small does not interlock and/or does not meet standards should be repaired and replaced with material that meets specifications to avoid sliding. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Riprap, not interlocking, riprap replacement | | |
| *References* | ***Meeting Minutes:*** | | Diskusi Teknis Pembahansan Pelaksanaan Pengisian Awal Waduk dan Kesiapan Operasi, 9 February 2023 |
| | ***Meeting Materials:*** | | Persiapan Operasi dan Pemiliharaan, February 2023 |
| | ***Other:*** | | Asbuilt drawing galian dan timbunan |

**ID:** 40 **Name:** Temef **Dam Type:** Selective random - fill **Dam Hight:** 53,0 **m**

| | | | |
|---|---|---|---|
| **Contents of Risk** | 1 | **When the risk was identified (date)** | Nov 2018 - Sep 2023 |
| | 2 | **Project phase in which risks were recognized** | Construction |
| | 3 | **Location (Structure/Area)** | Dam / Spillway / Landslide |
| | 4 | **Contents of risk** | Landslide at STA +300-500 Right and Left Spillway |
| | 5 | **Risk factors** | Geology formation, slope cutting |
| | 6 | **Events in which risks were recognized** | During excavation of spillway construction, several slope failure accured from 2018 to 2023 |
| | 7 | **Condition/Situation for risk realization** | Rain, earthquake |
| | 8 | **Impact if the risk realize** | Spillway demage, |
| **Perspectives on Risk Classification** | 9 | **Where risk exists** | Geology, rock strengh, slope cutting |
| | 10 | **Character** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | **Phase of Realization** | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | **Impact if the risk realize** | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | **Corresponding to risks** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

**Overview of Causal Relationships**

*slope failure at left hill of spillway* ⇒ *Construction of spillway excavated left hill of spillway, several landslide occured from 2018 to 2023* ⇒ *Heavy rain and earthquake trigger the landslide / slope failure* ⇒ *Slope failure / lanslide* ⇒ *Demage spillway, clogging spillway from material*

*Additional reinforcement for the slope* ⇒ *Risk reduction*

**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

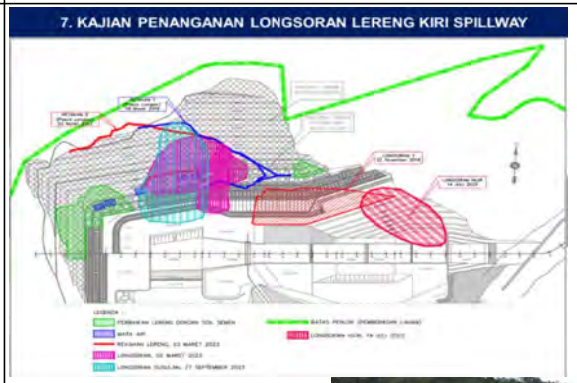



Figure-1 landslide historical at left slope of spillway at Temef Dam

Photo-1 Aerial photograph of lanslide that taken on 5 August 2023



**ID:** 40 **Name:** Temef **Dam Type:** Selective random - fill **Dam Hight:** 53,0 **m**

| | | | |
|---|---|---|---|
| **History** | **Recognition or not in the past** | Unrecognized | |
| | **When the risk was recognized** | **Project Phase:** Construction | **Date:** Nov 2018 - Sep 2023 |
| | **Status of corresponding** | Pile and gabion intalation / reinforcement | |
| **Project Phase** | **History of correspond to risks** | | |
| **Plan** | - | | |
| **Design** | - | | |
| **Construction** | Several lanslide occur during construction at Temef Dam especially at left hill of spillway structur. The landslide historical are:<br>- 22 November 2018 - near chute of spillway<br>- 2 March 2023 - near to appron of spillway<br>- 14 July 2023 - near to chute and stilling basin<br>- 27 September 2023 - near to appron of spillway<br>The consultant decide to add reinforcement with gabion and pile | | |
| **Impounding** | - | | |
| **Operation/ maintenance** | - | | |

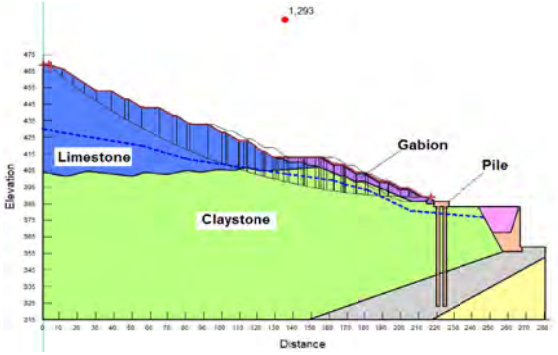



Figure-1 Proposed reinforcement for cutting slope at Temef Dam

| | | | |
|---|---|---|---|
| **Investigation /analysis** | **Investigation/analysis to identify factors, etc.** | | Laboratory testing for rock /soil parameter |
| | **Research/analysis, etc. to assess impact** | | Slope stability analysis |
| | **Analysis, etc. to determine the need for and methods of response** | | Gabion and pile |
| **How to respond to risk** | **Contents of measures (avoidance, reduction, transfer) or retention** | | Reduction |
| | **Measures** | **How to deal with** | Installation gabion and pile for reinforcement |
| | | **Basis for decision** | Sloe stability, dam safety / function |
| | **Retention (no measures)** | **Reason** | - |
| | | **Expected impact** | - |
| | **Availability and method of monitoring** | | - |
| | **Availability and method of information sharing** | | - |
| **Special Notes** | **Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.** | | |
| | 1) Technical issues<br>2) Constraints in project implementation | | |
| | - Gabions should also be added to the boundary between the bobonaro formation (claystone) and limestone to protect against moisture loss and scour, and drainage should be added between the limestone and bobonaro formation.<br>- Ensure that the installed gabions do not overload the spillway walls and that no further movement occurs. | | |
| **Applicable standards** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| **Keywords** | Spillway, slope failure, landslide, gabion, pile | | |
| **References** | **Meeting Minutes:** | | Risalah Pelaksanaan Konstruksi, 7 Agustus 2023 |
| | **Meeting Materials:** | | Paparan Bendungan Temef(Paket 3-4), 5 SePTember 2022 |
| | **Other:** | | Kajian Teknik Penanganan Longsoran Lereng Spillway Paket 3 |

**ID:** 40 **Name:** Temef **Dam Type:** Selective random - fill **Dam Hight:** 53,0 m

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | August 2023 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Upper spillway floor |
| | 4 | ***Contents of risk*** | Spillway demage, spillway failure |
| | 5 | ***Risk factors*** | Swelling pressure of claystone |
| | 6 | ***Events in which risks were recognized*** | During spillway excavation Bobonaro Clay was obeserved at upper spillway |
| | 7 | ***Condition/Situation for risk realization*** | Inpounding, high ground water level |
| | 8 | ***Impact if the risk realize*** | Spillway structure failur, dam failure |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, strengh, material |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Swelling pressure at upper floor of spillway* ⇒ *During spilway excavation bobonaro claystone was obserced => high swelling pressure potential* ⇒ *When impounding water level increase => increase water content of claytone* ⇒ *spillway structure failure* ⇒ *dam stability, flooding*

*Reinforcement for spillway floor* ⇒ *Risk Reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

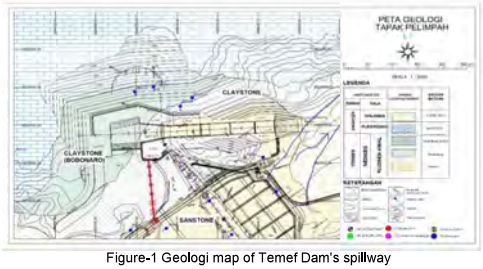



Figure-1 Geologi map of Temef Dam's spillway

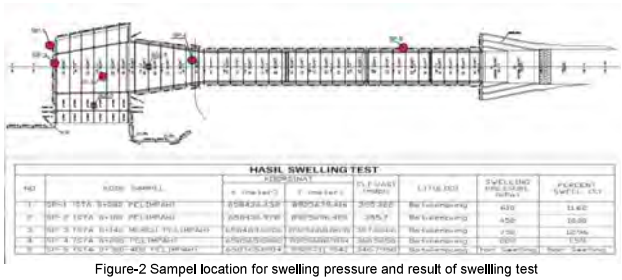



Figure-2 Sampel location for swelling pressure and result of swellling test



**ID:** 40 **Name:** Temef **Dam Type:** Selective random - fill **Dam Hight:** 53,0 m

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Unrecognized | |
| | *When the risk was recognized* | ***Project Phase:*** Construction | ***Date:*** August 2023 |
| | ***Status of corresponding*** | Reinforcement | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | The foundation of spillway has high swelling. The swelling pressure of the up to 750 kpa. Consultan planned to increace the thickness of spillway floor and anchor additional. | | |

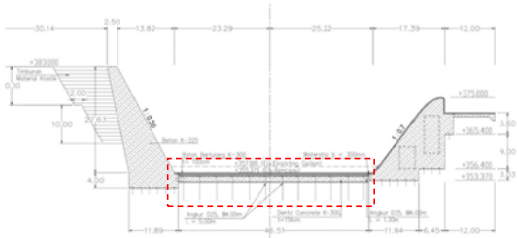


Figure-1 Reinforcement for swelling pressure countermessure by thickening floor and additional anchor

| | | | |
|---|---|---|---|
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *Investigation /analysis* | ***Investigation/analysis to identify factors, etc.*** | | Swelling pressure test |
| | ***Research/analysis, etc. to assess impact*** | | including swelling pressure parameter |
| | ***Analysis, etc. to determine the need for and methods of response*** | | - |
| *How to respond to risk* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Renforcement using anchor and thickening the concrete floor |
| | | ***Basis for decision*** | Dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issue | | |
| | To confirm the strengh of anchor, it recommended to carry out pull out test for anchor. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Spillway, swelling, anchor | | |
| *References* | ***Meeting Minutes:*** | | Risalah Pelaksanaan Konstruksi, 7 Agustus 2023 |
| | ***Meeting Materials:*** | | Paparan Bendungan Temef(Paket 3-4), 5 SePTember 2022<br>Kajian swellling pressure pada lantai spillway, 2023 |
| | ***Other:*** | | Kajian Teknik Penanganan Longsoran Lereng Spillway Paket 3 |

| ID: | | Name: Meniting | Dam Type: Random Filled Dam with central cor | Dam Hight: 74,0 m |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 17-Jun-22 | |
| | 2 | Project phase in which risks were recognized | Construction | |
| | 3 | Location (Structure/Area) | Dam / Foundation, Spillway / abutments | |
| | 4 | Contents of risk | Left abutment hills of the dam is prone to landslides. | |
| | 5 | Risk factors | Slope cutting, material properties | |
| | 6 | Events in which risks were recognized | The risk of landslides was identified on left abutment during foundation excavation | |
| | 7 | Condition/Situation for risk realization | Rain, run off water, earthquake | |
| | 8 | Impact if the risk realize | Foundation stability, dam breach, strukture demage | |
| Perspectives on Risk Classification | 9 | Where risk exists | Geology, foundation strengh | |
| | 10 | Character | ☑ Mainly caused by external forces | |
| | | | ☑ Mainly due to technical factors | |
| | | | ☐ Factors other than the above | |
| | 11 | Phase of Realization | ☐ Project Implementation | |
| | | | ☑ Operation | |
| | | | ☐ Due to large-scale external force action | |
| | | | ☑ Due to long-term use | |
| | | | ☐ Others | |
| | 12 | Impact if the risk realize | ☑ Affects dam safety | |
| | | | ☑ Affects dam function | |
| | | | ☐ Affect the schedule and costs of the projects | |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance | |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. | |
| | | | ☐ Risk retention under certain conditions | |
| Overview of Causal Relationships | | Excavation of left abutment ⇒ during site inspection of meninting, BTB team remains condition of cutting slope at left abutmnet of dam ⇒ heavy rain and earthquake trigger failure, exspecially at no slope protection ⇒ slope failure at left dam abutment ⇒ structure demage, dam breach, flooding | | |
| | | Protection and reinforcement of slope ⇒ Risk reduction | | |
| Explanatory Diagram (Schematic Diagram/ Photos, etc.) | |  | | |

**Figure 1**. Excavation Slope at Risk of Potential Ladslide



| ID: | | Name: Meniting | Dam Type: Random Filled Dam with central co | Dam Hight: 74,0 m |
|---|---|---|---|---|
| History | Recognition or not in the past | Unrecognized | | |
| | When the risk was recognized | Project Phase: Construction | Date: 17-Jun-22 | |
| | Status of corresponding | Additional protection " | | |
| Project Phase | History of correspond to risks | | | |
| Plan | - | | | |
| Design | - | | | |
| Construction | During inprection at february 2023, slope cutting at left abutment has been protecten partially | | | |
| |  | | | |

**Figure 1**. Slope cutting condition at left abutment of Meninting Dam

| | | | |
|---|---|---|---|
| Impounding | - | | |
| Operation/ maintenance | - | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | | Reduction |
| | Measures | How to deal with | Additional slope protection, sortcrete |
| | | Basis for decision | slope stability |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | | - |
| | Availability and method of information sharing | | - |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | - | | |
| | - | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| Keywords. | Dam abutment, slope failure, landslide, sortcrete | | |
| References | Meeting Minutes: | Laporan Inspeksi Pelaksanaan Konstruksi Bendungan Meninting, 20 Juni 2022 | |
| | Meeting Materials: | Kronologis Luapan Air pada Temporary Cofferdam, 20 Juni 2022 | |
| | Other: | Laporan Utama Sertifikasi Design, February 2017 | |

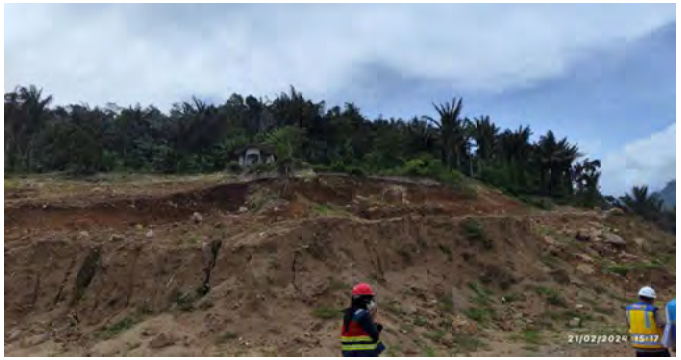
| ID: | | Name: Meniting | Dam Type: .andom Filled Dam with central co | Dam Hight: 74,0 m |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | Feb 2024 | |
| | 2 | Project phase in which risks were recognized | Construction | |
| | 3 | Location (Structure/Area) | Reservoir Area | |
| | 4 | Contents of risk | Slope failure. Landslide, reservoir sedimentation | |
| | 5 | Risk factors | Cutting slope, excavation method | |
| | 6 | Events in which risks were recognized | During excavation for ramdom material at quarry area | |
| | 7 | Condition/Situation for risk realization | Heavy rain, earthquake, excavation | |
| | 8 | Impact if the risk realize | over toping due to lanslide, reservoir sedimentation | |
| Perspectives on Risk Classification | 9 | Where risk exists | Geology, slope stability | |
| | 10 | Character | ☐ Mainly caused by external forces | |
| | | | ☐ Mainly due to technical factors | |
| | | | ☐ Factors other than the above | |
| | 11 | Phase of Realization | ☑ Project Implementation | |
| | | | ☑ Operation | |
| | | | ☐ Due to large-scale external force action | |
| | | | ☑ Due to long-term use | |
| | | | ☑ Others | |
| | 12 | Impact if the risk realize | ☑ Affects dam safety | |
| | | | ☑ Affects dam function | |
| | | | ☐ Affect the schedule and costs of the projects | |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance | |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. | |
| | | | ☐ Risk retention under certain conditions | |
| Overview of Causal Relationships | Sliding at quarry area ⇒ During excavation at quarry area, sliding occur => delay for material mining ⇒ quary area is impounded=> potential sliding of ⇒ Slope failure. Landslide, reservoir sedimentation ⇒ over toping due to lanslide, reservoir sedimentation; ⇘ Reinforcement for slope stabilization ⇒ Risk reduction | | | |
| Explanatory Diagram (Schematic Diagram/ Photos, etc.) |  | | | |

**Photo 1.** Lanslide at quary area of Meninting Dam



| ID: | | Name: Meniting | Dam Type: .andom Filled Dam with central co | Dam Hight: 74,0 m |
|---|---|---|---|---|
| History | Recognition or not in the past | Unrecognized | | |
| | When the risk was recognized | Project Phase: Construction | Date: Feb 2024 | |
| | Status of corresponding | Considering design for slope protection | | |
| Project Phase | History of correspond to risks | | | |
| Plan | - | | | |
| Design | - | | | |
| Construction | During excavation of quary area, landslide occurred. Landslide occurred after heavy rain at location. | | | |
| Impounding | - | | | |
| Operation/ maintenance | - | | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | Reduction | | |
| | Measures | How to deal with | Protection after completing excavation | |
| | | Basis for decision | impounding, water level fluctuation of Dam | |
| | Retention (no measures) | Reason | - | |
| | | Expected impact | - | |
| | Availability and method of monitoring | - | | |
| | Availability and method of information sharing | - | | |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | | |
| | 1) Technical issue | | | |
| | at the time of impounding, some of the ex quary locations will be submerged. the existing slope has experienced landslides during excavation, the slope should be protected after completion of the excavation, considering the slope will experience ups and downs of the reservoir water level. | | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | | |
| Keywords. | Quary, reservoir area, slope failure, slope protection | | | |
| References | Meeting Minutes: | Site Inspection 21 February 2024 | | |
| | Meeting Materials: | Pembangunan Bendungan Meninting, 20 February 2024 | | |
| | Other: | Laporan Utama Sertifikasi Design, February 2017 | | |

| ID: | | Name: Meniting | Dam Type: Random Filled Dam with central cor | Dam Hight: 74,0 m |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | Feb 2024 | |
| | 2 | Project phase in which risks were recognized | Construction | |
| | 3 | Location (Structure/Area) | Dam body, dam material | |
| | 4 | Contents of risk | Dam failure | |
| | 5 | Risk factors | Material leaching, piping | |
| | 6 | Events in which risks were recognized | During inspection, random material show many fine material of random zone | |
| | 7 | Condition/Situation for risk realization | Impounding, reservoir water fluctiotion | |
| | 8 | Impact if the risk realize | Sliding of dam slope, dam break, flooding | |
| Perspectives on Risk Classification | 9 | Where risk exists | Dam material, | |
| | 10 | Character | ☐ Mainly caused by external forces | |
| | | | ☑ Mainly due to technical factors | |
| | | | ☐ Factors other than the above | |
| | 11 | Phase of Realization | ☐ Project Implementation | |
| | | | ☑ Operation | |
| | | | ☐ Due to large-scale external force action | |
| | | | ☑ Due to long-term use | |
| | | | ☐ Others | |
| | 12 | Impact if the risk realize | ☑ Affects dam safety | |
| | | | ☐ Affects dam function | |
| | | | ☐ Affect the schedule and costs of the projects | |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance | |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. | |
| | | | ☐ Risk retention under certain conditions | |

