COYNE ET BELLIER
Ingénieurs Conseils

ELC ELECTROCONSULT

IPA
Energy + Water Economics

TECHNO-ECONOMIC ASSESSMENT STUDY
FOR ROGUN HYDROELECTRIC CONSTRUCTION PROJECT

OSHPC BARKI TOJIK

Phase II Report: Project Definition Options

Implementation Studies

- Objectives of the implementation studies
  - Establish detailed project schedule and cost estimate for each alternative
  - Input data for economic and financial analysis
- Structure of presentation
  - Project schedule
  - Cost estimate

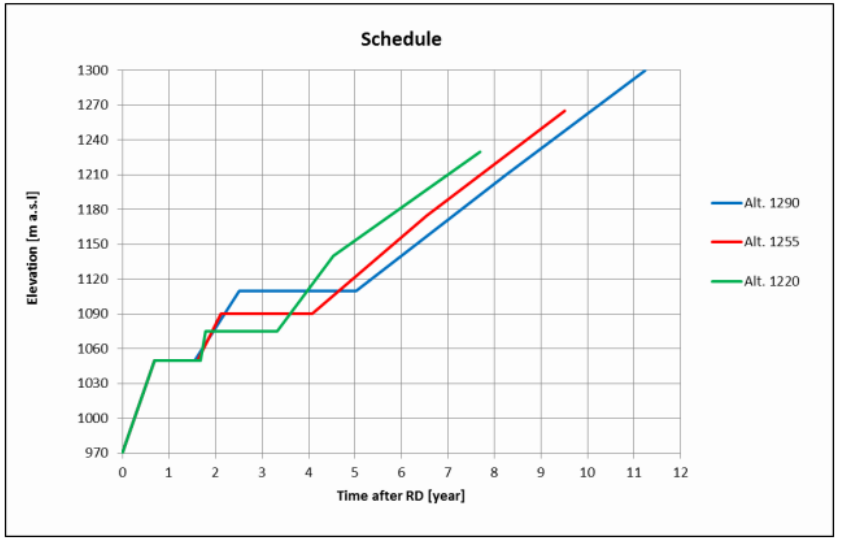
Project schedule

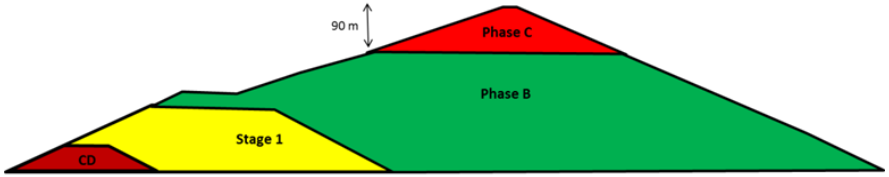
Project

- Objectives:
  - Produce the schedule of works for each dam alternative [1290; 1255; 1220] m asl;
  - Identify critical activities and critical path.
- Methodology:
  - Software: MICROSOFT PROJECT;
  - Identify the main works (hydraulic tunnels, powerhouse, …);
  - Identify the main task (excavation, concrete lining, …) for each work, and evaluate their duration.
- A detailed implementation schedule (about 270 items)
  - Contract activities (technical specifications, tender, evaluation and contract Award, mobilization);
  - Roads, site installations, transportation structures;
  - River diversion structures and sequences , flood management structures;
  - Power system structures;
  - Dam works.

Project schedule – Main hypotheses

- Embankment works:
  - 9 months per year, with 3 months of stoppage because of weather conditions (rain, snow and frost);
  - Shell: 11 months per year because of frost.
- Open air works:
  - Aggregate processing: 11 month per year because of frost;
  - Open air concrete: 11 months per year because of frost
- 25 working days per month
- 18 working hours per day.
- Construction rates:
  - Underground works: tunnel excavation and lining (12.5 m/week);
  - Dam: material placement rates (300 000 to 800 000 m3/month)





Project schedule – Critical paths and tasks

– Two critical paths identified

- Early generation phase
  - Powerhouse cavern stabilization works;
  - Powerhouse excavation of units 5 and 6;
  - Concrete and installation of units 5 and 6.
- Main dam works
  - Construction/rehabilitation of transport facilities;
  - Core foundation abutment excavation;
  - Core foundation excavation below elevation 1000 m asl;
  - RCC slab located under the core;
  - Core / embankment.

