



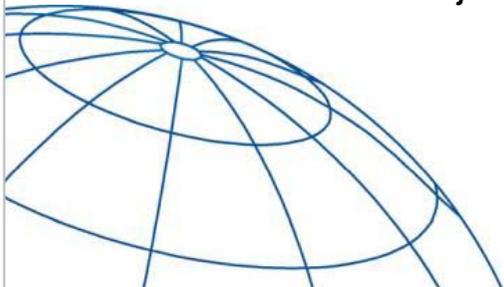
Գերմանական  
համագործակցություն  
DEUTSCHE ZUSAMMENARBEIT

# Consulting Services for the “Programme for the Promotion of Renewable Energies: German-Armenian Renewable Energy Fund (GAF-RE) Phase III”, BMZ ID 2012.7029.7

## Small Hydropower Projects (SHPP)

Project Process and Monitoring during Construction

Yerevan, 29.06.2017



**BMZ**



Federal Ministry  
for Economic Cooperation  
and Development



CENTRAL BANK OF ARMENIA

**KFW**



CONSULTING & IT

ENERGY

ENVIRONMENT

WATER & INFRASTRUCTURE

# Agenda

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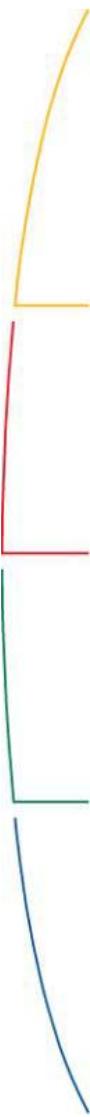
Important Issues as part of the Project Assessment



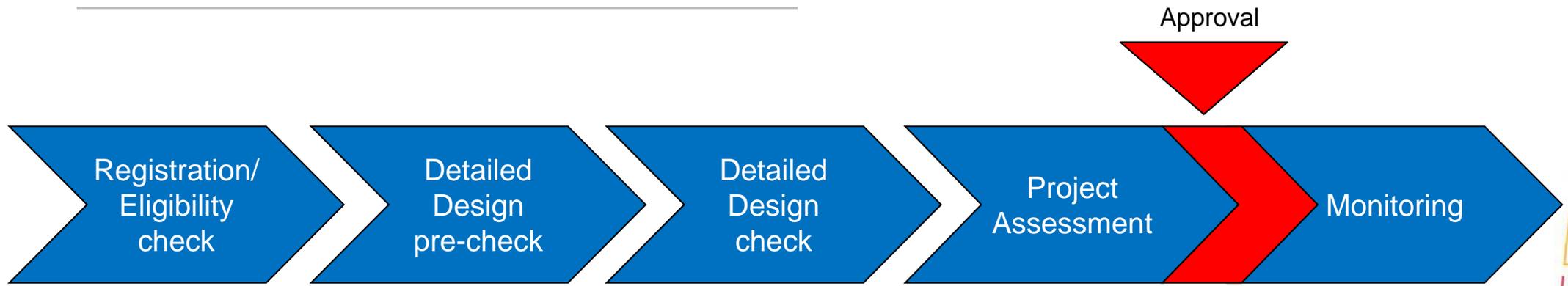
Loan Disbursement in Tranches



Project Monitoring during Construction



# Important issues as part of the project assessment



## Required Documents from Owners

- |  |   |   |   |  |
|--|---|---|---|--|
| <ul style="list-style-type: none"> <li>• Application form,</li> <li>• Pre-Feasibility Study,</li> <li>• Business Plan</li> <li>• Proof of landownership,</li> <li>• Licence for water-use,</li> <li>• Licence for construction,</li> <li>• etc.</li> </ul> | <ul style="list-style-type: none"> <li>• Detailed Design,</li> <li>• Land use arrangements,</li> <li>• Cost estimate,</li> <li>• Equipment selection / Data sheets,</li> <li>• Implementation concept</li> <li>• Construction/contracting arrangements,</li> <li>• Operation and maintenance arrangements,</li> <li>• etc.</li> </ul> | <ul style="list-style-type: none"> <li>• Pre-checked Detailed Design documents</li> </ul> | <ul style="list-style-type: none"> <li>• checked Detailed Design documents</li> </ul> | <ul style="list-style-type: none"> <li>• Updated Time schedule (monthly),</li> <li>• Data sheets equipment,</li> <li>• Progress documentation (monthly)</li> </ul> |
|--|---|---|---|--|

Close contact, feedback and guidance in preparing the required documents by the Consultant