**Overview of Causal Relationships**

Random zone material ⇒ the random zone look has many fine material=> no transition zone between randon zone and rockfill zone ⇒ after impounding water level may fluctuated and bring some fine material ⇒ material leaching and piping ⇒ slope failure of dam

material leaching and piping ⇒ additional transition zone ⇒ Risk Reduction

**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

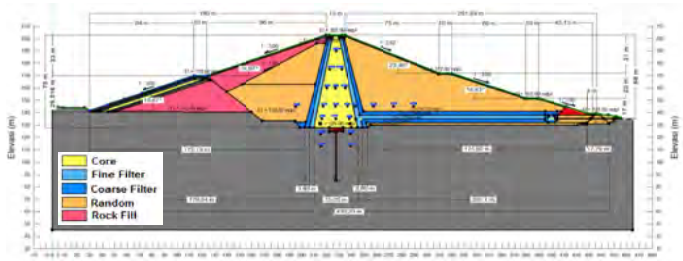



**Figure 1**. Original typical design of Meninting Dam

**Photo 1**. Visual condition of rondom zone and rockfill zone



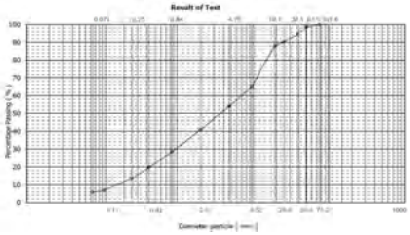
| ID: | | Name: Meniting | Dam Type: Random Filled Dam with central co | Dam Hight: 74,0 m |
|---|---|---|---|---|
| History | Recognition or not in the past | Unrecognized | | |
| | When the risk was recognized | Project Phase: Construction | Date: Feb 2024 | |
| | Status of corresponding | Considering modified the dam design | | |
| Project Phase | History of correspond to risks | | | |
| Plan | - | | | |
| Design |  | | | |

**Figure 1**. Gradation of random material during design

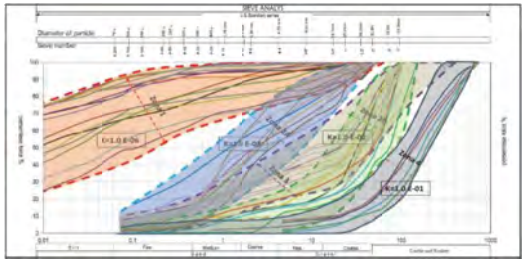
| | |
|---|---|
| Construction |  |

**Figure 2**. Gradation of meninting dam material

| | | | |
|---|---|---|---|
| Impounding | - | | |
| Operation/ maintenance | - | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | | Reduction |
| | Measures | How to deal with | Modify dam body design by adding trassition zone between random and rockfill |
| | | Basis for decision | dam safety |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | | - |
| | Availability and method of information sharing | | - |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | - | | |
| | - | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| Keywords. | | | |
| References | Meeting Minutes: | Site Inspection 21 February 2024 | |
| | Meeting Materials: | Pembangunan Bendungan Meninting, 20 February 2024 | |
| | Other: | Laporan Utama Sertifikasi Design, February 2017 | |

**ID:** 42 **Name:** Beringin Sila Dam **Dam Type:** Zonal with central core **Dam Hight:** 70,5 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | Sep 2022 |
| | 2 | ***Project phase in which risks were recognized*** | After Impounding |
| | 3 | ***Location (Structure/Area)*** | Reservoir, dam body |
| | 4 | ***Contents of risk*** | over topping, sedimentation |
| | 5 | ***Risk factors*** | Water level increase |
| | 6 | ***Events in which risks were recognized*** | Technical discussion of operation permit |
| | 7 | ***Condition/Situation for risk realization*** | Impounding, heavy rain, |
| | 8 | ***Impact if the risk realize*** | decresing reservoir capacity, dam breach |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Reservoir, hydrology, climate |
| | 10 | ***Character*** | ☑ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☐ Basically risk avoidance |
| | | | ☑ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Flash flooding potential* ⇒ *During technical discussion informed that beringin sila dam has flash flooding potential* ⇒ *Heavy rain at the uptream ( caldera catchment area)* ⇒ *Overtopping, sedimentatition* ⇒ *decresing reservoir capacity, dam breach*

*Special study regarding flash flaod => considering contermeasurement* ⇒ *Risk Retention*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

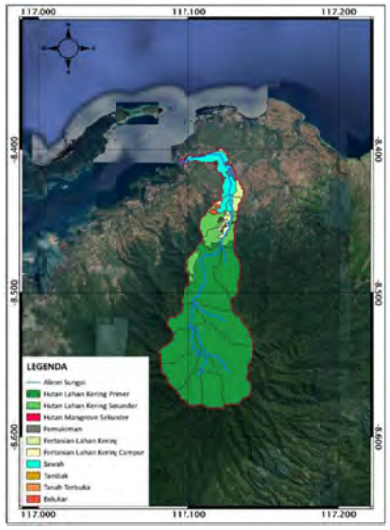



Figure-1 Watershed area of Beringin Sila Dam



**ID:** 42 **Name:** Beringin Sila Dam **Dam Type:** Zonal with central core **Dam Hight:** 70,5 **m**

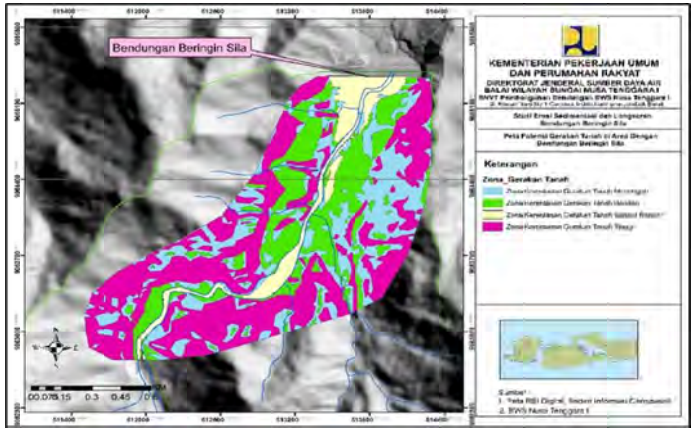
| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** Sep 2022 |
| | ***Status of corresponding*** | Cosidering special study for flash flood potential | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** |  | | |



Figure-1 Mass movement zone of Beringin Sila Reservoir area

| | | | |
|---|---|---|---|
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |
| *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* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Considering basic design of management of erosion and sedimentation problems due to the caldera |
| | | ***Basis for decision*** | Caldera watershed |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical Issues | | |
| | Flash flooding potential should be anticipated by preparing a sabo system design for lava control upstream of Beringin Sila Dam. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Reservoir, flash flooding, sabo system, sedimen control | | |
| *References* | ***Meeting Minutes:*** | | Risalah Konstruksi Dan Kesiapanpengisian Awal Waduk, 26 September 2022<br>Risalah Konstruksi Dan Kesiapanpengisian Awal Waduk, 12 September 2022 |
| | ***Meeting Materials:*** | | Paparan Sidang Pleno Beringin Sila |
| | ***Other:*** | | Laporan Akhir (PT. Indra Karya,2017): Detail Desain Bendungan Beringin Sila |

**ID:** 42 **Name:** Beringin Sila Dam **Dam Type:** Zonal with central core **Dam Hight:** 70,5 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | *When the risk was identified (date)* | 15-Nov-23 |
| | 2 | *Project phase in which risks were recognized* | Impounding |
| | 3 | *Location (Structure/Area)* | Dam Foundation |
| | 4 | *Contents of risk* | Piping of foundation, uplift of dam body |
| | 5 | *Risk factors* | Ineffective grouting indication |
| | 6 | *Events in which risks were recognized* | Piezometer monitoring of foundation |
| | 7 | *Condition/Situation for risk realization* | High water level of reservoir |
| | 8 | *Impact if the risk realize* | Dam break causing flooding |
| *Perspectives on Risk Classification* | 9 | *Where risk exists* | Geology, Permeability, Design / Foundation treatment |
| | 10 | *Character* | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | *Phase of Realization* | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | *Impact if the risk realize* | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | *Corresponding to risks* | ☐ Basically risk avoidance |
| | | | ☑ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

*Overview of Causal Relationships*

*Gouting of dam foundation* ⇒ *Piezometer monitoring at downsteam and upstream of grouting almost has same presure value* ⇒ *longterm of high water level of reservoir* ⇒ *uplift of dam body, piping of foundation* ⇒ *dam break causing flooding*

*monitoring of instrument and dam deformation* => *socialization of warning system* ⇒ *mitigation*

*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*

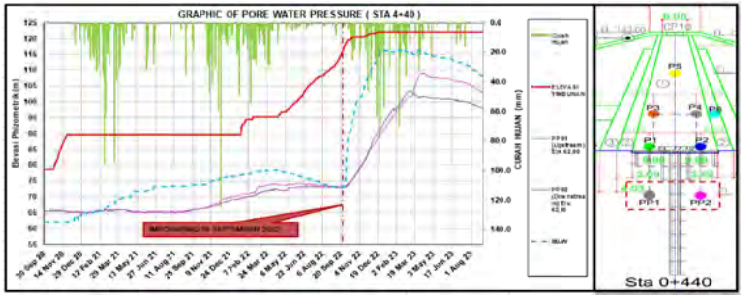
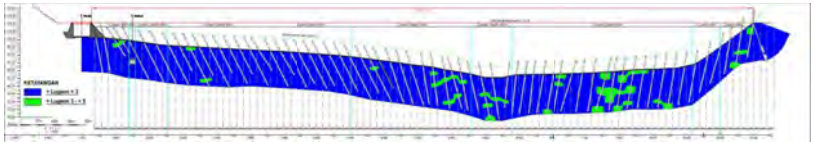



Figure-1 Piezometer reading at dam foundation (dowstrean and upstream of grouting)



**ID:** 42 **Name:** Beringin Sila Dam **Dam Type:** Zonal with central core **Dam Hight:** 70,5 **m**

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Unrecognized | |
| | *When the risk was recognized* | *Project Phase:* Impounding | *Date:* 15-Nov-23 |
| | *Status of corresponding* | Dam intrument monitoring | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* |  Figure-1 Lugeon profil of Beringin Sila Dam after grouting (check hole) | | |
| *Impounding* | Some seepage was observed after impoung, but during construction These seepages are already there | | |
| *Operation/ maintenance* | - | | |

| | | | |
|---|---|---|---|
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Retention |
| | *Measures* | *How to deal with* | - |
| | | *Basis for decision* | - |
| | *Retention (no measures)* | *Reason* | Dificullity of improvement after impounding |
| | | *Expected impact* | foundation seepage |
| | *Availability and method of monitoring* | | piezometer monitoring |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical Issue | | |
| | The V-notch's discharge is very large at 25 l/s. It is also possible that there are springs around the dam. It is necessary to check the origin of the seepage that occurs. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | | | |
| *References* | *Meeting Minutes:* | | Risalah Konstruksi Dan Kesiapanpengisian Awal Waduk, 26 September 2022<br>Risalah Konstruksi Dan Kesiapanpengisian Awal Waduk, 12 September 2022 |
| | *Meeting Materials:* | | Paparan Sidang Pleno Beringin Sila |
| | *Other:* | | Laporan Akhir (PT. Indra Karya,2017): Detail Desain Bendungan Beringin Sila |

**ID:** 43 **Name:** Tiu Suntuk Dam **Dam Type:** Rockfill dam with central core **Dam Hight:** 58,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | Jun 2023 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Reservoir area |
| | 4 | ***Contents of risk*** | Overtoping, sedimentation |
| | 5 | ***Risk factors*** | Slinding on the dam reservoir |
| | 6 | ***Events in which risks were recognized*** | During discussion there no information about sliding at reservoir area |
| | 7 | ***Condition/Situation for risk realization*** | Heavy rain, aarthquake, impounding |
| | 8 | ***Impact if the risk realize*** | Dam stability, dam failure, over sedimentation |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | reservoir, hydrolic |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Sliding at the reservoir area* ⇒ *No information about reservoir sliding => impouding reducing shear strengh of slope* ⇒ *Sliding occur may create big wave to dam body* ⇒ *overtoping, sedimentaion at reservoir* ⇒ *Dam failure, sediment acumulation*

*Identity sliding potential at reservoir, colculating quantity of mass that enter to reservoir* ⇒ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

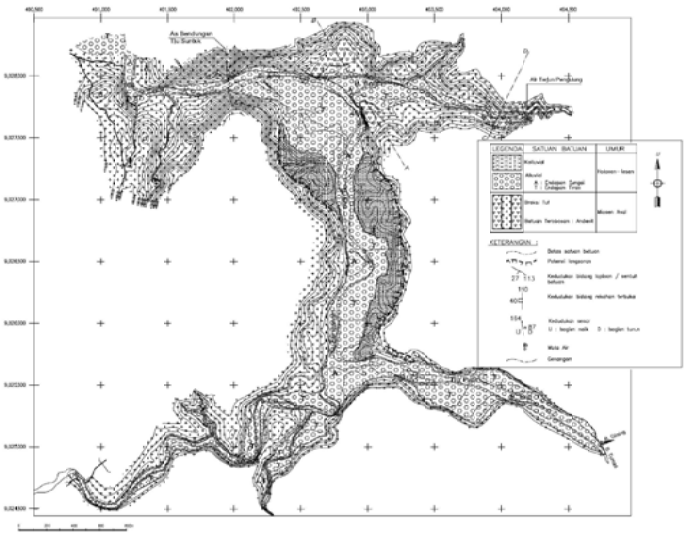


Figure-1 Geology map of reservoir area of Tiu Suntuk Dam (Indra Karya, 2019)



**ID:** 43 **Name:** Tiu Suntuk Dam **Dam Type:** Rockfill dam with central core **Dam Hight:** 58,0 **m**

| | | | |
|---|---|---|---|
| ***History*** | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Construction | ***Date:*** Jun 2023 |
| | ***Status of corresponding*** | Identity landslide potential at the reservoir area | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** | During construction the resoir of tiu suntuk dam was not mapped yet. | | |

Photo-1 Aerial photo of Tiu Suntuk Dam construction (dowstream to upsteam)

| | | | |
|---|---|---|---|
| ***Impounding*** | Initial impounding had been carried out on Oxtober 16, 2023 | | |
| ***Operation/ maintenance*** | - | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Conduction special investigation for reservoir |
| | | ***Basis for decision*** | slop stability |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical Issue | | |
| | a. An inventory of potential landslide areas should be carried out on the slopes of the reservoir basin.<br>b. Each location with the potential for landslides should be numbered, along with the coordinates of the location, the direction of the landslide, and the potential volume of landslides that can enter the reservoir. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Reservoir, sliding, mapping | | |
| ***References*** | ***Meeting Minutes:*** | Sidang Teknis Komisi Keamanan Bendungan Pembahasan Pelaksanaan Konstruksi Dan Kesiapan Pengisian , 23 Juni 2023 | |
| | ***Meeting Materials:*** | Monitoring Progres, 15 Juni 2023<br>Kajian Keamanan Bendungan | |
| | ***Other:*** | Laporan Utama, Mei 2019, PT. Indra Karya | |

**ID:** 43 **Name:** Tiu Suntuk Dam **Dam Type:** Rockfill dam with central core **Dam Hight:** 58,0 *m*

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | Des 2020 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Dam foundation |
| | 4 | ***Contents of risk*** | Foundation piping, foundation seepage, uplift |
| | 5 | ***Risk factors*** | Permeable foundation, ineffective grouting |
| | 6 | ***Events in which risks were recognized*** | During construction the no grout for foundation due lugeon value is 5 |
| | 7 | ***Condition/Situation for risk realization*** | impounding |
| | 8 | ***Impact if the risk realize*** | Dam failure, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, permeability, foundation |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☐ Basically risk avoidance |
| | | | ☑ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*No grouting of main dam deppest valey* ⇒ *the pilot hole of grouting show that the lugeon value is less than 6 at upper part (0-15 M) and less than 3 at lowe part (>15 m) at the* ⇒ *the material particel may be leached and flow through foundation, and seepage though foudation* ⇒ *Foundation piping, foundation seepage, uplift* ⇒ *dam failure, flooding*

*Monitoring the instrumentation* ⇒ *Risk retention*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

