MOEJ/GEC JCM Feasibility Study (FS) 2014
Summary of the Final Report

"3.7MW Run-of-river hydroelectric project"
(Implementing Entity: Japan NUS Co., Ltd)

1. Overview of the Proposed JCM Project

Study partners	Partner (Host Country): PT. Fajar Futra Energi Toraja (the partner) Taking necessary approvals and authorizations, Cooperation and survey to meet with the purpose of proposer Subcontractor (Japan): NEWJEC Inc. Study and Analysis about this project's feasibility, Report about problems, and Providing Solutions against them, Planning an effective construction plan based on the situation in the field, Subcontractor (Japan): Tohoku Electric Power Co., Inc., Reviewing an operation plan of this project, Proposal of the operation plan for more stable electricity supply, Subcontractor (Host Country): PT. CDM Indonesia Jaya Survey about laws and authorizations that are necessary or need to be noted for the operation, Survey and Coordination for a MRV methodology on the field, Subcontractor (Japan): Japan Quality Assurance Organization, Providing a review about the MRV methodology as a third party. Subcontractor (Japan): TOSHIBA CORPORATION Design of an optimal hydraulic turbine based on river flow, geological features, and geographical features etc. Design and Proposal of a generator and attached facilities.	
Project site	Tana Toraja, South Sulawesi, Indonesia	
Category of project	Renewable Energy	
Description of project	3.7MW Run-of-river hydroelectric project ("the Project") is an electricity sales business from an environmental-friendly small hydroelectric generator in Tana Toraja, South Sulawesi, Indonesia. The present power generation in this region is mainly from fossil fuels, while power shortages are serious issues due to the surging demand of electricity. The Project is capable of contributing a reduction of GHG discharge from the grid electricity, and a stable supply to the region.	
Expected project implementer	Japan	Japan NUS Co., Ltd (The proposer)

	Host country	PT. Fajar Futra Energi Toraja	
Initial investment*	1.8 billion JPY	**Date of groundbreaking***	TBD
Annual maintenance cost*	20 million JPY	**Construction period***	35 months
Willingness to investment*	Investment for minor interest.	**Date of project commencement***	TBD
Financial plan of project*	It is estimated that 30 percent of the initial investment of this project is from this proposer and the partner; the rest 70 percent is from a banking loan of which JANUS will borrow money from Japanese financial institutions. Maintenance and operation fees are planned to be recorded as an operation costs and others from the electricity sales.		
GHG emission reductions*	14,493 t-CO_2/year		

* For changes made after the interim report, their contents and reasons are provided in the following text.

2. Study Contents

(1) Project development and implementation

1) Project planning

- Construction Plan

A construction plan of the project by the partner was reviewed based on the field study. In their original plan, it was assumed to take 24 months for whole construction process from the beginning of expropriation of land to the launch of operation. But the assumed construction plan will take 35 months, about 3 years for whole construction process, 11 months more than original one. We summaries main reviewed articles and principles for process review as following.

Table 1 Main reviewed articles and Principles for process review in the Project Planning

Reviewed articles	Original Plan	Reviewed Plan	Principles for Process review
Expropriation of land	1 months	4 months (+3 months)	・It is estimated that it takes rather about 4 months than 1 month in an original plan to expropriate the construction site.
Design Review	2 months	6 months (+4 months)	・The scope of the work is to complete necessary documents for design and application procedure. ・It is estimated that it could take 6 months to study about geographical conditions alongside of the penstock route, the environment around the power house including a facility design.
Construction of basement and equipment	19 months	21 months (+2 months)	・The completion of an intake weir (including a water intake) is estimated to take 4 months to use the concrete agitator ($4.5m^3$ size) with about $100m^3$/days production capacity, while it takes one day respectively to complete the fundamental structure and the intake weir by concrete. ・The necessary construction period is assumed to be 11 months to fix steel pipes for 1,200m penstock: a conduction pipeline for the hydraulic generator. This period is consisted by the welding period for 2 days/points; 200 steel pipes with 6m length, and the fixation period for 0.5 day/pipe. ・Prior to a rock excavation before the intake weir construction and the penstock fixation, it obliges to finish a measurement and design for penstock's route. Each process takes 1 month. ・The rock excavation takes about 7 months necessarily requiring a further study for size and others. This assumption is flowingly calculated; 9 persons in 3 parties demolish 450m-size rock with $2m^3$/day/party. ・Other construction plan, such as a sedimentation basin, is assumed as a feasible construction term by sizes of facilities.