Project schedule – Contract periods

– Two contract periods in order to reduce as much as possible the overall construction time

- Pre-contract (preliminary works realised by a local contractor)
  - Extracting and stockpile material from quarry 15;
  - Rehabilitation of access roads, Rogun town building, fresh water supply and sanitation, telecommunication;
  - Completion of access tunnel;
  - Rehabilitation of access tunnel;
  - Works diversion tunnel;
  - Contract activities (Technical specifications, tender, evaluation and contract award, mobilization).
- Main contract (works realised by an international contractor)
  - Dam works;
  - Underground works;
  - Permanent equipment ;
  - Resettlement works.

Project schedule – Conclusion

- Two contract periods in order to reduce as much as possible the overall construction time:
  - Pre-contract (2 years);
  - Main contract (between 8 years and 11,6 years).
- Total duration of construction:
  - Between 10 and 13,5 years from TEAS validation and GoT's decision to proceed with the Project;
- Early generation phase:
  - 6 years after river diversion for 1290 and 1255 alternatives;
  - 6,8 years after river diversion for 1220 alternatives.
- A realistic schedule, that nevertheless requires:
  - A good coordination of all activities;
  - An adequate mobilization of equipment and labour as soon as construction begins.

KEY DATES in months counted from the TEAS validation and GoT decision to proceed with the Project

Time from Pre-Contract (in months)

	ALT. Fsl 1290	ALT. Fsl 1255	ALT. Fsl 1220
TEAS validation	0	0	0
River Diversion date	28	28	28
End of cofferdam construction	36	36	36
End of stage 1 dam construction	58	53	49
End of dam construction	163	142	120

	1290 masl	1255 masl	1220 masl
TEAS Validation	0	0	0
Diversion	28	28	28
Commissioning U 6 Temp.	73	73	82
Commissioning U 5 Temp.	75	75	84
End of Erection U4	85	85	85
End of Erection U3	98	98	98
End of Erection U2	112	112	112
End of Erection U1	112	112	112
Minimum Reservoir level reach	112	94	80
Temp U5 and U6 shut down	117	114	
Commissioning U 4	115	101	101
Commissioning U 3	117	114	114
Commissioning U 2	119	116	116
Commissioning U 1	121	118	118
Commissioning U 6	123	120	
Commissioning U 5	127	122	

Cost estimate

Cost estimate

– Objectives:

- **Terms of References:** "The Consultant shall prepare a project definition stage cost estimate for each option for the Rogun HPP with break down in local and foreign currency".
- Establish **a detailed Cost estimate** for each alternatives (9)
  - 3 dam alternatives: FSL = [1290; 1255; 1220] m asl;
  - 3 installed power capacities: High, Intermediate, Low.

– Methodology:

- Identified main items (dam works, underground works, mitigations measures,…)
- Define a list of **Unit prices**;
- Establish **Bill of quantities**;
- Cost = Sum of (Unit prices * Quantities).

– Hypothesis:

- Basic case: alternative 1290 m asl (a specific analysis);

Cost estimate – Methodology

– Phase 1 cost estimate: existing works

- A separated cost estimate is included in Phase 1 report;
- Useful to identify future works included in Phase 2 cost estimate;
- Total cost of Phase 1 is not considered as input data for economic and financial analysis.

– Phase 2 cost estimate : future works necessary to complete Rogun project

- Civil works (TEAS)
  - **General project cost** (mobilizations/demobilization, camps, roads);
  - **Dam works** (dam fills, dam excavations, grout curtain, grouting galleries);
  - **Underground works** (Powerhouse works, hydraulic tunnels, access tunnels).
- Permanent equipment (TEAS)
  - **E&M**: electro and mechanical equipment;
  - **TL/SS**: transmission lines;
  - **HSS**: hydro-mechanical equipment.
- Administration and engineering (TEAS): respectively 3% and 2% of "civil works + permanent equipment" costs
- Operation and Maintenance costs (O&M)
- Environmental and resettlement costs (ESIA)

Cost estimate – Methodology

– Civil works

- Basic wages of labour;
- Basic costs of materials delivered to the site;
- Capital and operating costs of the construction equipment;
- Site construction contingencies;
- Overhead and profits.

– Permanent equipment

- E&M:
  - Based on installed capacity: cost per KW;
  - Evaluating separately turbines, generator ;

    and remaining equipment (balance of plant -BOP).
- HSS:
  - Doesn't depend on installed capacities;
  - Evaluating main components (gates,…)

Cost estimate – Methodology

– Cost estimate does not include:

- Land acquisition and right of way (both permanent and temporary);
- Interests during construction;
- Taxes, duties and levies in Tajikistan, except for the Contractor's income tax.