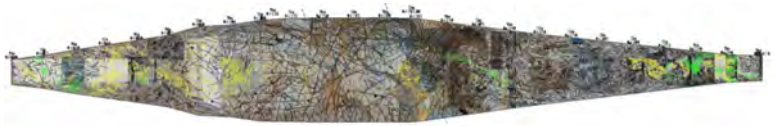


Figure-1 Crack distribution on coe dam foundation

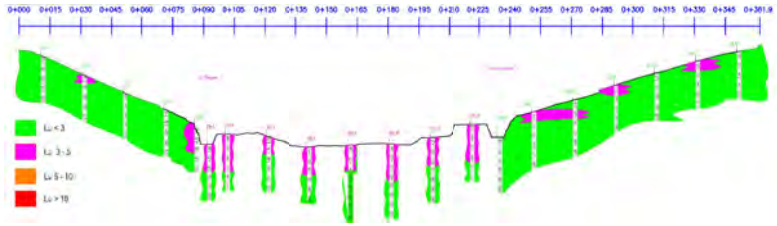
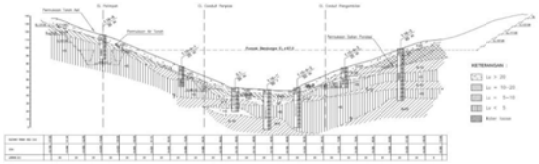
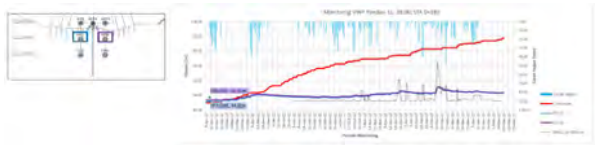


Figure-2 Lugeon profile of Tiu Suntuk Dam after grouting (check hole)



**ID:** 43 **Name:** Tiu Suntuk Dam **Dam Type:** Rockfill dam with central core **Dam Hight:** 58,0 *m*

| | | | | |
|---|---|---|---|---|
| *History* | *Recognition or not in the past* | Recognized | | |
| | *When the risk was recognized* | *Project Phase:* | *Date:* | #REF! |
| | *Status of corresponding* | | | |
| *Project Phase* | ***History of correspond to risks*** | | | |
| *Plan* | | | | |
| *Design* |  Figure-1 Lugeon profile during design (PT. Indra Karya, 2019) | | | |
| *Construction* |  Figure-2 Piezometer graph at lower part of dam foundation (STA 0+180)  Figure-3 Piezometer graph at upper part of dam foundation (STA 0+180) | | | |
| *Impounding* | - | | | |
| *Operation/ maintenance* | - | | | |
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | Retention | | |
| | *Measures* | *How to deal with* | - | |
| | | *Basis for decision* | - | |
| | *Retention (no measures)* | *Reason* | Lugeon is less than 5 | |
| | | *Expected impact* | - | |
| | *Availability and method of monitoring* | Piezometer monitoring at dam foundation | | |
| | *Availability and method of information sharing* | - | | |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | | |
| | 1) Technical Issues | | | |
| | Considering that the foundation is andesitic rock with small cracks which are feared to become seepage paths, the considerations for not carrying out curtain grouting on the riverbed foundation should be explained | | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | | |
| *Keywords.* | Dam foundation, no grouting, piezometer monitoring | | | |
| *References* | *Meeting Minutes:* | Sidang Teknis Komisi Keamanan Bendungan Pembahasan Pelaksanaan Konstruksi Dan Kesiapan Pengisian , 23 Juni 2023 | | |
| | *Meeting Materials:* | Monitoring Progres, 15 Juni 2023<br>Kajian Keamanan Bendungan | | |
| | *Other:* | Laporan Utama, Mei 2019, PT. Indra Karya | | |

**ID:** 44 **Name:** Manikin Dam **Dam Type:** Random fill with asphalt core **Dam Hight:** 50,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | *When the risk was identified (date)* | 19-Mar-21 |
| | 2 | *Project phase in which risks were recognized* | Construction |
| | 3 | *Location (Structure/Area)* | Tunnel |
| | 4 | *Contents of risk* | Tunnel deformation' |
| | 5 | *Risk factors* | Swelling pressure of claystone |
| | 6 | *Events in which risks were recognized* | Some steelrib of tunnel are experience deflection when tunneling |
| | 7 | *Condition/Situation for risk realization* | water penetration, ground water, impounding |
| | 8 | *Impact if the risk realize* | Demage of tunnel, structure failure |
| *Perspectives on Risk Classification* | 9 | *Where risk exists* | Geology, rock strengh, clay material |
| | 10 | *Character* | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | *Phase of Realization* | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | *Impact if the risk realize* | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | *Corresponding to risks* | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

*Overview of Causal Relationships*

*Tunneling in swellling clay* ⇨ *Deflected steelrib during tunneling* ⇨ *increasing water content of scaly claystone => increasing swelling pressure* ⇨ *Tunnel deformation* ⇨ *Demage of tunnel, structure failure*

*Cyrcle tunnel design & double reinforcement* ⇨ *Risk reduction*

*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*


Figure-1 Steelrib no.136 deformation at tunnel

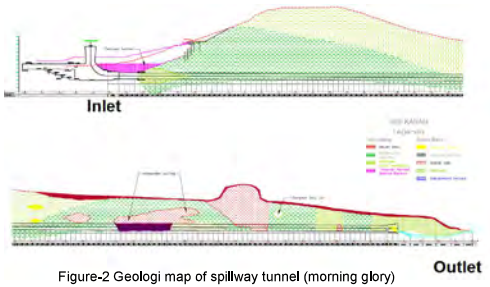



Figure-2 Geologi map of spillway tunnel (morning glory)



**ID:** 44 **Name:** Manikin Dam **Dam Type:** Random fill with asphalt core **Dam Hight:** 50,0 **m**

| | | | |
|---|---|---|---|
| *History* | *Recognition of not in the past* | Recognized | |
| | *When the risk was recognized* | *Project Phase:* Design | *Date:* 19-Mar-21 |
| | *Status of corresponding* | re-shaping the deformation area and Changing H-Beam with higher capacity | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | - | | |
| *Design* | During design, the rock characteristic of Manikin Dam has high swelling potential | | |
| *Construction* |  Photo-1 some H-Beam steels are deflected in the tunnel | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *Investigation /analysis* | *Investigation/analysis to identify factors, etc.* | | Swelling pressure analisys |
| | *Research/analysis, etc. to assess impact* | | Laboratorium testing |
| | *Analysis, etc. to determine the need for and methods of response* | | Software modeling |
| *How to respond to risk* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Reduction |
| | *Measures* | *How to deal with* | Changing the demaged steelrib, increasing steel capacity (strengh) |
| | | *Basis for decision* | Swelling rock |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | | - |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | - | | |
| | - | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Tunnel, Swelling pressure, Steelrib | | |
| *References* | *Meeting Minutes:* | | Risalah Pelaksanaan Konstruksi, 7 Agustus 2023<br>Risalah Tindak Lanjut Pelaksanaan Inspeksi, 5 SePTember 2022 |
| | *Meeting Materials:* | | Diskusi Teknik Kondisi Geologi, Paket 1, 12 Juli 2022<br>Rencana Penanganan Deformasi Terowongan Pelimpah Utama dan Pengelak, 7 Agustus 2023 |
| | *Other:* | | Laporan Geologi Dan Mekanika Tanah, PT. Indra Karya November 2018: Sertifikasi Desain Dan Model Test |

**ID:** 44 **Name:** Manikin Dam **Dam Type:** Random fill with asphalt core **Dam Hight:** 50,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2022 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Spillway channel |
| | 4 | ***Contents of risk*** | Slope failure |
| | 5 | ***Risk factors*** | Rock material, slaking, swelling pressure |
| | 6 | ***Events in which risks were recognized*** | During inspection in 2022 |
| | 7 | ***Condition/Situation for risk realization*** | Rain, earthquake, moisturation contain changing |
| | 8 | ***Impact if the risk realize*** | Channel clogging, spillway damage |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, slope stability, swelling clay |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*High excavation on swelling claystone* ⇒ *During technical discussion, the rock characteriztic were high swelling and shrinkage but high/large excavations are* ⇒ *increasing/decreasing water content => sliding trigger* ⇒ *Slope failure* ⇒ *Channel clogging, spillway damage*

*Changing designt to closed channel with backfill to counter swelling pressure* ⇒ *Risk avoidance*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

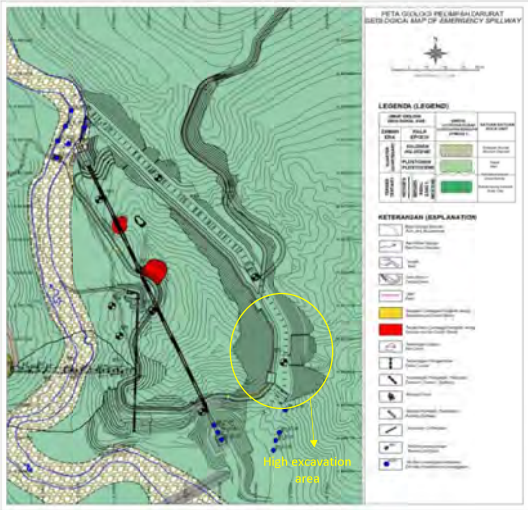



Figure-2 Geologi map of auxiliary spillway



**ID:** 44 **Name:** Manikin Dam **Dam Type:** Random fill with asphalt core **Dam Hight:** 50,0 **m**

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Recognized | |
| | *When the risk was recognized* | ***Project Phase:*** Design | ***Date:*** 2022 |
| | *Status of corresponding* | Additional slope protection | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* | During design, several location of auxiliary spillway was recommendent to be closed channel with box culvert to avoid swelling and shringkage of scally clay | | |
| *Construction* | During construction, the auxiliary spillway designed to be open channel | | |

Photo-1 Excavation on auxiliary spillway

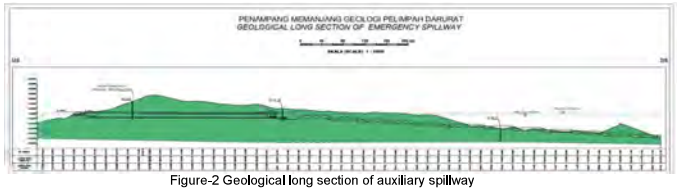



Figure-2 Geological long section of auxiliary spillway

| | | | |
|---|---|---|---|
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Avoidance |
| | *Measures* | *How to deal with* | Closed channel design |
| | | *Basis for decision* | Sliding potential |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | | - |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation. 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical issues | | |
| | There is a deep/high excavation near the upstream of the additional spillway. With bobonaro foundation there is potential pressure on the dam structure, embankment is required to counterweigh the swelling pressure and the structure should be monolith. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Auxiliary spillway, swelling, shringkage, landslide, slope failure, conduit, clossed channel | | |
| *References* | *Meeting Minutes:* | Risalah Pelaksanaan Konstruksi, 7 Agustus 2023<br>Risalah Tindak Lanjut Pelaksanaan Inspeksi, 5 SePTember 2022 | |
| | *Meeting Materials:* | Diskusi Teknik Kondisi Geologi, Paket 1, 12 Juli 2022<br>Rencana Penanganan Deformasi Terowongan Pelimpah Utama dan Pengelak, 7 Agustus 2023<br>Review design of Manikin dam 15 May 2024 | |
| | *Other:* | Laporan Geologi Dan Mekanika Tanah, PT. Indra Karya November 2018: Sertifikasi Desain Dan Model Test | |

**ID:** 44 **Name:** Manikin Dam **Dam Type:** Random fill with asphalt core **Dam Hight:** 50,0 m

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | Jun 2024 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Dam left abutment |
| | 4 | ***Contents of risk*** | Dam abutment sliding |
| | 5 | ***Risk factors*** | Exotic block of abutment |
| | 6 | ***Events in which risks were recognized*** | During technical discussion that left abutment has sliiding potential |
| | 7 | ***Condition/Situation for risk realization*** | Impounding |
| | 8 | ***Impact if the risk realize*** | Dam failure, foundation seepage, |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, rock strenght |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Dam abutment* ⇒ *The isolated hill on left dam abutment can be exotic block =⁄ exotic block is weak part of foundation* ⇒ *the boundary between exotic block and scaly claystone can be sliding* ⇒ *Sliding of dam abutment* ⇒ *Dam failure, flooding*

*removing exotic block or redesign of dam axial to* ⇒ *Risk avoidance*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

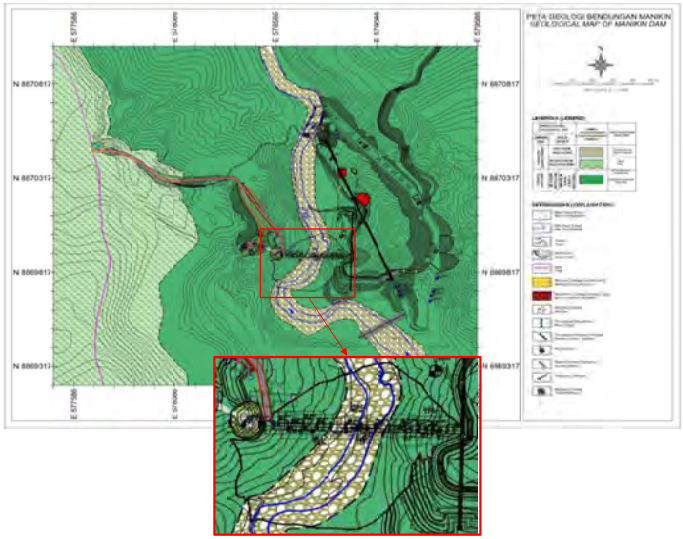
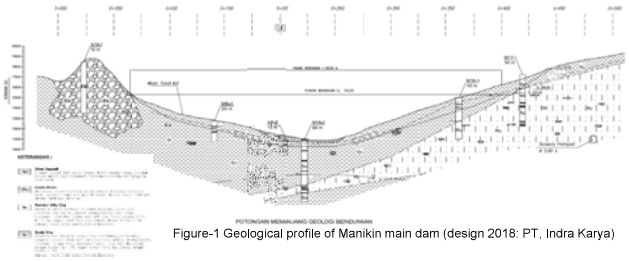



Figure-1 Geologi map of main dam of Manikin Dam



**ID:** 44 **Name:** Manikin Dam **Dam Type:** Random fill with asphalt core **Dam Hight:** 50,0 m

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Recognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Design | ***Date:*** 2018 |
| | ***Status of corresponding*** | Additional investigation for detail geology condition | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* |  Figure-1 Geological profile of Manikin main dam (design 2018: PT, Indra Karya) | | |
| *Construction* | | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *Investigation /analysis* | ***Investigation/analysis to identify factors, etc.*** | Considering drilling | |
| | ***Research/analysis, etc. to assess impact*** | - | |
| | ***Analysis, etc. to determine the need for and methods of response*** | - | |
| *How to respond to risk* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | Avoidance | |
| | *Measures* | ***How to deal with*** | Removing the block |
| | | ***Basis for decision*** | Dam safety |
| | *Retention (no measures)* | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | - | |
| | ***Availability and method of information sharing*** | - | |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | The sandstone on the left abutment needs a further study, if it is an exotic block floating on the Bobonaro Mudstone, at the time of impounding there is the potential for the rock to slip. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Dam abutment, sliding, redesign of dam axial | | |
| *References* | ***Meeting Minutes:*** | Risalah Pelaksanaan Konstruksi, 7 Agustus 2023<br>Risalah Tindak Lanjut Pelaksanaan Inspeksi, 5 SePTember 2022 | |
| | ***Meeting Materials:*** | Diskusi Teknik Kondisi Geologi, Paket 1, 12 Juli 2022<br>Rencana Penanganan Deformasi Terowongan Pelimpah Utama dan Pengelak, 7 Agustus 2023<br>Review design of Manikin dam 15 May 2024 | |
| | ***Other:*** | Laporan Geologi Dan Mekanika Tanah, PT. Indra Karya November 2018: Sertifikasi Desain Dan Model Test | |

**ID:** 45 **Name:** Way Apu Dam **Dam Type:** Zonal rockfill with Central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | *When the risk was identified (date)* | 26-Sep-22 |
| | 2 | *Project phase in which risks were recognized* | Construction |
| | 3 | *Location (Structure/Area)* | Dam / Diversion Dam / Diversion Tunnel: |
| | 4 | *Contents of risk* | Constraint in contruction, |
| | 5 | *Risk factors* | Poor RMR of rock mass, standing time |
| | 6 | *Events in which risks were recognized* | Tunneling |
| | 7 | *Condition/Situation for risk realization* | Excavation |
| | 8 | *Impact if the risk realize* | Infrastructure damage, significant financial losse |
| *Perspectives on Risk Classification* | 9 | *Where risk exists* | Geology / Strength, Permeability, Design / Diversion Tunnel |
| | 10 | *Character* | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | *Phase of Realization* | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | *Impact if the risk realize* | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | *Corresponding to risks* | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

*Overview of Causal Relationships*

*Tunnel Collapse* ⇨ *Several collapse occured in tunnel during excavation* ⇨ *stress release during excavation* ⇨ *Constraint in contruction* ⇨ *Infrastructure damage, financial lose*

*Backfill and grouting with several opsional methods* ⇨ *Risk reduction*

*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*

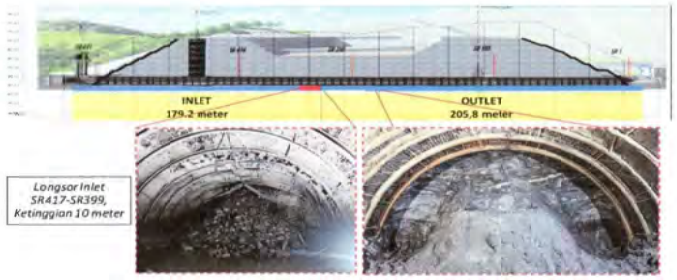



**Figure 1. Location of the collapse from SR417 to SR399 (Source: Presentation material on the progress of Way Apu Dam Package 1 construction, 2022)**



**ID:** 45 **Name:** Way Apu Dam **Dam Type:** Zonal rockfill with Central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Not recognized | |
| | *When the risk was recognized* | *Project Phase:* | *Date:* 26-Sep-22 |
| | *Status of corresponding* | Grouting and backfill | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | - | | |
| *Design* | Bieniawski (1989) is refference for tunneling method during design stage that using shotcrete and rockbolt | | |
| *Construction* | There are 4 opsions for collapse tunnel but in general backfill and grouting will be used in every option | | |