## Important issues as part of the project assessment



Reliability of Basic Design parameters, such as Topography, Geology, Hydrology

Careful calculation of hydrological analysis (based on daily data)

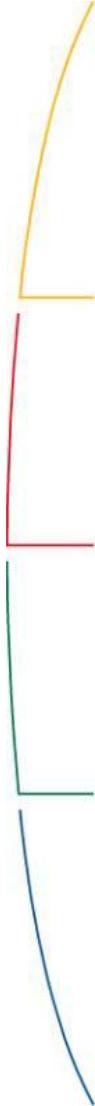
Detailed power and energy calculations

Detailed analysis of costs based on bill of quantities and unit rates

Review of layout and technical design, implementation schedule, assessment of optimization of design discharge, technical risks

Approval of environmental and social impact assessments

Financial feasibility of the project, cashflow

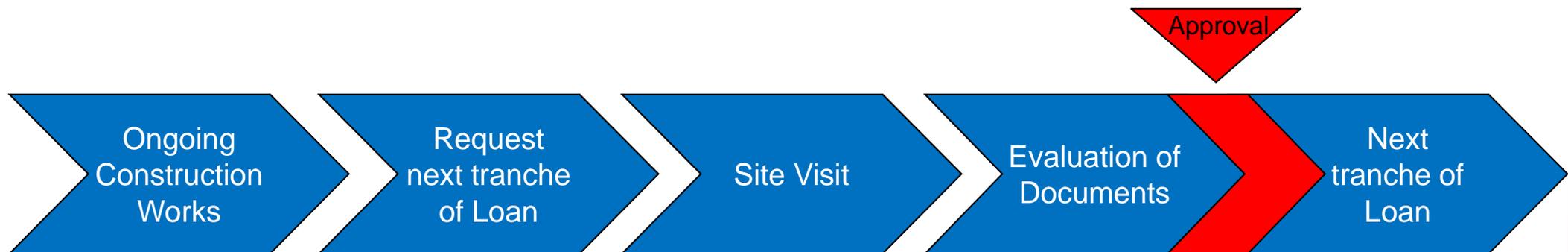


# Loan Disbursement in Tranches

Division of loan disbursement in tranches according to project cashflow.

Loan Retention to be disbursed after project completion.

Monitorings to ensure purposefully construction and utilization of previous loan tranche.



## Required Documents from Owners

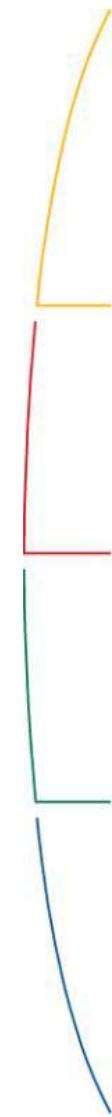
- Data sheets equipment,
- Stability calculations of relevant structures
- Request
- Construction Contracts
- Bill of quantities executed
- Bill of quantities to be executed
- Updated Time schedule
- Progress documentation since last tranche

## Project Monitoring during Construction

- While implementation of the project the GAF-RE team monitors the project execution and report on this to GAF
- Satisfactory monitoring is precondition for releasing the next tranche of the loan
- It is the responsibility of the borrower to provide information on time schedules, construction progress and costs to the GAF-RE team
- The GAF-RE team will monitor the accordance of the construction works / plant equipment with the information provided for the technical assessment
- After commissioning, the final monitoring will be conducted. If the monitoring is satisfactory the loan retention (10% of loan) will be disbursed

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# PROJECT MONITORING DURING CONSTRUCTION



# Project Monitoring during Construction

Updated Time Schedule

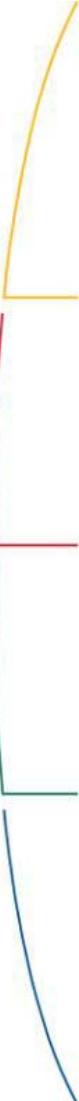
Nr.	Task Name	Dauer	Anfang
1	Preliminary and General	45	Di 01.03.05
7	River diversion during construction	32	Di 01.11.05
13	Water intake, sandtrap and flusher	186	Do 10.03.05
24	Fishpass, weir with stilling basin and gravel trap	173	Mi 01.03.06
36	Penstock	405	Di 01.03.05
48	Powerhouse	326	Mi 01.06.05
60	Testing and Commissioning	38	Di 19.09.06