- Operation Plan

We analyze an operational plan based on acquired information from the operational status and field studies in the hydro power plant run by the partner, and a small-scale 4MW conduit type hydropower plant run for long term. Main operational measures are summarized as follows.

Table 2 Major examination result about operation plan

Operation	Major Examining result (Plan)
Normal Operation	・ Establishment of operation work shift for 24 hours surveillance ・ Preparation for an operation manual ・ Preparation of an operation report format about operational results ・ Taking a time to share operation status (about an hour) between the precedent shift team and the poster one.

	・ Operational logging for Knowledge and Information share in the company. ・ Confirmation practice by manager for operation logs' storage.
Inspection control and Daily Patrol	・ Station of guardians around the facility ・ Circulating Check and Daily Patrol for generator operation status, and ・ maintenance of equipment ・ Documented Confirmation by managers for operation logs' storage.
Periodic examination and Overhaul	・ Annual inspection for severely abrasive parts such as a runner of water-turbine which requires more frequent inspection than usual exterior examining once a few years. ・ Internal inspection for disassembling parts check and parts exchange once a five to six years.
Operation-management manual	・ Confirmation of Shut-down procedure and Operational responsibility to prevent operational dangers such as "" ・ Describing about procedure during the operation, testing methods for equipment, and operational hours' confirmation in the manual. ・ Describing about step-by-step contact procedure and key management to stop, postpone and complete the operation safely.
Operation for emergency	・ Determination of aberrance, then fixing malfunction part if technically and materially feasible, otherwise holding a planning meeting for the recuperation. ・ Immediate start of a maintenance preparation in case of emergency, otherwise holding a maintenance-planning meeting. ・ Immediate report and request for instruction to relevant departments in the case of severe accident during the operation. ・ Report to concerning departments immediately after settling down the situation

- Financial Plan

The project inevitably calls for services of financial institutions due to the size of this business development. Therefore we study mainly 2 options for this project: borrowing money from Indonesian banks, and from Japanese banks.

About Indonesian banking loan, it is assumed to be difficult to use their services due to the stable interest rate hardly fallen to single lower digits (Normally the interest rate for corporate finance is among 10 – 17 %).

About Japanese banking loan, Japanese bank indicates a condition of debt-equity ratio, maximum loan amount, loan currency, necessity of collateral, interest rates for finance, repayment method, and repayment period based on outline and size of the project.

After these studies, the further detailed study for fundraising is required about a borrowing from Japanese banks to the proposer (for subleasing to JV), an investment to JV, and an application of JCM scheme.

- Profitability Analysis

The profitability analysis of the project is practiced based on following assumptions.

The initial investment on the project is 1,800 million JPY, while the operation and maintenance fee is 20 million JPY/ year.[1]

- Challenges of the project

We summaries challenges of the project from the view point of technical term, legal term, and financial term as following table.

[1] This result of the operation and maintenance cost (“O&M cost”) is more conservative profitability analysis compared with the initial result as 10 million JPY/year. Differences are mainly an inclusion to of insurance fee initially as a different cost, and a longer period MRV.