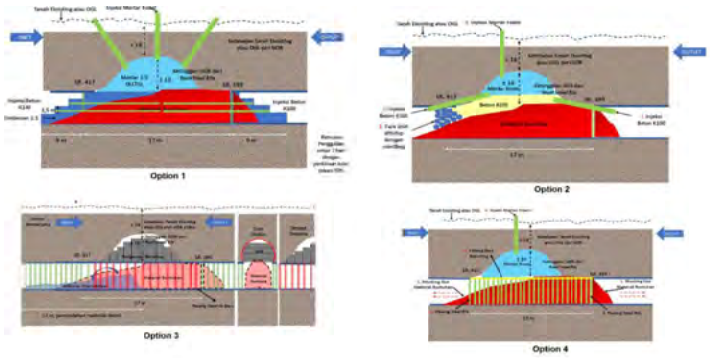


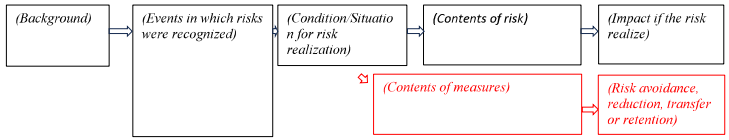

**Figure 1Tunnel improvement of Way Apu Dam**

| | | | |
|---|---|---|---|
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Reduction |
| | *Measures* | *How to deal with* | conducting grouting and mortar backfill |
| | | *Basis for decision* | poor rock mass |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | | - |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical issues,<br>2) Constraints in project implementation requirements (Construction time, costs, etc.) | | |
| | The collapse of the tunnel may be caused by a combination of factors, including poor rock, Ground Over Break (GoB), and an incomplete support system. Further investigation and analysis are needed to determine the exact cause and formulate the appropriate solution. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Tunnel, colapse, grouting and backfill | | |
| *References* | *Meeting Minutes:* | | Penyampaian laporan inspeksi lapangan dalam rangka pelaksanaan konstruksi 10 Oktober 2022 |
| | *Meeting Materials:* | | Progres Pekerjaan Paket 1, 26 SePTember 2022 |
| | *Other:* | | - |

**ID:** 45 **Name:** Way Apu Dam **Dam Type:** Zonal rockfill with Central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | *When the risk was identified (date)* | |
| | 2 | *Project phase in which risks were recognized* | Construction |
| | 3 | *Location (Structure/Area)* | Dam foundation |
| | 4 | *Contents of risk* | Foundation seepage, uplift |
| | 5 | *Risk factors* | Permeable foundation |
| | 6 | *Events in which risks were recognized* | |
| | 7 | *Condition/Situation for risk realization* | |
| | 8 | *Impact if the risk realize* | |
| *Perspectives on Risk Classification* | 9 | *Where risk exists* | |
| | 10 | *Character* | ☐ Mainly caused by external forces |
| | | | ☐ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | *Phase of Realization* | ☐ Project Implementation |
| | | | ☐ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | *Impact if the risk realize* | ☐ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | *Corresponding to risks* | ☐ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

*Overview of Causal Relationships*




*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*

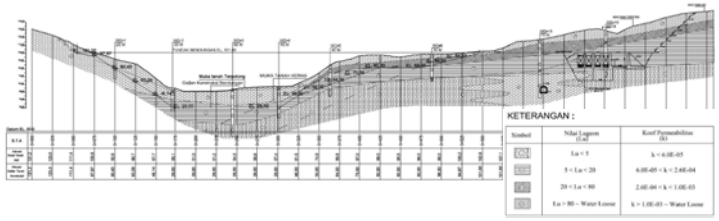



Figure 1. Long section of Way Apu dam lugeon value at the dam foundation (Design 2017: PT. Indra Karya)



**ID:** 45 **Name:** Way Apu Dam **Dam Type:** Zonal rockfill with Central core **Dam Hight:** 72,0 **m**

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Recongnized | |
| | *When the risk was recognized* | *Project Phase:* Design | *Date:* 2017 |
| | *Status of corresponding* | - | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | | | |
| *Design* | During design the grouting depth is recommended by formula "Depth grouting=1/3.heigh of water level + constantan (8 to 25) | | |
| *Construction* | The grouting design in the dam body was designed with a depth of 20 - 33 m for curtain grouting, the Way Apu Dam height which reaches 72 m. | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |

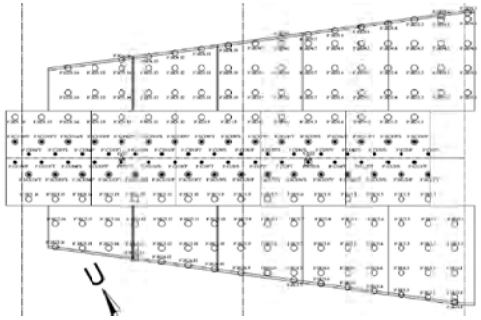


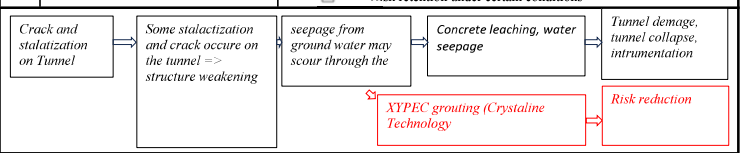
Figure 1 Grouting layout of Way Apu dam at the left abutment

| | | | |
|---|---|---|---|
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Reduction |
| | *Measures* | *How to deal with* | Considering depth of grouting is 2/3 of dam heigh |
| | | *Basis for decision* | Foundation seepage |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | | - |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical issues | | |
| | Consider the design grouting depth taken as 2/3 Head of the reservoir based on the Grouting Guidelines for Dams. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Dam Foundation, Permeable founation, grouting depth | | |
| *References* | *Meeting Minutes:* | Penyampaian laporan inspeksi lapangan dalam rangka pelaksanaan konstruksi 10 Oktober 2022 | |
| | *Meeting Materials:* | Progres Pekerjaan Paket 1, 26 SePTember 2022 | |
| | *Other:* | Laporan penunjang: Analisa Geologi dan Mekanika Tanah (PT. Indra Karya, 2017) | |

**ID:** 46 **Name:** Rukoh Dam **Dam Type:** Random Rock with Central Core **Dam Hight:** 84,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | *When the risk was identified (date)* | June 2023 |
| | 2 | *Project phase in which risks were recognized* | Construction |
| | 3 | *Location (Structure/Area)* | Tunnel |
| | 4 | *Contents of risk* | Concrete leaching, water seepage |
| | 5 | *Risk factors* | Disolve cement, cracking on concrete |
| | 6 | *Events in which risks were recognized* | after finishingn lining of tunnel, stalactization and crack occure on the tunnel |
| | 7 | *Condition/Situation for risk realization* | Impounding, increasing ground water level |
| | 8 | *Impact if the risk realize* | Tunnel demage, tunnel collapse, intrumentation damage |
| *Perspectives on Risk Classification* | 9 | *Where risk exists* | Structure, ground water |
| | 10 | *Character* | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | *Phase of Realization* | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | *Impact if the risk realize* | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | *Corresponding to risks* | ☐ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☑ Risk retention under certain conditions |

*Overview of Causal Relationships*




*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*

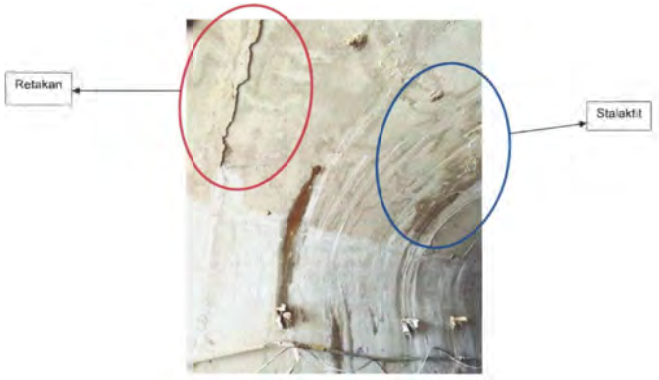



Photo-1 Crack (red) and Stalactite (blue) in the tunnel



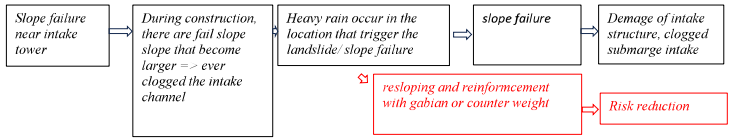
**ID:** 46 **Name:** Rukoh Dam **Dam Type:** Random Rock with Central Core **Dam Hight:** 84,0 **m**

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Unrecognized | |
| | *When the risk was recognized* | *Project Phase:* Construction | *Date:* June 2023 |
| | *Status of corresponding* | Decluttering | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | Based on field checks, this is not a crack in the concrete lining wall, but rather a difference in concrete thickness during casting between segments that looks like a crack from camera shots. Furthermore, decluttering will be carried out at that point. | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *Investigation /analysis* | *Investigation/analysis to identify factors, etc.* | Field survey | |
| | *Research/analysis, etc. to assess impact* | - | |
| | *Analysis, etc. to determine the need for and methods of response* | - | |
| *How to respond to risk* | *Contents of measures (avoidance, reduction, transfer) or retention* | Retention | |
| | *Measures* | *How to deal with* | - |
| | | *Basis for decision* | - |
| | *Retention (no measures)* | *Reason* | No cracking just difference in concrete thickness |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | - | |
| | *Availability and method of information sharing* | - | |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical issues | | |
| | While the stalactites currently appear to be small and few, it should be noted that the calcitation/lime leaching process in the tunnel needs to be monitored periodically. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Stalactization / lime leaching, reducing material qquality, monitoring | | |
| *References* | *Meeting Minutes:* | Laporan Inspeksi bendungan Rukoh, 15 Agustus 2023 | |
| | *Meeting Materials:* | - | |
| | *Other:* | Kajian Keamanan Bendungan Rukoh: Dalam rangka pengisian awal waduk (Juli, 2024) | |

**ID:** 46 **Name:** Rukoh Dam **Dam Type:** Random Rock with Central Core **Dam Hight:** 84,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 15-Dec-21 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Intake slope, Behind intake |
| | 4 | ***Contents of risk*** | slope failure |
| | 5 | ***Risk factors*** | Steep slope, poor rock mass |
| | 6 | ***Events in which risks were recognized*** | small sliding occurred during excavation and become larger at behing of intake |
| | 7 | ***Condition/Situation for risk realization*** | impounding, earthquake, rain |
| | 8 | ***Impact if the risk realize*** | Demage of intake structure, clogged submarge intake |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, rock strengh, slope stabillity |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☐ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***




***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

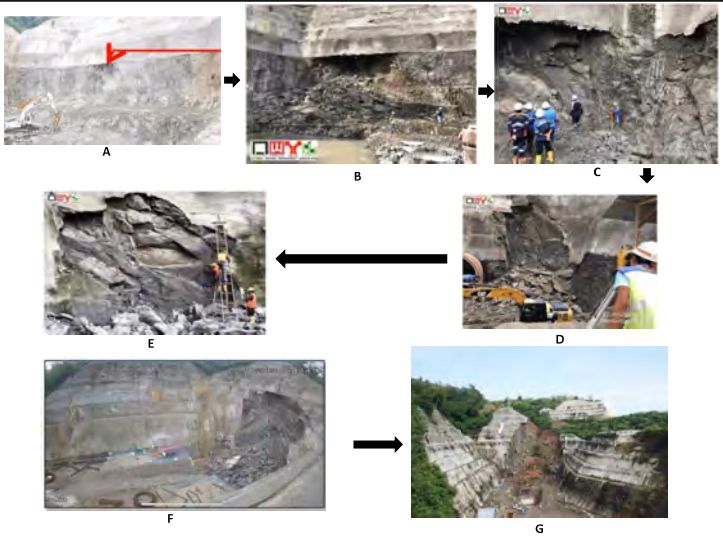



Photo1. Landslide chronology (A) December 15, 2021; (B) January 5, 2022; (C) July 25, 2022; (D) July 27, 2022; (E) November 16, 2022; (F) January 20, 2023; (G) December 13, 2023.



**ID:** 46 **Name:** Rukoh Dam **Dam Type:** Random Rock with Central Core **Dam Hight:** 84,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Construction | ***Date:*** 15-Dec-21 |
| | ***Status of corresponding*** | Re-sloping and counter weight construction | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** | Countermeasurement was conducted by excavation slope more gentle and increase the width of the berm and reinforce it by doing shotcrete work and installing Rockbolte with L = 6 meters installed zig zag with a distance of 3 meters. Furthermore, counterweight reinforcement work was carried out at the front of the intake drop inlet to the excavation slope using sandstone excavation material and random stone material and covered with rip rap using a berm with a width of 10 meters and a slope of 1: 1.50 and 1: 1.75. | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |

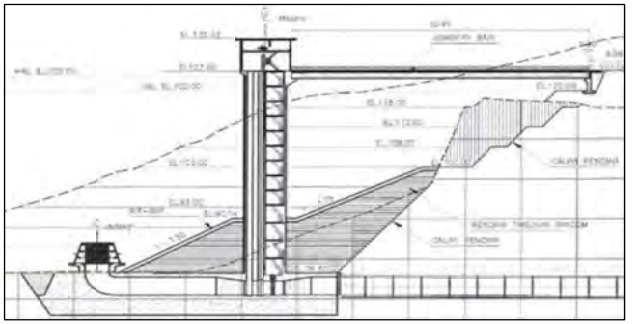


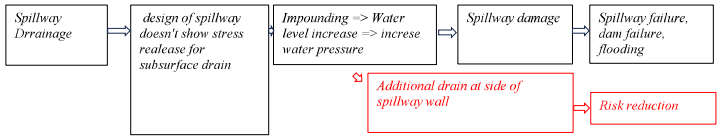
Figure-1 Countermeasurement design for slope failure at intake tower

| | | | |
|---|---|---|---|
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Re-sloping and counter weight instalation |
| | | ***Basis for decision*** | Slope reinforcement |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical Issues | | |
| | At locations where tunnel intakes are a problem during implementation (sliding), consideration should be given to installing monitoring instruments such as inclinometer or surface monument. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Intake, slope failure, counter weight | | |
| *References* | ***Meeting Minutes:*** | Laporan Inspeksi bendungan Rukoh, 15 Agustus 2023 | |
| | ***Meeting Materials:*** | - | |
| | ***Other:*** | Kajian Keamanan Bendungan Rukoh: Dalam rangka pengisian awal waduk (Juli, 2024) | |

**ID:** 46 **Name:** Rukoh Dam **Dam Type:** Random Rock with Central Core **Dam Hight:** 84,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 21-Jun-24 |
| | 2 | ***Project phase in which risks were recognized*** | Construction |
| | 3 | ***Location (Structure/Area)*** | Spillway |
| | 4 | ***Contents of risk*** | Spillway damage |
| | 5 | ***Risk factors*** | Uplift pressure |
| | 6 | ***Events in which risks were recognized*** | During technical discussion, the design of spillway doesn't show stress realease for subsurface drain |
| | 7 | ***Condition/Situation for risk realization*** | Impounding, increasing ground water level |
| | 8 | ***Impact if the risk realize*** | Spillway failure, dam failure, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, rock permeability, water level |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☑ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***




***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

Photo-1 Work of drain pipe installation at the outside of spillway wall

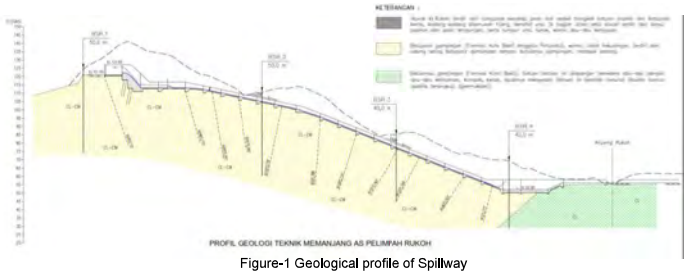
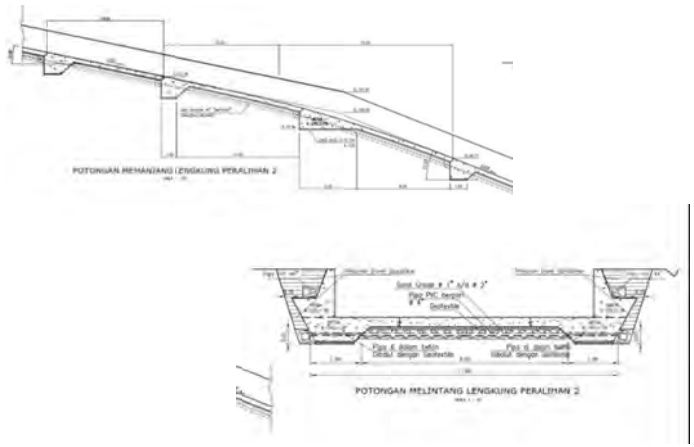



Figure-1 Geological profile of Spillway



**ID:** 46 **Name:** Rukoh Dam **Dam Type:** Random Rock with Central Core **Dam Hight:** 84,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Construction | ***Date:*** 21-Jun-24 |
| | ***Status of corresponding*** | Additional drain at side of spillway wall | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** |  Photo-1 Drainage sistem of spillway at rukoh dam | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |

| | | | |
|---|---|---|---|
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | additional drain at side of spillway |
| | | ***Basis for decision*** | Uplift pressure realease, dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical Issues | | |
| | - To install a drain pipe requires excavation of the wall, so there is a considerable risk of damage to the foundation. To anticipate foundation damage, great care should be taken in installing the drain pipe outside the side wall.<br>- C23backfilling should be done adequately so that the stability of the foundation does not decrease. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Spillway, uplift pressure, drainage | | |
| *References* | ***Meeting Minutes:*** | Laporan Inspeksi bendungan Rukoh, 15 Agustus 2023 | |
| | ***Meeting Materials:*** | - | |
| | ***Other:*** | Kajian Keamanan Bendungan Rukoh: Dalam rangka pengisian awal waduk (Juli, 2024) | |