Project: Gargjar\_workprogramme.mpp

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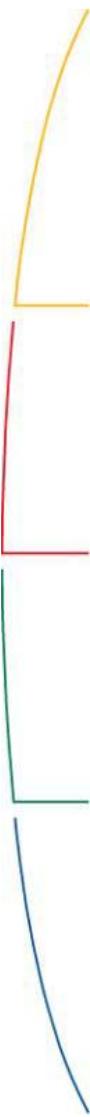
# Project monitoring during construction

Construction Sites need to be accessible – condition of Access Roads



# Project monitoring during construction

Adequate reinforcement needs to be applied



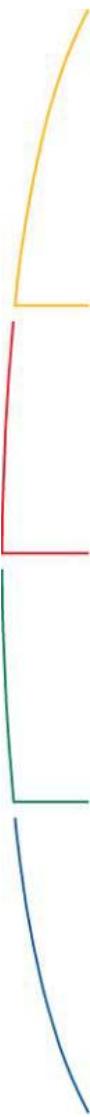
# Project monitoring during construction

Concrete / Construction Quality -> Sandtrap



# Project monitoring during construction

Adequate concrete / construction quality needs to be provided -> leakage



# Project monitoring during construction

Concrete / Construction Quality -> Spillway



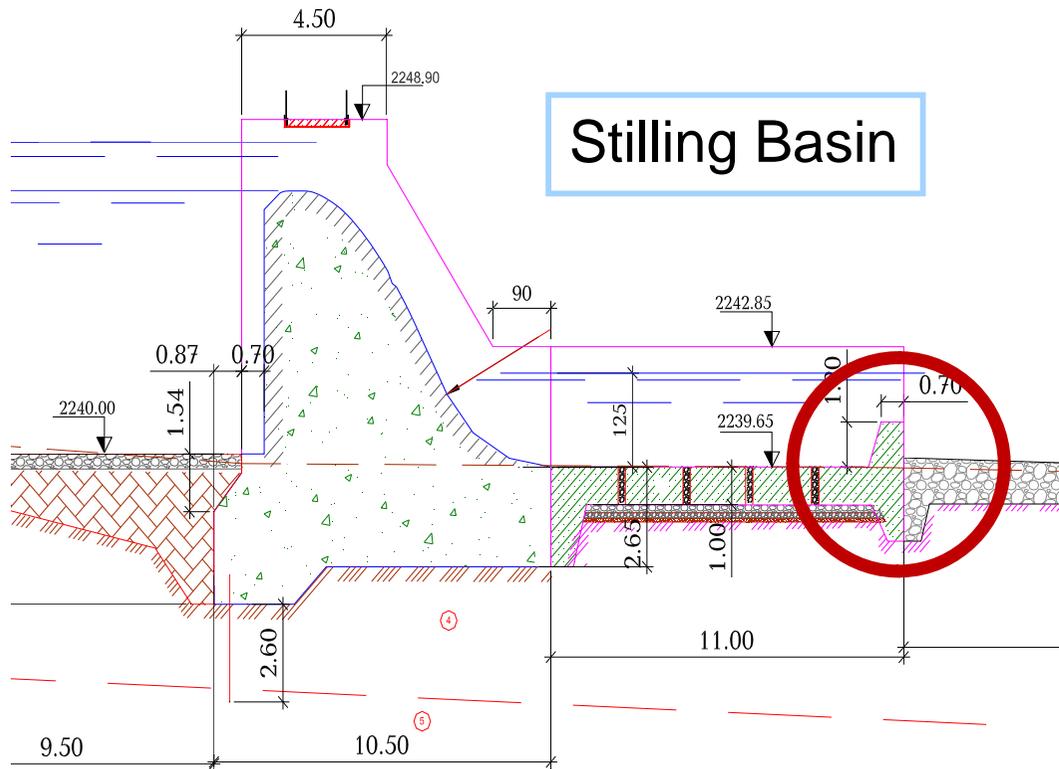
During reconstruction



After reconstruction

# Project monitoring during construction

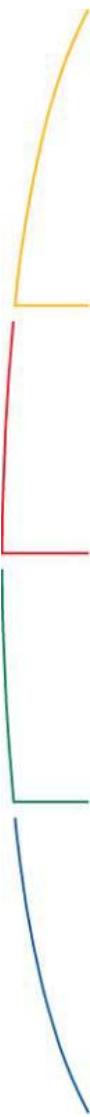
## Compliance with Detailed Design – Example Stilling Basin



Stilling Basin End Sill not constructed  
 -> No energy dissipation in flood cases