Table 3 Challenges of the project

Article		Challenge
Technical Issues	Fundamental rock of building facilities	A basement of the building couldn't reach to the rock basin based on the current construction plan before our revision, because a candidate point of an intake weir is composed of sand silt; hence Additionally, a candidate point of a power generator is also on a thick layer of sedimentation; Is necessary to study a geological feature by a boring inspection, and strengthen a basement of the building by additional construction, Because the basement couldn't reach to the rock basin based on the current construction plan before our revision neither.
	Landslide of soft ground	An observation of ground-water-level and a stabilization of dam's side slope are necessary, as there is a risk of landslides in rain season if the base is not solid, and a ground-water-level is high.
	Handling boulder	There is a possibility in increasing the construction fee in the case that the building placement and the construction feasible place are limited, and a detouring construction of boulders is difficult. (An increase of the construction fee was considered in the profitability analysis.)
	Annual average flow rate	Calibration and Correction are required by On-Site measurement in dry season for The run-off analysis estimating a flow rate by precipitation data.
	Maximum flood amount of 100-year probability	It is necessary to clarify Maximum Flood Amount of 100-year probability's effects on an intake weir design after renewing high water mark analysis from additive precipitation data logged by the precipitation observatory for longer term data in the vicinity of target site.
Legal Issues	Investment Negative List	It would be difficult for a proposer to be a major investor in the project, as this action is against a compliance with internal corporate rules, unless there is no compromised agreement between proposer and the local partner.
Financial Issues	Accuracy improvement of profitability analysis	There is still a room for improvement of the profitability analysis, as all the technical uncertain elements are unsolved.
	Investment return upon risks	There is a concern about investment return worth taking risks which are geographical and geological risk, additional investment cost to clarify uncertain factor such as flow, and limitation due to Indonesian negative list.

2) Permits and License for the project development and implementation

Permits and Licenses for the project development follows these process; a succinct feasibility study by proposers, a registration of a business development company to the Investment Coordinating Board of Indonesia and the ministry of Justice and Human Rights Affairs, Obtaining the permits for the development, and applying the permission for site development to the governing regency.

After obtaining permits and license, PLN, the purchaser of generating electricity, conducts a due diligence about the operation and fundraising for the project. Subsequently business development permission is necessary from Ministry of Energy and Mineral Resources based on the result of precedent due diligence.

Concerning permits about an environmental subject, it is necessary to have an authorization of UKL-UPL; Program for environmental management and monitoring by the State Ministry of Milieu. In addition the environment impact assessment is not necessary as the size of development is out of its subject.

Currently we are taking permits of above-mentioned process: project development permits by the Investment Coordinating Board of Indonesia, the ministry of Justice and Human Rights Affairs, the governing regency; permits and license from PLN, and the ministry of Energy and Mineral Resources; the authorization by UKL-UPL.

Hereafter it will be necessary to register a Joint Venture Company (the JV) as a foreign direct invested company after the increase of capital from the proposer to the partner. This is due to the proposer's final decision of investment.

The obtained permits and license can be taken over from the SPC founded by the partner to the JV, even

though a local founded SPC turns to be a foreign direct invested company.

After the change of financiers composition, JV can be eligible to obtain a legitimate license as an electricity supplier after 3-step procedures; firstly obtaining a license as a temporary electricity supplier from the ministry of Energy and Mineral Resources, secondly concluding a power purchase agreement with PLN, lastly closing a financial contract with finance institutions.

3) Advantage of Japanese technology

A computational fluid dynamics (CFD) analysis planned to be applied in this project. The CFD analysis is a three-dimensional computer simulation technology about an internal flow rate and pressure of water turbine by the determination of on-site river condition such as a flow rate and a turbine shape of hydropower generator. This technology is expected to contribute an optimized design based on the site condition, and an introduction with high efficiency and low failure risk, while a "ready-made waterpower generator" tends to be exposed to earlier and wider risk such as degradation of power generator and malfunctions, because there are differences between efficient measurement condition and on-site data due to unoptimised water turbine.

The following figure shows a subjective quantitative evaluation about a state-of-art CFD technology in the world wide CFD analysis competition "Turbine99 Workshop".

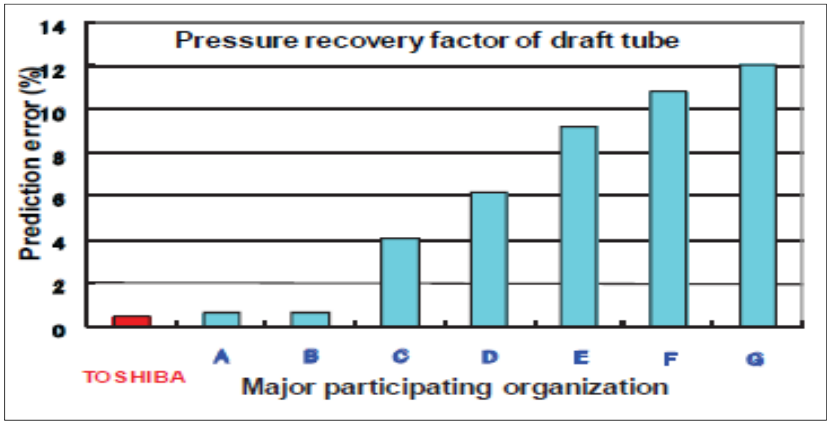

Fig. 1 Comparison with the model test result and the others.