**ID:** 48 **Name:** Bajulmati Dam **Dam Type:** Zonal with vertical core **Dam Hight:** 47,8 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 7-Jul-22 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Dam / Structure / Stability |
| | 4 | ***Contents of risk*** | Crack on dam crest, water seepage though core |
| | 5 | ***Risk factors*** | Settlement |
| | 6 | ***Events in which risks were recognized*** | During inpection after impouding |
| | 7 | ***Condition/Situation for risk realization*** | Impounding |
| | 8 | ***Impact if the risk realize*** | Dam failre, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Structure / Strength, Design, Stability / Dam creast |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Crack at the dam crest* ⇒ *several crack was observed at the right bank of the dam (near spillway)* ⇒ *Impouding* ⇒ *Crack on dam crest => water seepage though core* ⇒ *Dam failre, flooding*

*(Contents of measures)* ⇨ *(Risk avoidance, reduction, transfer or retention)*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

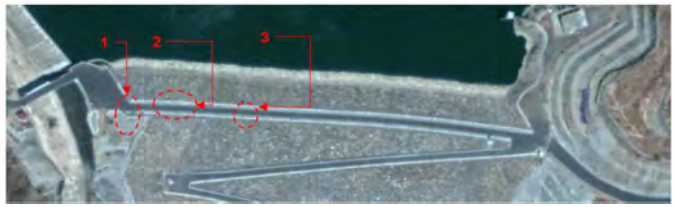



Figure 1 location of crack of Bajulmati dam

Photo-1 Cracks in the canstine at the dam crest



**ID:** 48 **Name:** Bajulmati Dam **Dam Type:** Zonal with vertical core **Dam Hight:** 47,8 **m**

| | | | |
|---|---|---|---|
| *History* | | ***Recognition or not in the past*** | Unrecognized |
| | | ***When the risk was recognized*** | ***Project Phase:*** Impounding ***Date:*** 7-Jul-22 |
| | | ***Status of corresponding*** | - |
| ***Project Phase*** | | ***History of correspond to risks*** | |
| ***Plan*** | | - | |
| ***Design*** | | - | |

***Construction***

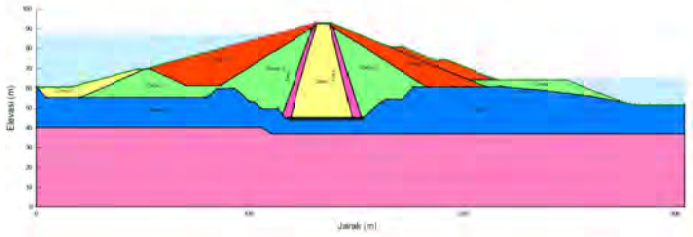



Figure-1 Typical design of Bajulmati Dam

***Impounding***

Figure-1 Parameter embankment and foundation of Bajulmati Dam

| Zona | Jenis Material | Parameter Tanah | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $\gamma_{unsat}$ | $\gamma_{sat}$ | $v$ | $c$ | $\phi$ | $\psi$ | $k$ |
| | | kN/m$^3$ | kN/m$^3$ | | kPa | ° | ° | m/s |
| 1 | *Clay* | 13,01 | 17,62 | 0,35 | 32 | 15,5 | 0 | 1e-7 |
| 2 | *Filter* | 15,97 | 19,78 | 0,3 | 10 | 30 | 0 | 2e-3 |
| 3 | *Soft Rock* | 12,79 | 17,75 | 0,3 | 11 | 28 | 0 | 1e-3 |
| 4 | *Coarse Rock* | 15,89 | 20,41 | 0,3 | 12 | 40 | 10 | 2e-2 |
| Fondasi | *Gravelly Sand* | 15,97 | 15,97 | 0,3 | 11 | 30 | 0 | 2e-3 |
| Fondasi | *Lapilly Tuff* | 12,79 | 17,75 | 0,3 | 12 | 28 | 0 | 1e-3 |

| | | | |
|---|---|---|---|
| ***Operation/ maintenance*** | | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | - |
| | ***Measures*** | ***How to deal with*** | - |
| | | ***Basis for decision*** | - |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords*** | | | |
| *References* | ***Meeting Minutes:*** | | |
| | ***Meeting Materials:*** | | |
| | ***Other:*** | | Laporan Inspeksi Bendungan Bajulmati (2020) |

**ID:** 51-05 **Name:** Titab **Dam Type:** andom Rock Dam with Central co **Dam Hight:** 82,5 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | **When the risk was identified (date)** | 2022 |
| | 2 | **Project phase in which risks were recognized** | Construction |
| | 3 | **Location (Structure/Area)** | Dam / Foundation, Dam material |
| | 4 | **Contents of risk** | settlement, piping |
| | 5 | **Risk factors** | Material leaching, |
| | 6 | **Events in which risks were recognized** | After impounding, 4 seepages ware observed at dam toe during inspection |
| | 7 | **Condition/Situation for risk realization** | Impounding, water flow though core |
| | 8 | **Impact if the risk realize** | Dam break, uncontrol seepage |
| *Perspectives on Risk Classification* | 9 | **Where risk exists** | Geology, embankment material |
| | 10 | **Character** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | **Phase of Realization** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | **Impact if the risk realize** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | **Corresponding to risks** | ☐ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☑ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Toe dam seepage* ⇒ *After impounding, 4 seepages ware observed at dam toe during inspection* ⇒ *Continue water seepage from dam body may bring particel of dam material* ⇒ *settlement, piping* ⇒ *Dam break, uncontrol seepage*

*Special investigation for seepage source => countter measure* ⇒ *Risk Retention*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

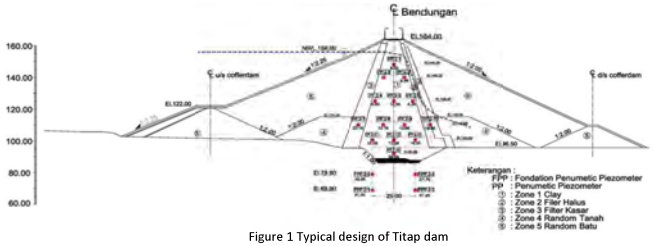



Figure 1 Typical design of Titap dam

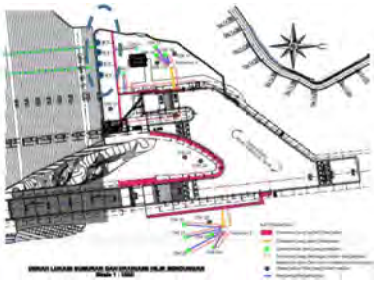


Figure 2 Seepage location at the dam toe (blue dot)



**ID:** 51-05 **Name:** Titab **Dam Type:** andom Rock Dam with Central co **Dam Hight:** 82,5 **m**

| | | | |
|---|---|---|---|
| *History* | **Recognition or not in the past** | Unrecognized | |
| | **When the risk was recognized** | **Project Phase:** Impounding | **Date:** 2022 |
| | **Status of corresponding** | Monitoring the seepage | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* | - | | |

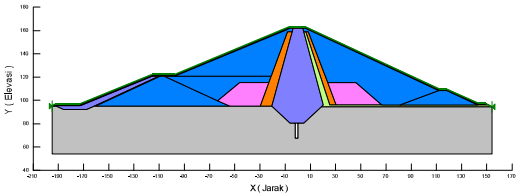



Figure 1 Typical design of Titap dam when design stage

| | |
|---|---|
| *Construction* | |
| *Impounding* | |

Photo 1 Sepage at the toe of Titab Dam (4 ocations)

| | | | |
|---|---|---|---|
| *Operation/ maintenance* | - | | |
| *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* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Retention |
| | ***Measures*** | ***How to deal with*** | - |
| | | ***Basis for decision*** | - |
| | ***Retention (no measures)*** | ***Reason*** | Monitoring seepage water |
| | | ***Expected impact*** | Material leaching |
| | ***Availability and method of monitoring*** | | water discharge |
| | ***Availability and method of information sharing*** | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | It is necessary to investigate the electrical survey from the body of the dam (upstream) to the downstream to correlate the instrument readings with the presence of seepage in the dam. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords* | Seepage, dam body, monitoring | | |
| *References* | ***Meeting Minutes:*** | | |
| | ***Meeting Materials:*** | | sidang teknis izin operasi 17 Mei 2023<br>Geologi beundungan titab, 14 Mei 2023 |
| | ***Other:*** | | Studi Penyelidikan Geologi Tambahan dan Penyempurnaan Desain Bendungan Titab dalam proses Sertifikasi Desain |

**ID:** 51-05 **Name:** Titab **Dam Type:** :andom Rock Dam with Central co **Dam Hight:** 82,5 m

| | | | |
|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 2022 |
| | 2 | Project phase in which risks were recognized | Impounding |
| | 3 | Location (Structure/Area) | Downstream of main dam |
| | 4 | Contents of risk | Uplift potential, piping |
| | 5 | Risk factors | spring water, artesian water |
| | 6 | Events in which risks were recognized | after impounding several observation well experienced artesian |
| | 7 | Condition/Situation for risk realization | impounding, increasing ground water level |
| | 8 | Impact if the risk realize | Dam failure. Flooding |
| Perspectives on Risk Classification | 9 | Where risk exists | Geology, foundation, hydrogeology |
| | 10 | Character | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | Phase of Realization | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | Impact if the risk realize | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

**Overview of Causal Relationships**

*Artesian water in the observation well at the downstream of the main dam* ⇒ *after impounding, several observation well experienced artesian* ⇒ *artesian water pressure increasing by impounding, increasing ground water* ⇒ *Uplift potential, piping* ⇒ *Dam failure, Flooding*

*Instalation of relief well to reduce the water pressure* ⇒ *Risk reduction,*

**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

Figure 1 Location of instrument instalation of Titap Dam



Photo- 1 Artesian water of OW-5



**ID:** 51-05 **Name:** Titab **Dam Type:** :andom Rock Dam with Central co **Dam Hight:** 82,5 m

| | | | |
|---|---|---|---|
| History | Recognition or not in the past | Unrecognize | |
| | When the risk was recognized | Project Phase: Impounding | Date: 2022 |
| | Status of corresponding | Instalation relief well (release well) | |
| Project Phase | History of correspond to risks | | |
| Plan | - | | |
| Design | - | | |
| Construction | - | | |
| Impounding | OW3,4,6,8,9 relatively stable and do not influenced by reservoir water level | | |

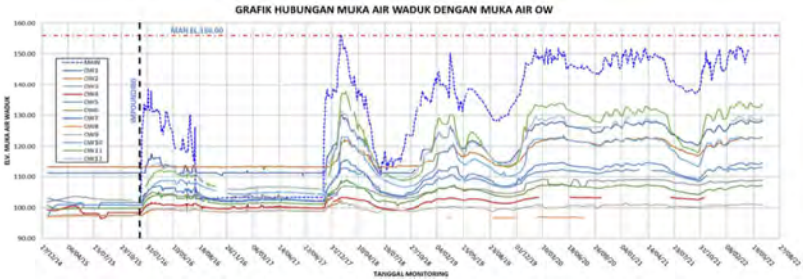



Figure 1 corelation graph between reservoir water level and observation well

| | | | |
|---|---|---|---|
| Operation/ maintenance | | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | | Reduction |
| | Measures | How to deal with | Instalation of relief well |
| | | Basis for decision | monitoring of obseving artesian characteriztic |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | | - |
| | Availability and method of information sharing | | - |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | 1) Technical issues | | |
| | based on OW monitoring, the OW at the abutment is relatlatively do not influenced by reservoir water level but the other is influenced, the special investigation should be conducted to ensure source of artesian water | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| Keywords. | Dam foundation, artesian water, relief well | | |
| References | Meeting Minutes: | | |
| | Meeting Materials: | | sidang teknis izin operasi 17 Mei 2023<br>Geologi beundungan titab, 14 Mei 2023 |
| | Other: | | Studi Penyelidikan Geologi Tambahan dan Penyempurnaan Desain Bendungan Titab dalam proses Sertifikasi Desain |

*ID:* 52-06 *Name:* Jati Gede *Dam Type:* Rock Filled with vertical core *Dam Hight:* 110,0 *m*

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | *When the risk was identified (date)* | 5-Jul-23 |
| | 2 | *Project phase in which risks were recognized* | Operation |
| | 3 | *Location (Structure/Area)* | Reservoir area |
| | 4 | *Contents of risk* | Slope stability, slope failure potential |
| | 5 | *Risk factors* | Instalation anchor for flaoting solar panel system |
| | 6 | *Events in which risks were recognized* | During technical discussion for Floating solar panel design |
| | 7 | *Condition/Situation for risk realization* | Resevoir water level rise up, water current flow |
| | 8 | *Impact if the risk realize* | Increasing resevoir sedimentation |
| *Perspectives on Risk Classification* | 9 | *Where risk exists* | Geology, rock mass strenght, |
| | 10 | *Character* | ☑ Mainly caused by external forces |
| | | | ☐ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | *Phase of Realization* | ☑ Project Implementation |
| | | | ☐ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | *Impact if the risk realize* | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | *Corresponding to risks* | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

*Overview of Causal Relationships*

*Anchor instalation at reservoir area* ⇒ *Jatigede dam is planned to be installed by floating solar panel that need ancor for the panel* ⇒ *Water level & water current => increasing strain of the slope* ⇒ *Slope failure* ⇒ *Incresing reservoir sedimentation*

*Placing anchor at the fair or strong rock mass* ⇒ *Risk reduction*

*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*


Figure-1 Floating solar panel location at Jatigede Dam Reservoir



*ID:* 52-06 *Name:* Jati Gede *Dam Type:* Rock Filled with vertical core *Dam Hight:* 110,0 *m*

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Unrecognized | |
| | *When the risk was recognized* | *Project Phase:* Operation | *Date:* 5-Jul-23 |
| | *Status of corresponding* | - | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | - | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | Additonal floating solar panel is planned to be installed at reservoir of Jatigede Dam | | |

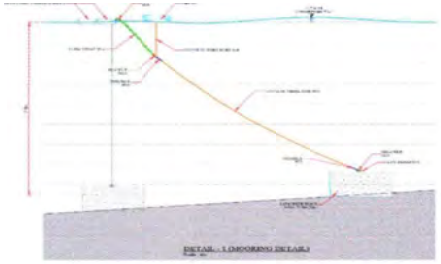


Figure-1 Detail profile of anchor and mooring system

| | | | |
|---|---|---|---|
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Reduction |
| | *Measures* | *How to deal with* | Anchoring to the fair/strong rock mass |
| | | *Basis for decision* | Slope stability |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | | - |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical issues | | |
| | a. The earthquake load used in the analysis should be adjusted to the earthquake return period used in the slope stability analysis of the dam body, which depends on the Dam Risk Class.<br>b. The analysis should consider the engineering geological conditions and the slope angle of the reservoir slope at the location where the anchor is planned to be installed. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Reservoir, slope stability, anchor | | |
| *References* | *Meeting Minutes:* | | Diskusi teknik pengembangan pembangkit listrik tenana surya, 5 juli 2023 |
| | *Meeting Materials:* | | PLTS terapung di wadukk, 2023<br>Rencan pembangkit listrik tenaga panel surya, 23 juli 2023 |
| | *Other:* | | |

**ID:** 53-07 **Name:** Teritip **Dam Type:** Homogeneous dam **Dam Hight:** 11,7 *m*

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2022 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Left abutment hill |
| | 4 | ***Contents of risk*** | Slope failure, landslide |
| | 5 | ***Risk factors*** | Slope cutting, soil/rock parameter, water contain |
| | 6 | ***Events in which risks were recognized*** | During impouding, landslide occur at the right of dam abutment |
| | 7 | ***Condition/Situation for risk realization*** | Impounding, water table, earthquake |
| | 8 | ***Impact if the risk realize*** | Sedimentataion, structure damage |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, rock/soil strengh |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Slope failure* ⇨ *During impouding, landslide occur at the right of dam abutment* ⇨ *impouding=> rising up water table =>incresing moisturation =>decresing* ⇨ *Slope failure, landslide* ⇨ *Sedimentation, structure damage*

*Instalation cantilever wall and soldier pile* ⇨ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

Photo-1 Slope failure/landslide condition at right abutment of Teritip Dam

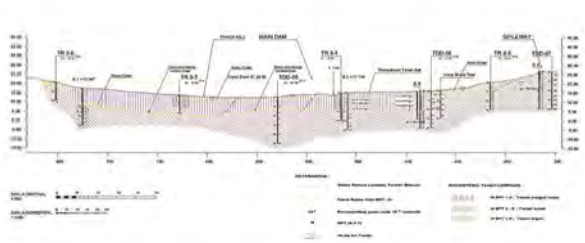
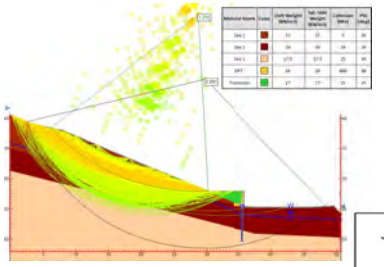
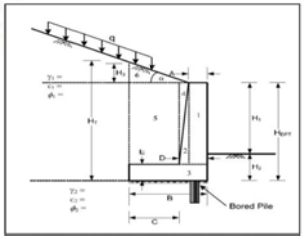


Figure-1 Standard penetration profile of Teririp Dam axial



**ID:** 53-07 **Name:** Teritip **Dam Type:** Homogeneous dam **Dam Hight:** 11,7 *m*

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impouding | ***Date:*** 2022 |
| | ***Status of corresponding*** | Intalation cantilever wall and soldier pile | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | - | | |
| *Impounding* |  Figure-1 Slope stability analysis after cantelever and pile instalation<br>  Figure-2 Design and dimension of cantelever wall. | | |
| *Operation/ maintenance* | - | | |

| | | | |
|---|---|---|---|
| *Investigation /analysis* | ***Investigation/analysis to identify factors, etc.*** | | Drilling investigation |
| | ***Research/analysis, etc. to assess impact*** | | - |
| | ***Analysis, etc. to determine the need for and methods of response*** | | - |
| *How to respond to risk* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Instanlation caterlevel wall and pile |
| | | ***Basis for decision*** | Slope stability,dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | a. If there are many fault patterns at the dam site, it is possible that the type that occurs is a complex landslide. The potential type of complex landslide should be evaluated and identified again.<br>b. Because the landslide is likely to be influenced by groundwater conditions, an evaluation of groundwater conditions on the right abutment slope should be carried out. Plot the groundwater level in the cross section of the abutment hill that experienced a landslide.<br>c. related to the material parameters used in the analysis, if not all landslide material is stripped and still used, it should use the residual shear stress parameter that can be from the back analysis, instead of using the affective stress. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Abutment, landslide, slope failure, caterlever wall, pile | | |
| *References* | ***Meeting Minutes:*** | | Diskusi teknis pembahasan izin operasi bendungan teritip, 2 August 2022 |
| | ***Meeting Materials:*** | | Penangan Longsorang Tebing<br>Sertifikasi OP, 2 Agustus 2022 |
| | ***Other:*** | | |