# Project monitoring during construction

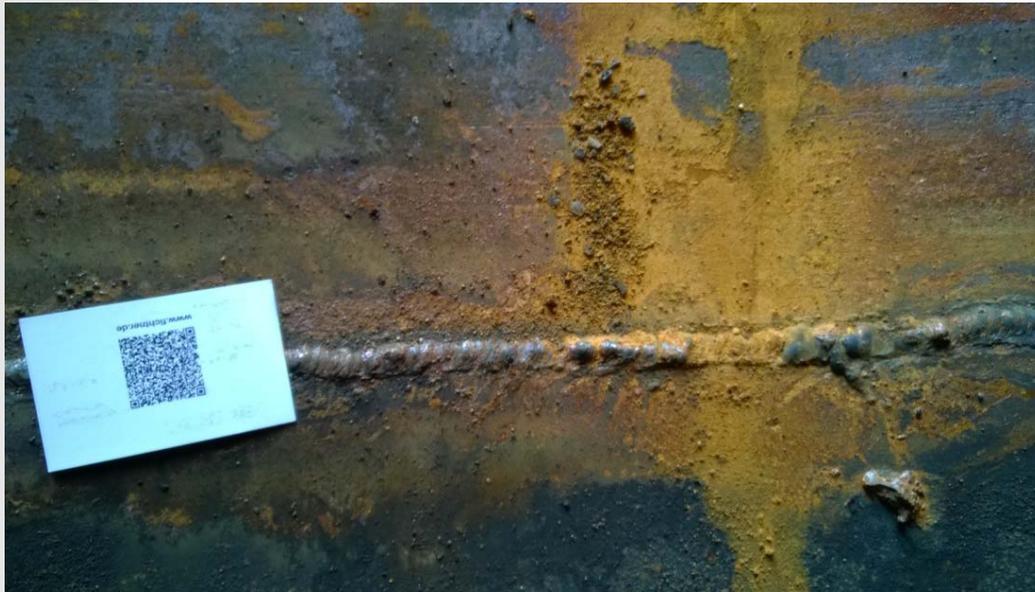
Functionality of Fishpass : no step between river bed and fishpass entrance



# Project monitoring during construction



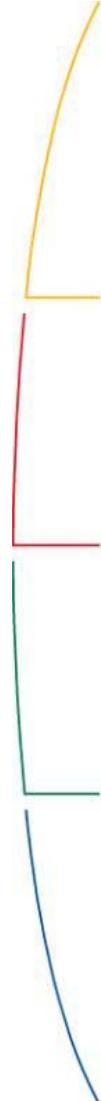
Penstock Quality -> Penstock Pipes



Poor Welding -> additional friction losses



Circular Shape?



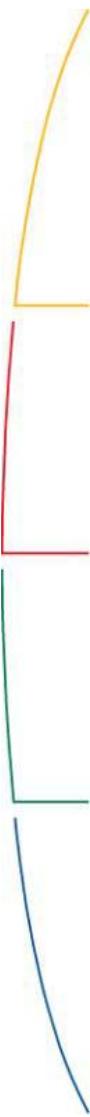
# Project monitoring during construction

Penstock Quality -> Penstock Support, Corrosion Protection



# Project monitoring during construction

Adequate foundations need to be provided for all structures



# Project monitoring during construction

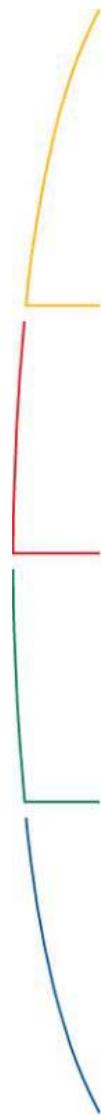
Powerhouse needs to be durable: roof, walls, beams, pillars