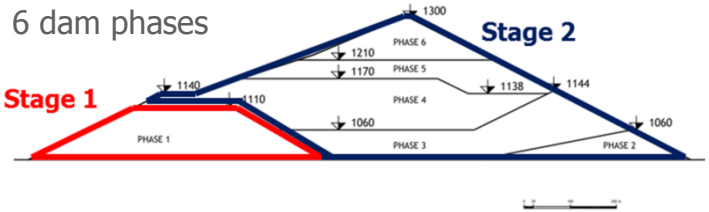
– Physical contingencies are considered:

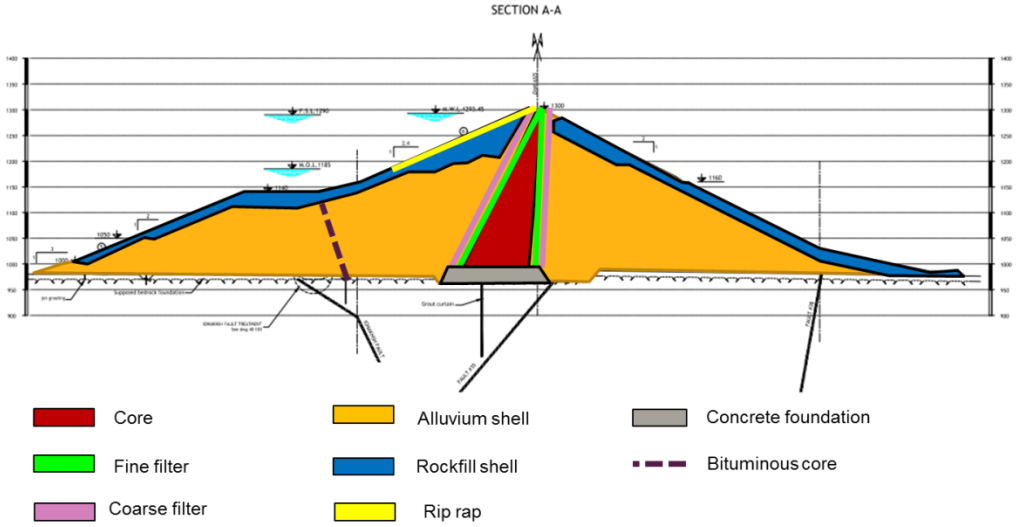
- Analysis performed for each specific item (civil works and permanent equipment);
- Mean value is about 11% of civil works + permanent equipment costs.

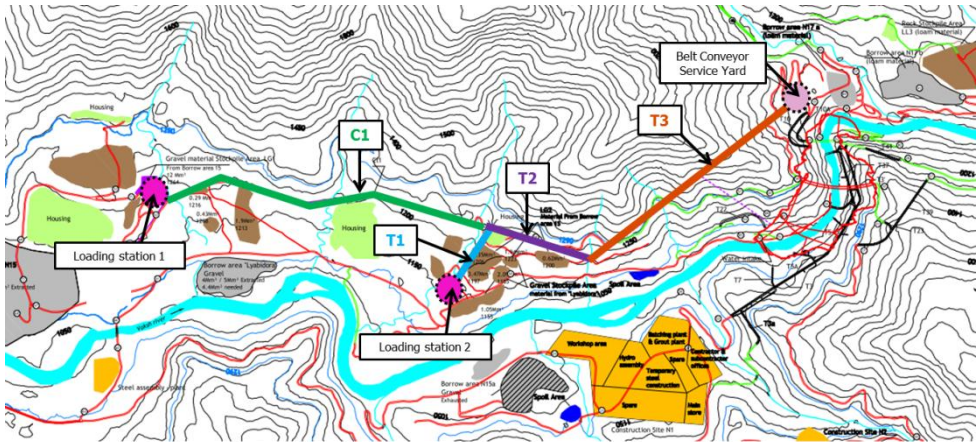
Cost estimate – Dam works evaluation

– Evaluation takes into account:

- Material:
  - Type (rockfill, alluvium shell, core,…)
  - Sources of materials
  - Material stockpiles
  - Conditioning processes
- Ways of transport
  - By trucks /conveyor
  - By roads / tunnels
  - Considered slope and velocities
- Dam phasing (material placement)
  - 6 dam phases







Implementation studies - Conclusion

- Input data for economic and financial analysis are:

– Cost estimate:

  - Total cost of the project;
  - Local and foreign components.

– Implementation schedule:

  - Total duration of construction: between 10 and 13,5 years from TEAS validation and GoT's decision to proceed with the Project;
  - Capex disbursement curve.

THANK YOU FOR YOUR ATTENTION