**ID:** 53-07 **Name:** Teritip **Dam Type:** Homogeneous dam **Dam Hight:** 11,7 *m*

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2022 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Dam body, dam material |
| | 4 | ***Contents of risk*** | Piping, differential settlement |
| | 5 | ***Risk factors*** | Material consolidation |
| | 6 | ***Events in which risks were recognized*** | During inpection for dam operation permit |
| | 7 | ***Condition/Situation for risk realization*** | Impouding, dam overburden |
| | 8 | ***Impact if the risk realize*** | Dam failure, overtopping, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Embankment material, geological foundation |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☐ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☑ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Settlement of dam body* ⇒ *During inpection for dam operation permit, the intumentation indicated unaven settlement of dam* ⇒ *dam overburden cause settlement to be faster* ⇒ *Piping, differential settlement* ⇒ *Dam failure, overtopping, flooding*

*Monitoring of dam* ⇒ *Risk retention*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

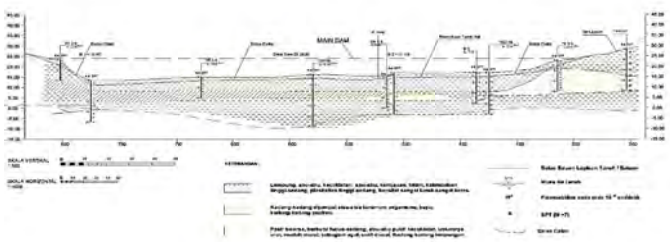


Figure-1 Geolgical profile of Teritip Dam axial

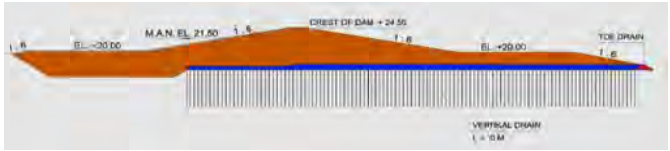
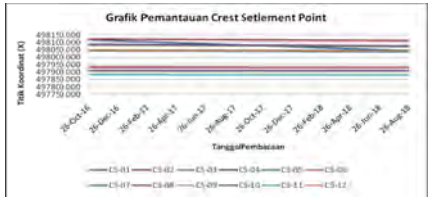
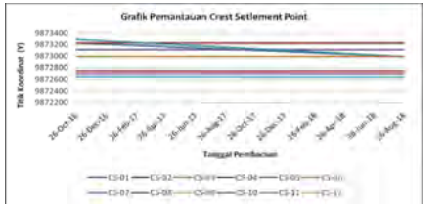



Figure-2 Typical design of Teritip Dam



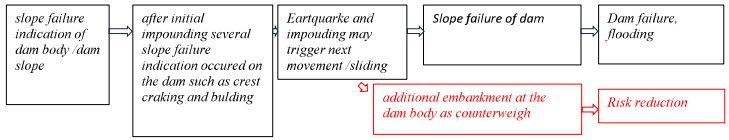
**ID:** 53-07 **Name:** Teritip **Dam Type:** Homogeneous dam **Dam Hight:** 11,7 *m*

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Unrecognized | |
| | *When the risk was recognized* | ***Project Phase:*** Impounding | ***Date:*** 2022 |
| | *Status of corresponding* | Monitoring dam instrumentation | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | - | | |
| *Impounding* |   Figure-1 Monitoring of crest settlement point of X movement   Figure-2 Monitoring of crest settlement point of Y movement | | |
| *Operation/ maintenance* | | | |
| *Investigation /analysis* | *Investigation/analysis to identify factors, etc.* | | crest settlement point |
| | *Research/analysis, etc. to assess impact* | | Instrument analisys |
| | *Analysis, etc. to determine the need for and methods of response* | | - |
| *How to respond to risk* | *Contents of measures (avoidance, reduction, transfer) or retention* | | Retention |
| | *Measures* | *How to deal with* | - |
| | | *Basis for decision* | - |
| | *Retention (no measures)* | *Reason* | settlement of dam cannot be avoided |
| | | *Expected impact* | internal cracking |
| | *Availability and method of monitoring* | | Piezometer, multi layer settlement, inclinometer |
| | *Availability and method of information sharing* | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues<br>a. It should also be evaluated with the actual conditions in the field, as well as the correlation of the position of the CS-01 point which has decreased.<br>b. Graphic depiction of surface monuments should be drawn on the longitudinal cross section (as built drawing), so that the trend and tend of the decline (z direction) are visible. in the depiction there are 2 different scales, for example the longitudinal cross section in mater and the decline in mm or cm, the magnitude of the decline is depicted in a form that shows the magnitude and direction of the decline.<br>c. Results of the measurement of the X and Y directions are depicted in a drawing plan (lay out) and also in vector form. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Dam material, settlement, | | |
| *References* | *Meeting Minutes:* | Diskusi teknis pembahasan izin operasi bendungan teritip, 2 August 2022 | |
| | *Meeting Materials:* | Penangan Longsorang Tebing<br>Sertifikasi OP, 2 Agustus 2022 | |
| | *Other:* | | |

**ID:** 54-08 **Name:** Gondang **Dam Type:** 'onal random filled with central cor **Dam Hight:** 71,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 6-Jul-20 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Dam body |
| | 4 | ***Contents of risk*** | Slope failure of dam |
| | 5 | ***Risk factors*** | Slope degree, dam matrial, water contain |
| | 6 | ***Events in which risks were recognized*** | impection after impouding shows longitudinal crack at dam crest |
| | 7 | ***Condition/Situation for risk realization*** | Eartquarke, impouding, |
| | 8 | ***Impact if the risk realize*** | Dam failure, flooding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Dam material |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☐ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***




***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***


Figure-1 Existing of Gondang dam typical design before counterweght embankment

Photo-1 cracking on the dam crest (documentation 2020) that indicate instable slope



**ID:** 54-08 **Name:** Gondang **Dam Type:** 'onal random filled with central co**Dam Hight:** 71,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** 6-Jul-20 |
| | ***Status of corresponding*** | Additional embankment counterweigh | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** | | | |

***Impounding***

results of the stability analysis of the slope without counterweight under rapid drowdown from normal waterland +515.00m to low waterland +496.00m without earthquake had safety factor is less than 1.2 at the downstream slope

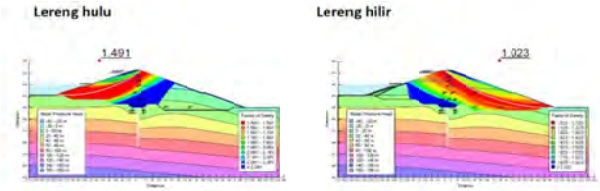



Figure-1 Dam stability analysis of Gondang dam without counterweight

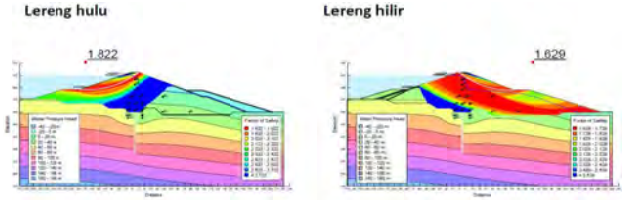



Figure-1 Dam stability analysis of Gondang dam with counterweight

| | | | |
|---|---|---|---|
| ***Operation/ maintenance*** | - | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Additional consterweigh embankment |
| | | ***Basis for decision*** | Dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issue | | |
| | A chronology should be prepared that explains the following:<br>a. The initial design of the Gondang Dam<br>b. The design changes made during the construction of the Gondang Dam.<br>c. The design of the Gondang Dam as a result of construction implementation and the problems that caused the need for counterweights.<br>d. The design of counterweights to handle post-construction problems. Counterweight design to handle post-construction problems. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Dam body, slope failure, counterweight | | |
| ***References*** | ***Meeting Minutes:*** | | |
| | ***Meeting Materials:*** | | Rencana Konstruksi Counter Weight, 2021<br>Sertifikasi OP Bendugan Gonadang, Juli 2023 |
| | ***Other:*** | | Laporan inspeksi bendungan gondang, 13 Maret 2023 |

**ID:** 55-09 **Name:** Sei Gong **Dam Type:** Homogeneous earth-filled dam **Dam Hight:** 16,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2022 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Main dam downstream slope |
| | 4 | ***Contents of risk*** | Slope failure, slope erosion |
| | 5 | ***Risk factors*** | uncovered protection of slope, slope protection |
| | 6 | ***Events in which risks were recognized*** | During inspection for dam operation permit |
| | 7 | ***Condition/Situation for risk realization*** | Rainfall, raunoff water |
| | 8 | ***Impact if the risk realize*** | Dam failure due to sliding |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Dam material |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Dam slope protection* ⇒ *during inspction there was places that the dam slope were covered from erossion* ⇒ *when rains, the runoff water may eroded the slope material* ⇒ *continue eroded on surface can be lanslide at slope* ⇒ *Dam failure*

*re-protec for unprotected slope* ⇒ *Risk reduction*

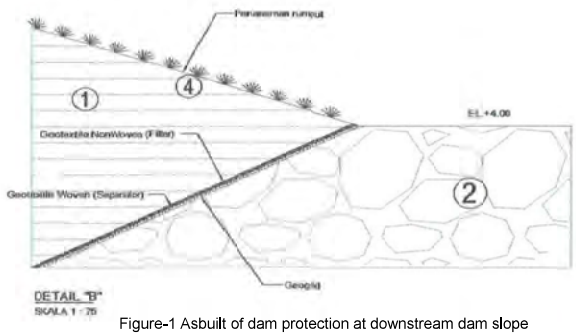
***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

Photo-1 photograph of Seigong dam from downstream to upstream that show several slope is unprotected well

Photo-2 the consition of unprotected downstream slope of Seigong Dam



**ID:** 55-09 **Name:** Sei Gong **Dam Type:** Homogeneous earth-filled dam **Dam Hight:** 16,0 **m**

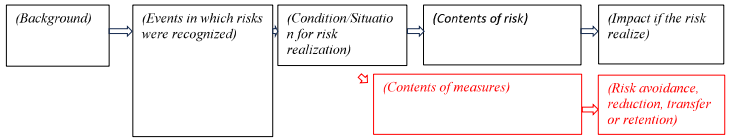
| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** 2022 |
| | ***Status of corresponding*** | Re-protect the slope | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** |  Figure-1 Asbuilt of dam protection at downstream dam slope | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |

| | | | |
|---|---|---|---|
| ***Investigation /analysis*** | ***Investigation/analysis to identify factors, etc.*** | | Visual inspection |
| | ***Research/analysis, etc. to assess impact*** | | - |
| | ***Analysis, etc. to determine the need for and methods of response*** | | - |
| ***How to respond to risk*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Reprotect the slope |
| | | ***Basis for decision*** | Dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) technical issue | | |
| | At the location of the downstream slope protection using grass that has not grown evenly. at the location of the upstream slope protection using riprap, but from some photos it appears that there is no transition between embankment material and riprap (rock) which has the potential to occur erosion during the rise and fall of reservoir water. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Dam slope, erossion, slope protection | | |
| ***References*** | ***Meeting Minutes:*** | | |
| | ***Meeting Materials:*** | | Sertifikasi Ijin Operasional-Umum<br>Geologi, Desember 2022 |
| | ***Other:*** | | As Built Tubuh Bendungan |

**ID:** 55-09 **Name:** Sei Gong **Dam Type:** Homogeneous earth-filled dam **Dam Hight:** 16,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2022 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Spillway |
| | 4 | ***Contents of risk*** | Lanslide near to spillway structure |
| | 5 | ***Risk factors*** | Slope cutting, rock/soil condition |
| | 6 | ***Events in which risks were recognized*** | after impounding lanslide was onserved at left of spillway |
| | 7 | ***Condition/Situation for risk realization*** | rain, impounding, water content |
| | 8 | ***Impact if the risk realize*** | abutment sliding, spillway demage |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Gelogy, spillway foundation |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***




***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

Based on geology map of Seigong Dam, the foundation of spillway is Sandy claystone (lempung pasiran) grey, slightly hard, compacted, hard, containing fine to medium grained of sand low pasticity.

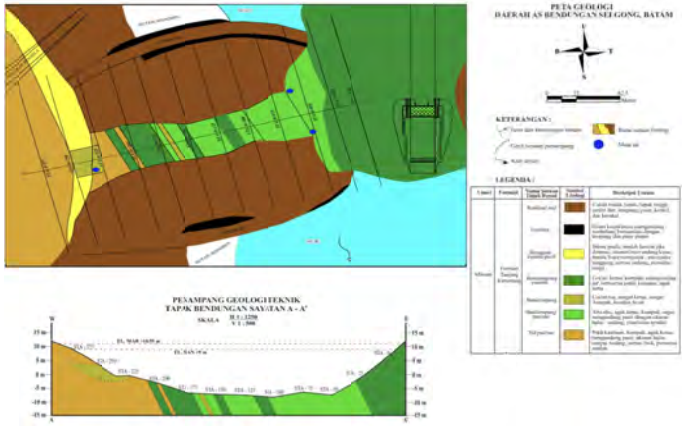



Figure-1 Geology map of spillway and maindam



**ID:** 55-09 **Name:** Sei Gong **Dam Type:** Homogeneous earth-filled dam **Dam Hight:** 16,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** 2022 |
| | ***Status of corresponding*** | Retaining wall instalation | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** | - | | |
| ***Impounding*** |  Photo-1 Sliding occured at right of spillway after impouding<br>  Photo-2 Retaining wall was installed for slope rainforcement | | |
| ***Operation/ maintenance*** | | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Instalation retaining wall |
| | | ***Basis for decision*** | slope stability |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issue | | |
| | The rock formation surrounding the spillway is claystone, claystone tend to be slaking then it necersary to be protected too. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Spillway abutment, landslide, retaining wall | | |
| ***References*** | ***Meeting Minutes:*** | | |
| | ***Meeting Materials:*** | | Sertifikasi Ijin Operasional-Umum<br>Geologi, Desember 2022 |
| | ***Other:*** | | As Built Tubuh Bendungan |

| ID: | | Name: Raknamo | Dam Type: Zonal with central core | Dam Hight: 37,2 m |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | September 2023 | |
| | 2 | Project phase in which risks were recognized | Operation | |
| | 3 | Location (Structure/Area) | Dam body, core zone | |
| | 4 | Contents of risk | material piping, hydroulic fracture | |
| | 5 | Risk factors | Drilling pressure, air/water pressure | |
| | 6 | Events in which risks were recognized | During operation, Inclinometer was broken and will be replaced new one | |
| | 7 | Condition/Situation for risk realization | drilling on the dam core with pressure | |
| | 8 | Impact if the risk realize | Dam body seepage, dam failure | |
| Perspectives on Risk Classification | 9 | Where risk exists | Dam material, drilling method | |
| | 10 | Character | ☐ Mainly caused by external forces | |
| | | | ☑ Mainly due to technical factors | |
| | | | ☐ Factors other than the above | |
| | 11 | Phase of Realization | ☐ Project Implementation | |
| | | | ☐ Operation | |
| | | | ☑ Due to large-scale external force action | |
| | | | ☑ Due to long-term use | |
| | | | ☐ Others | |
| | 12 | Impact if the risk realize | ☑ Affects dam safety | |
| | | | ☐ Affects dam function | |
| | | | ☐ Affect the schedule and costs of the projects | |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance | |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. | |
| | | | ☐ Risk retention under certain conditions | |

**Overview of Causal Relationships**

*Changing of broken inclinometer* ⇒ *Drilling on dam body will be conducted to install new inclinometer* ⇒ *pressure during drilling may cause material condition changing of dam* ⇒ *material piping, hydroulic fracture* ⇒ *Dam body seepage, dam failure*

Considering the importance of new inclinometer => may not be installed if there no any dam movement ⇒ *Risk*