Toshiba, a 3 times winners in a row, shows to have a realization technology with an error range less than 0.5%. The CFD analysis, a mere computer simulation technology, is required to set a baseline model confirmed its technical character by a testing model and a model introduction, then calibrate above mentioned technology. In other words, the accumulation of hydro turbine's introduction experience leads to an accuracy of simulation results water power generator.

4) MRV structure

Parameters required to be monitored in the project are only two: total amount of annual generating electricity (EGy) and a grid emission factor of the electricity grid to which the power generator in the project supplies (EFgrid). The temporal MRV structure is described as follows:

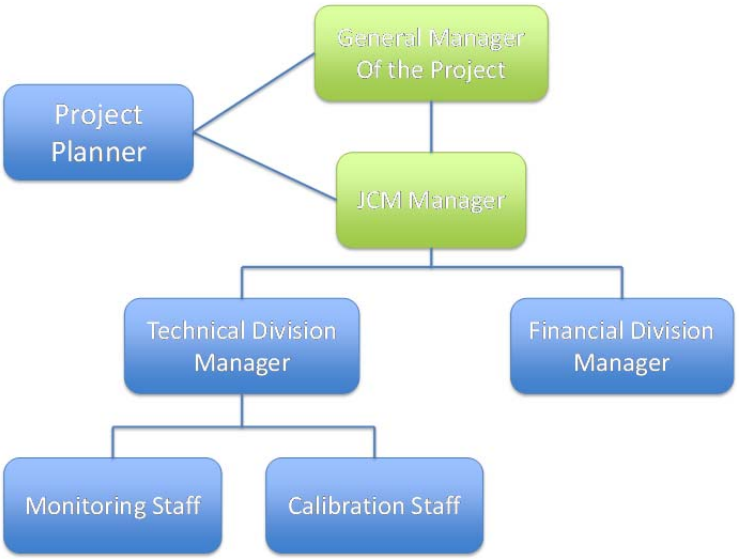

Fig 2　MRV structure（tentative）

Monitoring Staffs in the technical division mainly check the amount data of electricity which is automatically recorded, and the storage condition. Calibration staffs in the technical division calibrate for monitoring devices such as electricity meter based on the national standard (or international standard, or a manual of device's maker). Technical division manager is in charge of the management of these activities. Financial division manages vouchers of electricity sales to PLN which is very important data as the reference for cross check of electricity meter's figure. JCM manager is responsible for covering all these monitoring activities.

The proposer of the project receive and check the original or copied data recorded through monitoring process in order to make monitoring reports. And the proposer also checks another monitoring parameter: a grid emission factor of Indonesian electricity grid time to time as well.

Electricity meters are not necessary for JCM project as its monitoring device, but also essential logging devices for measuring electricity sales to PLN, therefore selected devices will be highly reliable and durable.

From the viewpoint of JCM management, both monitoring data and vouchers of electricity sales for cross check in the project are required to be stored in longer term than those in operation of conventional power stations. Additionally JCM managers and staffs need to note a special care to handle and store those data because of different record media: digital data and paper note, while the data handling and storage manual need to be prepared as well. An educational program for this method seems to be basically held once a year or after post rotation in the organization.

5) Environmental integrity and Sustainable development in host country

This project does not require an Environmental Assessment due to the size of the project. On the other hand, the project needs to be authorized with a practice and a preparation of a program UKL-UPL; Indonesian Environment Management and Environment Monitoring Program based on Indonesian law "Law No. 32, Environmental Protection and Management in 2009". "UKL-UPL" is an environmental management and monitoring program determined by business operator with evaluations and reports every three months based on the determined procedure. This UKL-UPL program has already been officially admitted by the prefectural

environmental department; therefore this project does not impact negatively to the environment. Furthermore JBIC's Guidelines for Confirmation of Environmental and Social Considerations was applied to check the environmental compatibility of this project. It turns out that a run-of-river type water flow hydro power generation system without dam seems to have less negative environmental impact on downstream area or recession areas of the river.