Portal Crane needs to be installed for installation and maintenance purposes



# Project monitoring during construction

Reverse Pumps as Turbine -> very low efficiency



# Project monitoring during construction

## Turbines and Generators



Francis Turbine : Local Production



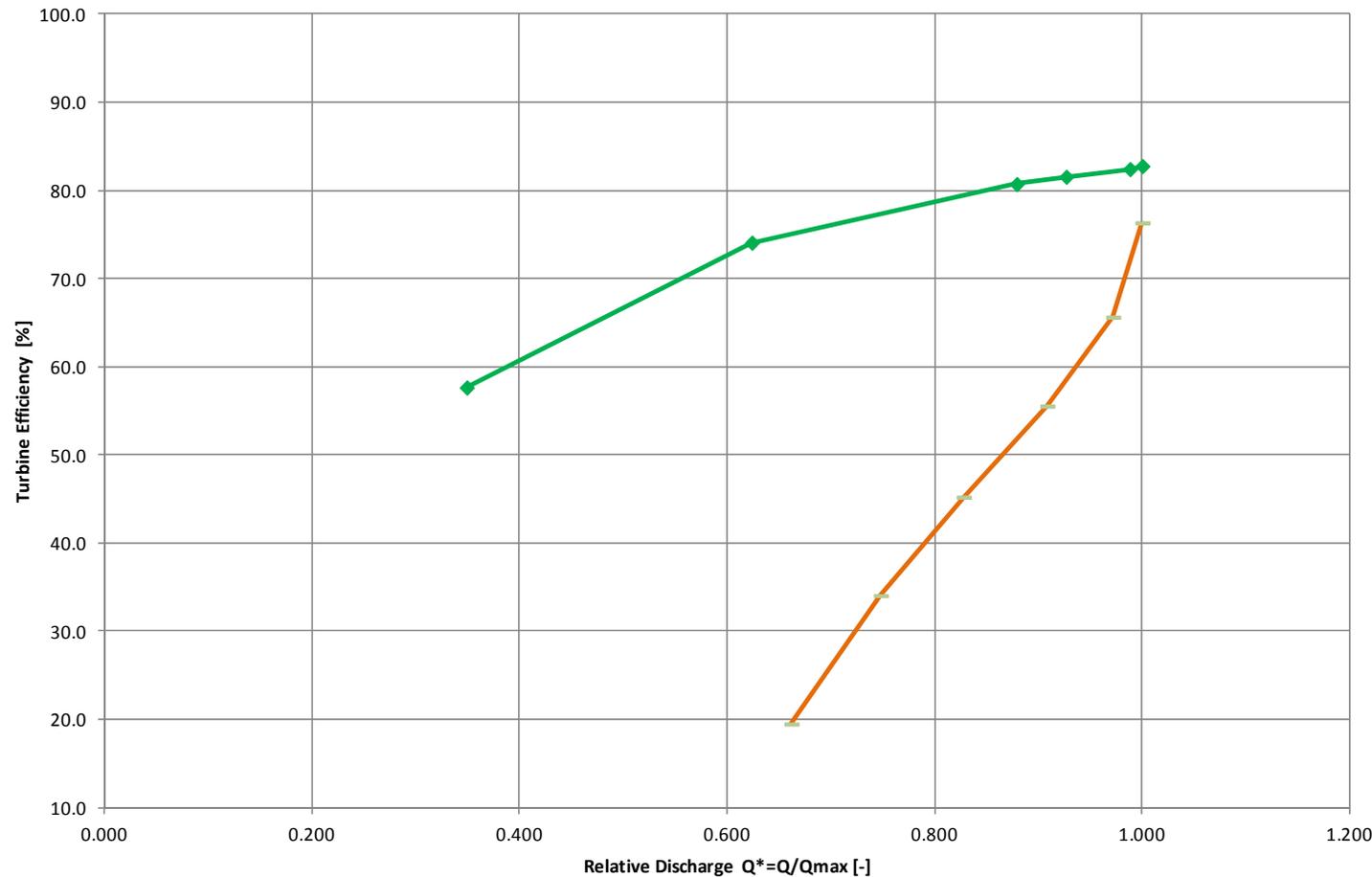
Francis Turbine: European Production

# Project monitoring during construction

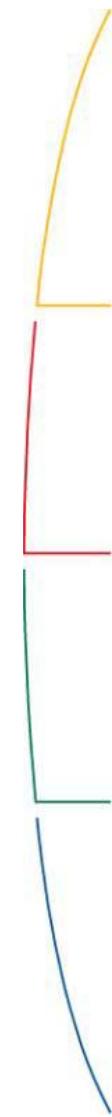


## Turbines and Generators

Comparison: Turbine Efficiency (Relative Discharge)

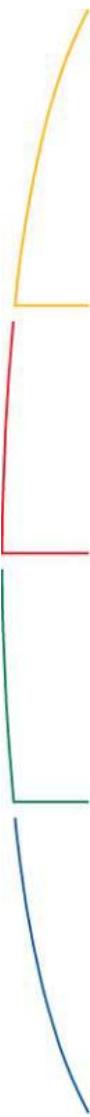


- Francis – European
- Francis – Local



# Project monitoring during construction

Switchyard needs to be fenced, warning signs attached



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Thank you for your Attention!