**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

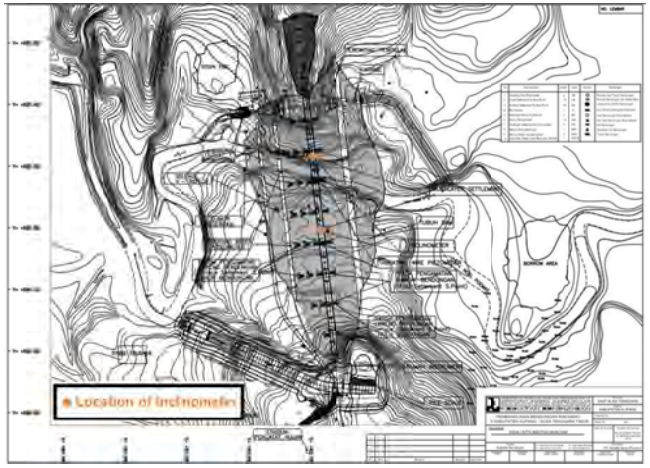



Figure-1 Location af inclinometer after finishing construction of Raknamo Dam



| ID: | Name: Raknamo | | Dam Type: Zonal with central core | Dam Hight: 37,2 m |
|---|---|---|---|---|
| History | Recognition or not in the past | | Unrecognized | |
| | When the risk was recognized | | Project Phase: Operation | Date: September 2023 |
| | Status of corresponding | | Considering the importance inclinometer instalation regarding the dam characteriztic | |
| Project Phase | History of correspond to risks | | | |
| Plan | - | | | |
| Design | - | | | |
| Construction | There were two inclinometers installed in the dam body during construction. | | | |
| Impounding | - | | | |
| Operation/ maintenance | - | | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | | Avoidance | |
| | Measures | How to deal with | avoid drilling on dam considering inclinometer needs | |
| | | Basis for decision | Dam safety | |
| | Retention (no measures) | Reason | - | |
| | | Expected impact | - | |
| | Availability and method of monitoring | | - | |
| | Availability and method of information sharing | | - | |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | | |
| | 1) technical issue | | | |
| | The urgency of drilling for the installation of the new instrument should be explained in the drilling guidelines report taking into account the suggestions. If it is considered not important, drilling for the installation of a new inclinometer can be considered not to be carried out. | | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | | |
| Keywords. | Dam body, drilling, avoidance drilling | | | |
| References | Meeting Minutes: | | Risalah diskusi teknis pembahasan perencanaan program pengeboran, 1 September 2023 | |
| | Meeting Materials: | | | |
| | Other: | | Laporan Pemantauan Perilaku Bendungan Raknamo Pada Pengisian Awal Waduk Tahap I S/D Tanggal 31 Juli 2018 | |

| ID: | | Name: Raknamo | Dam Type: Zonal with central core | Dam Hight: 37,2 m |
|---|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 2018 | |
| | 2 | Project phase in which risks were recognized | Impounding | |
| | 3 | Location (Structure/Area) | Dam body, dam material | |
| | 4 | Contents of risk | Dam leakage, piping, core cracking | |
| | 5 | Risk factors | Settlement, material consolidation | |
| | 6 | Events in which risks were recognized | during first stage of impounding at elevation 94.7 (LWL) | |
| | 7 | Condition/Situation for risk realization | Impounding, settlement due to overburden | |
| | 8 | Impact if the risk realize | Piping causes dam failure, flooding at downstream | |
| Perspectives on Risk Classification | 9 | Where risk exists | Dam body, material, | |
| | 10 | Character | ☐ Mainly caused by external forces | |
| | | | ☑ Mainly due to technical factors | |
| | | | ☐ Factors other than the above | |
| | 11 | Phase of Realization | ☐ Project Implementation | |
| | | | ☑ Operation | |
| | | | ☐ Due to large-scale external force action | |
| | | | ☑ Due to long-term use | |
| | | | ☐ Others | |
| | 12 | Impact if the risk realize | ☑ Affects dam safety | |
| | | | ☐ Affects dam function | |
| | | | ☐ Affect the schedule and costs of the projects | |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance | |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. | |
| | | | ☐ Risk retention under certain conditions | |

**Overview of Causal Relationships**

*Dam Deformation* ⇨ *during first stage of impounding at elevation 94.7 (LWL)* ⇨ *Impounding, settlement due to overburden* ⇨ *Dam leakage, piping, core cracking* ⇨ *Piping causes dam failure, flooding at downstream*

*Monitoring of dam characteriztic* ⇨ *(Risk retention)*

**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

Lebar retakan diukur rata-rata 1 cm, foto Juli 2018 | Kedalaman retakan diukur rata-rata 29 cm, foto Juli 2018

Photo-1 cracking on the sidewalk of dam crest

Retakan di bagian hilir trotoar, foto tanggal 31 Maret 2018 | Rstakan di bagian hilir trotoar tidak berkembang, foto tanggal 31 Juli 2018

Photo-2 continue cracking trought embankment



| ID: | | Name: Raknamo | Dam Type: Zonal with central core | Dam Hight: 37,2 m |
|---|---|---|---|---|
| History | | Recognition or not in the past | Unrecognized | |
| | | When the risk was recognized | Project Phase: Impounding | Date: 2018 |
| | | Status of corresponding | Monitoring | |
| Project Phase | | History of correspond to risks | | |
| Plan | | - | | |
| Design | | - | | |
| Construction | | - | | |

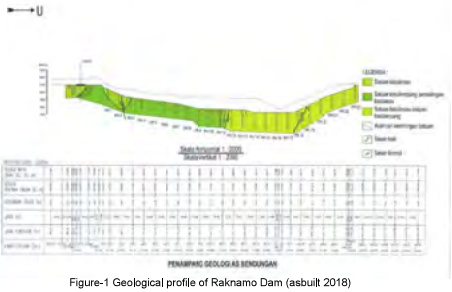



Figure-1 Geological profile of Raknamo Dam (asbuilt 2018)

| Impounding | - |
|---|---|

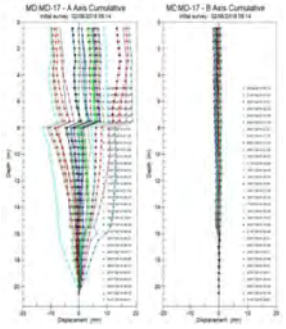



Figure-1 Inclinometer reading on MD-17 shows sudden settlement of dam core

| Operation/ maintenance | - | | |
|---|---|---|---|
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | | Retention |
| | Measures | How to deal with | - |
| | | Basis for decision | - |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | | - |
| | Availability and method of information sharing | | - |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | 1) Theonical issues | | |
| | The right abutment has stepper slope excavation that has differential settlement potential | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| Keywords | | | |
| References | Meeting Minutes: | | Risalah diskusi teknis pembahasan perencanaan program pengeboran, 1 September 2023 |
| | Meeting Materials: | | |
| | Other: | | Laporan Pemantauan Perilaku Bendungan Raknamo Pada Pengisian Awal Waduk Tahap I S/D Tanggal 31 Juli 2018 |

**ID:** 57-11 **Name:** Rotiklot **Dam Type:** Random earthfill with central core **Dam Hight:** 42,5 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | **When the risk was identified (date)** | 2021 |
| | 2 | **Project phase in which risks were recognized** | Impounding |
| | 3 | **Location (Structure/Area)** | Left abutment of dam at the downstream slope |
| | 4 | **Contents of risk** | Landslind, slope failure |
| | 5 | **Risk factors** | Water content, water level, rock/soil properties |
| | 6 | **Events in which risks were recognized** | After impounding, landslide occur at dam left abutment |
| | 7 | **Condition/Situation for risk realization** | impounding, ground water level raising up |
| | 8 | **Impact if the risk realize** | abutment failure, dam failure |
| *Perspectives on Risk Classification* | 9 | **Where risk exists** | Geology, rock strenght, natural water level |
| | 10 | **Character** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | **Phase of Realization** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | **Impact if the risk realize** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | **Corresponding to risks** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*slope falure /landslide at dam abutment* ⇒ *After impounding, landslide occur at dam left abutment* ⇒ *impounding can raising up ground water level then increasing natural moisturation of rock/soil* ⇒ *Landslind, slope failure* ⇒ *abutment failure, dam failure*

*reinforcement of abutment slope* ⇒ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

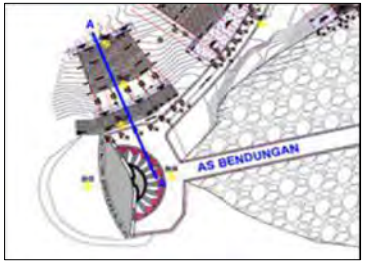



Figure-1 Location of landslide at left dam abutment of Rotiklot Dam

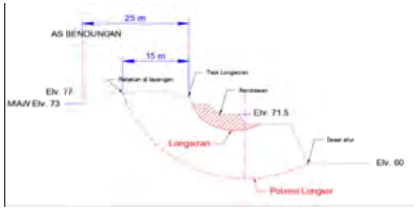
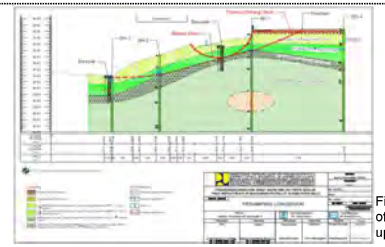
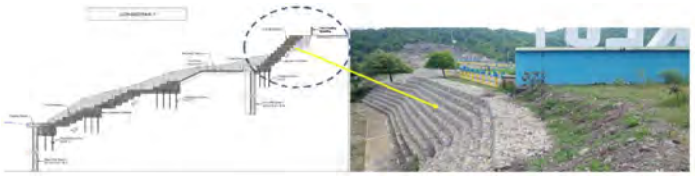



Figure-1 Sketch of landslide



**ID:** 57-11 **Name:** Rotiklot **Dam Type:** Rrockfill with central core **Dam Hight:** 42,5 **m**

| | | | |
|---|---|---|---|
| *History* | **Recognition or not in the past** | Unrecogized | |
| | **When the risk was recognized** | **Project Phase:** Impouding | **Date:** 2021 |
| | **Status of corresponding** | Slope reinforcement using pile and gabion | |
| *Project Phase* | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | - | | |
| *Impounding* |  Figure-1 Geology profile of landslide at lef abutment of Rotiklot Dam that shows residual of of clay at upper part and claystone at lower part | | |
| |  Figure-2 Reinforcement of slope using gabion and borpile | | |
| *Operation/ maintenance* | | | |

| | | | |
|---|---|---|---|
| *Investigation /analysis* | **Investigation/analysis to identify factors, etc.** | | Geotechnical drilling investigation |
| | **Research/analysis, etc. to assess impact** | | - |
| | **Analysis, etc. to determine the need for and methods of response** | | slope stability analysis and slope back analysis |
| *How to respond to risk* | **Contents of measures (avoidance, reduction, transfer) or retention** | | Reduction |
| | **Measures** | **How to deal with** | Intalation gabian an pile for reinsforcement |
| | | **Basis for decision** | dam safety |
| | **Retention (no measures)** | **Reason** | - |
| | | **Expected impact** | - |
| | **Availability and method of monitoring** | | - |
| | **Availability and method of information sharing** | | - |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | a. Currently, it is planned to install 1 inclinometer in this area. The need for instrumentation installation should be reviewed again.<br>b. Consider installing a piezometer and Observation Well (OW) to monitor groundwater flow behavior and pore water pressure.<br>c. It is necessary to evaluate the type, type of landslide that occurred and the condition of the geological layers and their repairs (bored piles and gabions) on the influence of the groundwater level originating from the reservoir so that the position and number of inclinometer points are optimal (perhaps more than one inclinometer point is needed). | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Abutment, landslide, gabion and pile | | |
| *References* | **Meeting Minutes:** | | Risalah diskusi teknis pembahasan perencanaan program pengeboran, 1 September 2023 |
| | **Meeting Materials:** | | Diskusi Teknis Persetujuan Izin Operasi dan Pemeliharaan, 2023_rev |
| | **Other:** | | |

**ID:** 58-12 **Name:** Tanju **Dam Type:** Random fill with central core **Dam Hight:** 23,5 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 9-Sep-22 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Spillway, Structure |
| | 4 | ***Contents of risk*** | Cracks on the right wall of the spillway channel to the spillway structure. |
| | 5 | ***Risk factors*** | Structure conection, spillway foundation |
| | 6 | ***Events in which risks were recognized*** | The presence of cracks in the spillway channel was identified during inspection. |
| | 7 | ***Condition/Situation for risk realization*** | impounding, spillout water, water flow, ground water pressure |
| | 8 | ***Impact if the risk realize*** | spillway failure, endangering the stability of the dam. |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Spillway, spillway structure |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Cracking on spillway* ⇨ *Inpection after impouing, the spillway show some crack* ⇨ *water flow, ground water pressure can cause scouring and leaching* ⇨ *Cracking on spillway => become larger* ⇨ *spillway failure, endangering the stability of the dam.*

*(Contents of measures)* ⇨ *(Risk avoidance, reduction, transfer or retention)*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

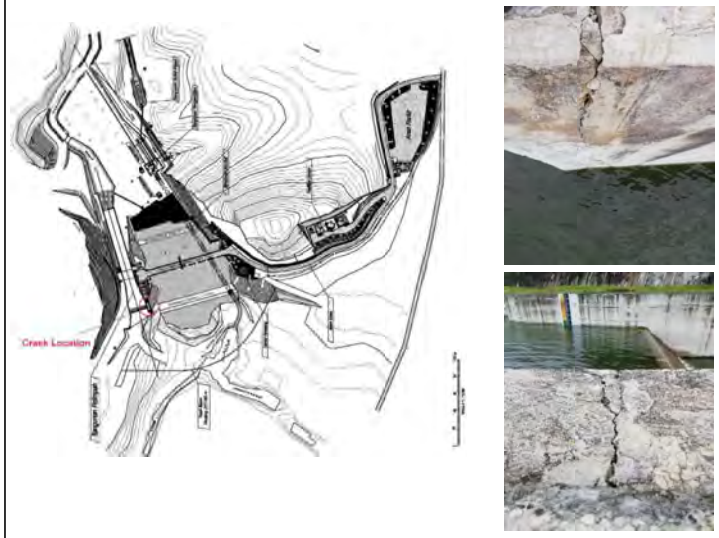


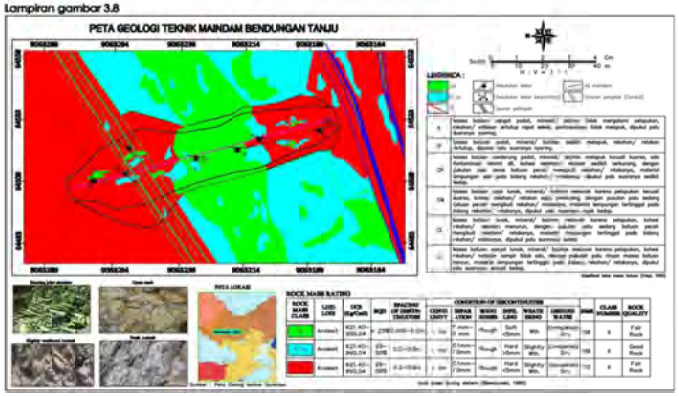





Figure-1 Crack location and condition at Tanju Dam (image of 2021)



**ID:** 58-12 **Name:** Tanju **Dam Type:** Random fill with central core **Dam Hight:** 23,5 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** 2021 |
| | ***Status of corresponding*** | Cement injection, grouting consodition between foundation and structure | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** |   Figure-1 Engineering geology map of main dam-spillway of Tanju Dam | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |

| | | | |
|---|---|---|---|
| *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* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | | Reduction |
| | ***Measures*** | ***How to deal with*** | Cement injection and consolidationo grouting |
| | | ***Basis for decision*** | Dam and strukture safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | | - |
| | ***Availability and method of information sharing*** | | - |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | a. It is necessary to re-examine the cause of the crack, whether it is related to concrete joints, foundation conditions, or other reasons, so that the solution can overcome these causes.<br>b. The consultant should prepare detailed design drawings, technical specifications and methods for grouting and injection.<br>c. Dam managers should immediately plan to repair cracks in the guide walls of the spillways. | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Spillway, Cracking, Grouting | | |
| *References* | ***Meeting Minutes:*** | | Risalah Sidang Pleno Pelaksanaan Pengisian Awal Waduk dan Kesiapan Operasi, 9 SePTember 2022 |
| | ***Meeting Materials:*** | | Draft-Sidang Pleno Persiapan dan Sertifikasi OP, 3 November 2021 |
| | ***Other:*** | | Laporan supervisi bendungan tanju dan milla (PT. Yodya Karya, 2015) |

**ID:** 58-12 **Name:** Tanju **Dam Type:** Random fill with central core **Dam Hight:** 23,5 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2021 |
| | 2 | ***Project phase in which risks were recognized*** | Impounding |
| | 3 | ***Location (Structure/Area)*** | Dam body, riprap |
| | 4 | ***Contents of risk*** | Slilding of dam slope |
| | 5 | ***Risk factors*** | Weathered slope protection |
| | 6 | ***Events in which risks were recognized*** | Inspection for operation permite |
| | 7 | ***Condition/Situation for risk realization*** | Rain, climate |
| | 8 | ***Impact if the risk realize*** | Instable dam slope, slope failure of dam |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Material, geology, rock strengh |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Weathred Riprap* ⇒ *During Inspection for operation permite several weathered riprap was observed at downstream of dam* ⇒ *Weathered riprap can be eroded easily that trigger slope failure of dam* ⇒ *Slilding /slope failure of dam* ⇒ *Instable dam slope*

↘ *Replacing weathered riprap with the fresh one as specification* ⇨ *Risk reduction*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

Photo-1 Rip-rap at downstream slopes of the Dam, shows that partially weathered



**ID:** 58-12 **Name:** Tanju **Dam Type:** Random fill with central core **Dam Hight:** 23,5 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** impounding | ***Date:*** 2021 |
| | ***Status of corresponding*** | Replacing riprap with the fresh one | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| ***Plan*** | - | | |
| ***Design*** | - | | |
| ***Construction*** | - | | |
| ***Impounding*** | - | | |
| ***Operation/ maintenance*** | - | | |
| ***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*** | ***Contents of measures (avoidance, reduction, transfer) or retention*** | Reduction | |
| | ***Measures*** | ***How to deal with*** | Replacing riprap as specification |
| | | ***Basis for decision*** | Dam safety |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | - | |
| | ***Availability and method of information sharing*** | - | |
| ***Special Notes*** | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues<br>a. To ensure the condition and level of weathering of riprap, laboratory tests must be carried out with an adequate and statistically representative number of samples.<br>b. Laboratory tests for riprap stone materials at least include the following:<br>1. Absorption test; 2. Specific gravity test; 3. Test for immutability or durability; 4. Uniaxial test; 5. Slake durability test; 6. Abrasion test | | |
| ***Applicable standards*** | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| ***Keywords.*** | Riprap. weathered, replacement | | |
| ***References*** | ***Meeting Minutes:*** | Risalah Sidang Pleno Pelaksanaan Pengisian Awal Waduk dan Kesiapan Operasi, 9 SePTember 2022 | |
| | ***Meeting Materials:*** | Draft-Sidang Pleno Persiapan dan Sertifikasi OP, 3 November 2021 | |
| | ***Other:*** | Laporan supervisi bendungan tanju dan milla (PT. Yodya Karya, 2015) | |