The land utilization by this project is authorized by the content of indigenous people. Upcoming disputes about property will be settled by the relative law and the authorities in order to avoid negative social impacts.

The positive impact on environment and the contribution to a sustainable growth is to substitute renewable electricity for electricity grid to cut the Green House Gas emission, improve the electricity quality, and support individual and business development. Electricity is perceived as a fundamental infrastructure to satisfy a basic human need, an inclusive growth, and poverty reduction. This project expects to contribute significantly to the development of host country by the electricity business in Sulawesi where the infrastructure of the island still needs a further development rather than other islands in Indonesia.

6) Toward project realization (planned schedule and possible obstacles to be overcome)

According to this JCM F/S for the project, the following conclusions come out.

First, there is a concern about the increase of construction fee from the review of partner's precedent study. This is due to two reasons: further detail study for the river flow and the geographic character of the project site. This result sheds light on the difference of approach between the proposer and the partner. In detail, the proposer intends to minimize the risk of the project by all available measure, while the partner is willing to minimize the amount of expense for further study and constructions.

Secondly the proposer is obliged to be a minor investor to the SPC for the project, as a major investment to SPC from the proposer can be contrary to neither Indonesian negative list nor the proposer's corporate compliance. The limitation to the proposer's investment choice is against the partner's expectation, accordingly the partner require the proposer of following: a present clarification of firm commitment to the project, and an acceptance of the proposer's business initiative. These requirements are inacceptable for the proposer.

Consequently it is necessary to settle these arguments regarding two parties' business approach.

(2) JCM methodology development

1) Eligibility criteria

Eligibility criteria are selected as a quantifiable and consistent indicator through our meticulous study as following table.

Table 4 Eligibility Criteria of MRV Methodology

Criteria 1	The hydraulic power generation system in the project ought to be a conduit type hydropower plant. Additionally this methodology is applied to a new hydropower project.
Criteria 2	Electricity supply in the project is obliged to be a distribution through national grids or regional grids, or a distribution to facilities of specific electricity consumers, or a distribution through national/regional grids defined in the contract of Electric Power Consignment.
Criteria 3	The hydraulic head of power generator in the project ought to be optimized through CFD analysis.

2) Calculation of GHG emissions (including reference and project emissions)

Reference emissions are calculated on the basis of net project electricity generation that replaces the import of grid electricity to the cement factory where the project is implemented.

$$RE_y = EG_y * EF_{grid}$$

Where,

REy =	Reference emissions in year y (t CO_2/year)
EGy =	The quantity of net electricity generated by the project which is supplied to the grid in year y (MWh/year)
EFgrid =	CO2 emission factor for the regional grid in Indonesia which is connected by the project (tCO_2/MWh)

A planned installed capacity: 3.585MW is a sum of 2 installed hydraulic power generators: respectively 2.457MW and 1.128MW taking account into the difference of river flow between the rainy season and the dry season. An estimated annual operation rate is 65 %.

Thus EGy is calculated as follows:

EGy = 3.585(MW)×24×365×0.65 = 20,413 (MW/year)

Based on the proposed MRVmethodology, We apply the EFgrid rate as the Ex-ante = 0.710 (tCO_2/MWh). Hence REy is calculated as follows:

REy =	EGy × EFgrid
=	20,413 (MW/year) × 0.710 (tCO_2/MWh)
=	14,493 (tCO_2/year)

There is no project emission in the project. Thus in the project, Emission reductions are calculated as 14,493 tCO_2／year.

3) Data and parameters fixed *ex ante*

At the beginning of this project, *ex ante* was estimated to be a CO_2 emission factor for the regional grid in Indonesia which is connected by the project. Third party, however, indicated that this factor was inappropriate due to its variance on the time of project launch, and in the midst of operation.

Therefore there is no CO_2 emission factor before launch of the project, a CO_2 emission factor for the regional grid is determined as one of parameters.