**ID:** 61-15 **Name:** Logung **Dam Type:** Earthfill random with central core **Dam Hight:** 55,0 **m**

| | | | |
|---|---|---|---|
| *Contents of Risk* | 1 | ***When the risk was identified (date)*** | 2021 |
| | 2 | ***Project phase in which risks were recognized*** | Impouding |
| | 3 | ***Location (Structure/Area)*** | Reservoir area |
| | 4 | ***Contents of risk*** | Overtopping, erossion |
| | 5 | ***Risk factors*** | Landslide of reservoir |
| | 6 | ***Events in which risks were recognized*** | During inspection for dam operation permit |
| | 7 | ***Condition/Situation for risk realization*** | Rain, water content, earthquake |
| | 8 | ***Impact if the risk realize*** | Dam failure, flooding, uncontrol water flow |
| *Perspectives on Risk Classification* | 9 | ***Where risk exists*** | Geology, material, rock strengh |
| | 10 | ***Character*** | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | ***Phase of Realization*** | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | ***Impact if the risk realize*** | ☑ Affects dam safety |
| | | | ☐ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | ***Corresponding to risks*** | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

***Overview of Causal Relationships***

*Dam Reservoir landslide* ⇨ *after impounding, several plaseces has landslide potential surrounding dam reservoir area* ⇨ *Rain, water content, earthquake and impounding can trigger landslide at reservoir* ⇨ *Overtopping, erossion* ⇨ *Dam failure, flooding, uncontrol water flow*

*Monitoring* ⇨ *Risk Retention*

***Explanatory Diagram (Schematic Diagram/ Photos, etc.)***

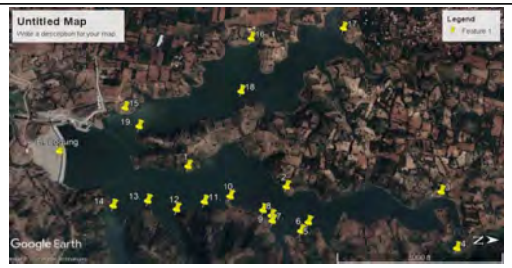



Figure-1 Location of landslide potential at Logung Dam

Photo-1 Documentation of Landslide potential at Logung dam reservoir area



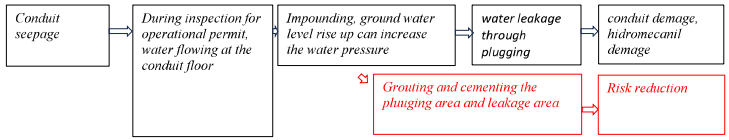
**ID:** 61-15 **Name:** Logung **Dam Type:** Earthfill random with central core **Dam Hight:** 55,0 **m**

| | | | |
|---|---|---|---|
| *History* | ***Recognition or not in the past*** | Unrecognized | |
| | ***When the risk was recognized*** | ***Project Phase:*** Impounding | ***Date:*** 2021 |
| | ***Status of corresponding*** | Monitoring | |
| ***Project Phase*** | ***History of correspond to risks*** | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | - | | |
| *Impounding* | - | | |
| *Operation/ maintenance* | - | | |
| *Investigation /analysis* | ***Investigation/analysis to identify factors, etc.*** | Geological mapping of mass potential volume | |
| | ***Research/analysis, etc. to assess impact*** | Reservoir sedimentation | |
| | ***Analysis, etc. to determine the need for and methods of response*** | aerial photograph | |
| *How to respond to risk* | ***Contents of measures (avoidance, reduction, transfer) or retention*** | Retention | |
| | ***Measures*** | ***How to deal with*** | - |
| | | ***Basis for decision*** | - |
| | ***Retention (no measures)*** | ***Reason*** | - |
| | | ***Expected impact*** | - |
| | ***Availability and method of monitoring*** | - | |
| | ***Availability and method of information sharing*** | - | |
| *Special Notes* | ***Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.*** | | |
| | 1) Technical issues | | |
| | a. Considering that the location of the Logung Dam also has the potential for an earthquake with a moderate magnitude, if an earthquake occurs, special inspections can be carried out immediately, including inspections on all the slopes of the reservoir inundation.<br>b. Greenbelt areas should be handled immediately, especially in locations that are still in a bare condition by planting trees and making terraces. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Reservoir, landslide, monitoring | | |
| *References* | ***Meeting Minutes:*** | Risalah sidang pleno Pelaksanaan Pengisian Awal Waduk, 11 Maret 2022 | |
| | ***Meeting Materials:*** | Sidang Pleno Sertifikasi Operasi dan Pemeliharaan, 2022 | |
| | ***Other:*** | | |

**ID:** 61-15 **Name:** Logung **Dam Type:** Earthfill random with central core **Dam Hight:** 55,0 **m**

| | | | |
|---|---|---|---|
| Contents of Risk | 1 | When the risk was identified (date) | 2021 |
| | 2 | Project phase in which risks were recognized | Impounding |
| | 3 | Location (Structure/Area) | Conduit |
| | 4 | Contents of risk | Water seepage at the conduit |
| | 5 | Risk factors | water leakage through plugging other location |
| | 6 | Events in which risks were recognized | During inspection for operational permit |
| | 7 | Condition/Situation for risk realization | Impounding, ground water level rise up |
| | 8 | Impact if the risk realize | conduit demage, hidromecanical damage |
| Perspectives on Risk Classification | 9 | Where risk exists | Material, dam structure |
| | 10 | Character | ☐ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | 11 | Phase of Realization | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☐ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | 12 | Impact if the risk realize | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | 13 | Corresponding to risks | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

**Overview of Causal Relationships**




**Explanatory Diagram (Schematic Diagram/ Photos, etc.)**

Photo-1 uncontrol water flow at the conduit of Logung dam

Photo-2 water Leakage at the upper of conduit



**ID:** 61-15 **Name:** Logung **Dam Type:** Earthfill random with central core **Dam Hight:** 55,0 **m**

| | | | |
|---|---|---|---|
| History | Recognition or not in the past | Unrecognzed | |
| | When the risk was recognized | Project Phase: Impounding | Date: 2021 |
| | Status of corresponding | Conduting Grouting and cementing at leakage area an pluuging | |
| Project Phase | History of correspond to risks | | |
| Plan | - | | |
| Design | - | | |

**Construction**

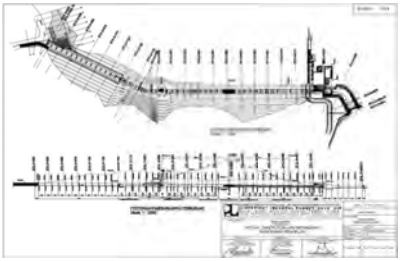


Figure-1 Asbuilt drawing of conduit diversion

**Impounding**

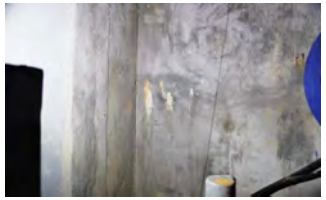


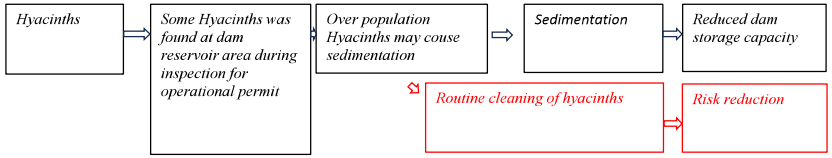
Photo-1 Grouting and cementing at plugging area and leakage zone

| | | | |
|---|---|---|---|
| Operation/ maintenance | - | | |
| 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 | Contents of measures (avoidance, reduction, transfer) or retention | | Reduction |
| | Measures | How to deal with | Grouting and cementing |
| | | Basis for decision | dam function, hidromecanical function |
| | Retention (no measures) | Reason | - |
| | | Expected impact | - |
| | Availability and method of monitoring | | - |
| | Availability and method of information sharing | | - |
| Special Notes | Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc. | | |
| | - | | |
| | - | | |
| Applicable standards | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| Keywords. | Conduit, seepage, grouting, cementing | | |
| References | Meeting Minutes: | | Risalah sidang pleno Pelaksanaan Pengisian Awal Waduk, 11 Maret 2022 |
| | Meeting Materials: | | Sidang Pleno Sertifikasi Operasi dan Pemeliharaan, 2022 |
| | Other: | | Asbuild Drawing Pengelak |

*ID:* 61-15 *Name:* Logung *Dam Type:* Earthfill random with central core *Dam Hight:* 55,0 *m*

| | | | |
|---|---|---|---|
| *Contents of Risk* | *1* | *When the risk was identified (date)* | 2021 |
| | *2* | *Project phase in which risks were recognized* | Impounding |
| | *3* | *Location (Structure/Area)* | Reservoir |
| | *4* | *Contents of risk* | Sedimentation |
| | *5* | *Risk factors* | Hyacinths |
| | *6* | *Events in which risks were recognized* | During inspection for dam operational permit |
| | *7* | *Condition/Situation for risk realization* | Overpopulation Hyacinths |
| | *8* | *Impact if the risk realize* | Reduced dam storage capacity |
| *Perspectives on Risk Classification* | *9* | *Where risk exists* | Reservoir area |
| | *10* | *Character* | ☑ Mainly caused by external forces |
| | | | ☑ Mainly due to technical factors |
| | | | ☐ Factors other than the above |
| | *11* | *Phase of Realization* | ☐ Project Implementation |
| | | | ☑ Operation |
| | | | ☑ Due to large-scale external force action |
| | | | ☑ Due to long-term use |
| | | | ☐ Others |
| | *12* | *Impact if the risk realize* | ☐ Affects dam safety |
| | | | ☑ Affects dam function |
| | | | ☐ Affect the schedule and costs of the projects |
| | *13* | *Corresponding to risks* | ☑ Basically risk avoidance |
| | | | ☐ Consider mitigation measures as risk avoidance is difficult. |
| | | | ☐ Risk retention under certain conditions |

*Overview of Causal Relationships*




*Explanatory Diagram (Schematic Diagram/ Photos, etc.)*

Photo-1 Hyacinths grow at dam reservoir



*ID:* 61-15 *Name:* Logung *Dam Type:* Earthfill random with central core *Dam Hight:* 55,0 *m*

| | | | |
|---|---|---|---|
| *History* | *Recognition or not in the past* | Unrecognized | |
| | *When the risk was recognized* | *Project Phase:* Impounding | *Date:* 2021 |
| | *Status of corresponding* | Creaning | |
| *Project Phase* | *History of correspond to risks* | | |
| *Plan* | - | | |
| *Design* | - | | |
| *Construction* | | | |
| *Impounding* |  Photo-1 Hyacinths cleaning activity at dam reservoir | | |
| *Operation/ maintenance* | - | | |
| *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* | *Contents of measures (avoidance, reduction, transfer) or retention* | Reduction | |
| | *Measures* | *How to deal with* | Creaning the hyacinths |
| | | *Basis for decision* | Dam sedimentation |
| | *Retention (no measures)* | *Reason* | - |
| | | *Expected impact* | - |
| | *Availability and method of monitoring* | - | |
| | *Availability and method of information sharing* | - | |
| *Special Notes* | *Challenges: 1) Technical issues, 2) Constraints in project implementation requirements (Construction time, costs, etc.), 3) Constraints in dam operation, 4) Issues due to human and organisational factors, results of risk response - 5) Impact on processes, costs, etc., 6) Reflection points (room for improvement of risk management methods), etc.* | | |
| | 1) Technical issues | | |
| | a. The presence of water hyacinth should always be monitored and handled properly, and included in the routine maintenance of reservoir inundation in the OP guidelines.<br>b. Anticipation of the existence of water hyacinth and eutrophication is contested together with the local TKPSDA related to the causes and handling starting from the upstream watershed of the reservoir pond. | | |
| *Applicable standards* | (Describe standards related to geological study, dam design, and countermeasure design.) | | |
| *Keywords.* | Reservoir, hyacinths, cleaning | | |
| *References* | *Meeting Minutes:* | Risalah sidang pleno Pelaksanaan Pengisian Awal Waduk, 11 Maret 2022 | |
| | *Meeting Materials:* | Sidang Pleno Sertifikasi Operasi dan Pemeliharaan, 2022 | |
| | *Other:* | | |

# Attachment 3 Minutes of Discussion on Dam Risk Management

# Minutes of Meeting (MoM)
# Dam Risk Assessment

**Date** : February 11, 2025
**Location** : Balai Teknik Bendungan
**Time** : 13:30 – Finished

---

1. **Focus Areas of Discussion**

**A. Dam Risk Management System Study**

- The study will focus on "risks that arise or are recognized during dam surveys, design, and construction."
- The goal is to identify risks in advance and implement countermeasures to ensure safety post-construction while preventing accidents, delays, and cost increases during construction.
- This approach is proactive and differs from ICOLD and US Army methodologies.
- Additional emphasis should be placed on risk management during construction and future maintenance development.
- More specificity is needed regarding the focus areas of the study.

**B. Key Topics for Analysis**

a. Geological Issues (80% Focus)km
b. Foundation
c. Material
d. Human Resources
   - Indonesian experts already have relevant records.
   - A classification system should be developed to compile a database based on zones.
   - The database should document damages and vulnerabilities in the design, construction, and operation & maintenance phases.
   - The study should categorize the characteristics of each phase to establish keywords and best practices.

2. **Action Plan**

**1) Based on Experience**

- Develop a database to record historical dam risk cases.
- Create a classification system for risks by zone and phase (design, construction, operation & maintenance).

**2) Develop Countermeasures**

- Establish a complete set of countermeasures to mitigate risks effectively.
- Ensure that solutions are comprehensive and feasible.

**3) Data Verification**

- Review and update Cirata Dam data as it is outdated.

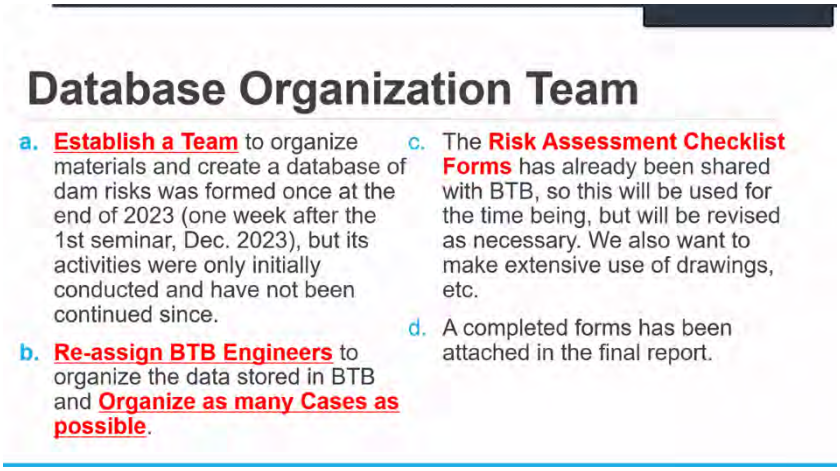
**4) TOR (Terms of Reference) and Templates**

- A TOR needs to be created to define the scope and structure of risk assessment.
- Standardized templates should be developed for consistency in data collection and reporting.

**5) KKB Inclusion**

- KKB should be incorporated into the evaluation process for a more comprehensive assessment.

- It should add as point “e” on this slide to include KKB as the evaluator.




**3. Additional Notes**

- The study is not an overly complex task but requires attention to vulnerabilities.
- Practical differences in risk assessment and mitigation practices must be considered.
- The database must be continuously updated.
- A manual should be created to guide database entries.
- A "Medical Record Book" for 61 dams should be maintained to document the implementation process.

**4. Key Discussions and Agreements**

- **Shimizu san:** Presented Dam Risk Management, which was previously shared in the INACOLD Seminar twice. The current discussion focuses on future plans and necessary activities in dam risk management.
- **Risk Definition Discussion:** Evaluating risk based on past events, potential hazards, dam performance under various conditions, and consequences of dam failure.
- **Scope Constraint Clarification:** The study focuses on risks that arise during the feasibility study and construction phases but can be extended to the operation and maintenance phases.
- **Database Development:**
  - Utilize past events to guide actions on potential dam failures.
  - Ensure transparency by documenting dam failures openly instead of covering them up.
  - Develop templates for recording dam failures categorized by spillway, geotechnical aspects, dam body, etc.
  - Establish a classification system based on dam zones and construction phases.
- **Implementation Plan:**
  - Ensure that BTB and KKB have clear database organization and risk management assignments.
  - Develop a format for risk cases, including background, identification and analysis, assessment, countermeasures, and monitoring.
  - To establish recommendations, BTB will compile past experiences, technical meetings, and dam safety committee inputs.
- **Budget Challenges:**
  - Current financial constraints prevent hiring consultants; instead, existing resources must be maximized.
  - Team formation for database compilation will rely on existing personnel, possibly working overtime.
  - Consideration of alternative funding sources like JICA sponsorship.

- **Field Application:**
  - The database should be designed to allow engineers to access relevant past cases quickly.
  - The database should be practical, enabling immediate reference during site visits.
- **Guidelines and Documentation:**
  - The final outcome should include a manual guideline to ensure proper database entry and usage.
  - Establishment of "Medical Record Books" for 61 dams covering the construction phase.
  - Adoption of Japanese-style risk documentation formats to improve database usability.
- **Long-Term Strategy:**
  - The database should serve as a reference for dam safety assessments and decision-making.
  - A structured approach to risk management should be established, learning from past experiences.

**6. Next Steps**

1. **Finalization of Templates and TOR** → Ensure consistency and clarity in data collection.
2. **Pilot Database Implementation** → Start with records from 10 existing projects as the sample.
3. **Assignment of Responsibilities** → Clarify BTB and KKB roles in database management.
4. **Continuous Improvement** → Regular updates and reviews of the database and risk assessments.
5. **Further Collaboration** → Engage stakeholders, including JICA, for potential sponsorship and support (expected).

**Closing Remarks**

- **Yamamoto san:** Emphasized the importance of continuing risk assessment efforts despite budget constraints.
- **Consensus:** The importance of database management was strongly agreed upon, ensuring a structured approach to dam risk assessment and mitigation.

---

The meeting concluded with an agreement to proceed with the outlined action plan, ensuring a comprehensive risk management system for future dam safety in Indonesia.