THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

JEPIC

Annex-XVI : Hidden Hydro Opportunities

Present Status of "Hidden Hydro Opportunities" Development in Japan

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Shuhei TAKEGAWA

Japan Electric Power Information Center, Inc.

Contents

1. Tasks of Annex-XVI “Hidden Hydro Opportunities”

The work plan will be subdivided into 4 Tasks.

Subtask 1. Updating Hydropower Inventories

Subtask 2. Improving Performance from Existing Hydropower

Subtask 3. Adding Power to “Non-power Dams” and Water Management Facilities

Subtask 4. Hydropower Technology Research and Innovation in the context of Hidden Hydropower Opportunities

2. Case Studies for Subtask.2 in Japan

Subtask.2 : Improving performance from Existing Hydropower

Case 1. Expansion of Equipment

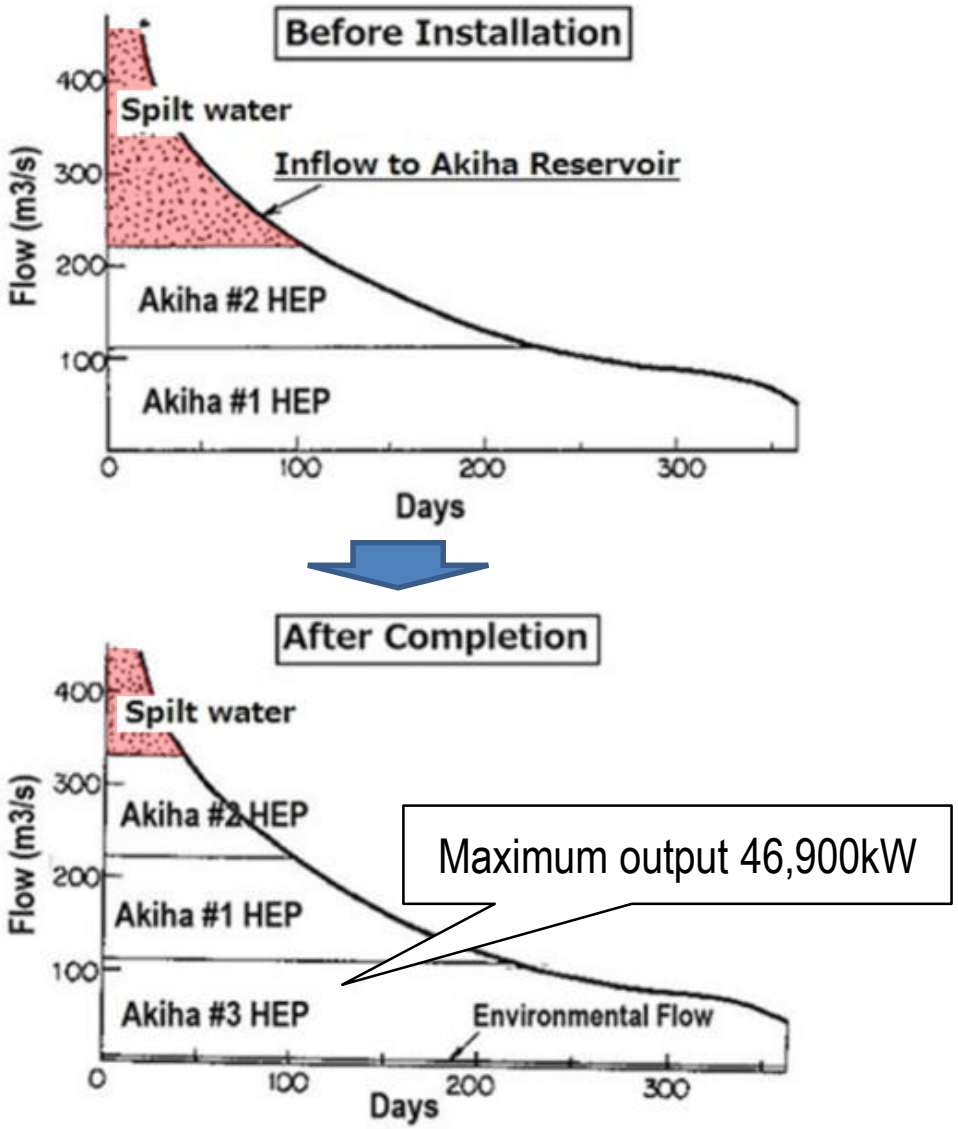
Case 2. Improvement of Dam

Case 3. Improvement of Power Plant Operation and Diversion

Case 4. Optimized output by water diversion between existing hydropower plants

Case 1. Expansion of Equipment

- Effective utilization of spilt flow from the existing dam by adding small hydropower plant -

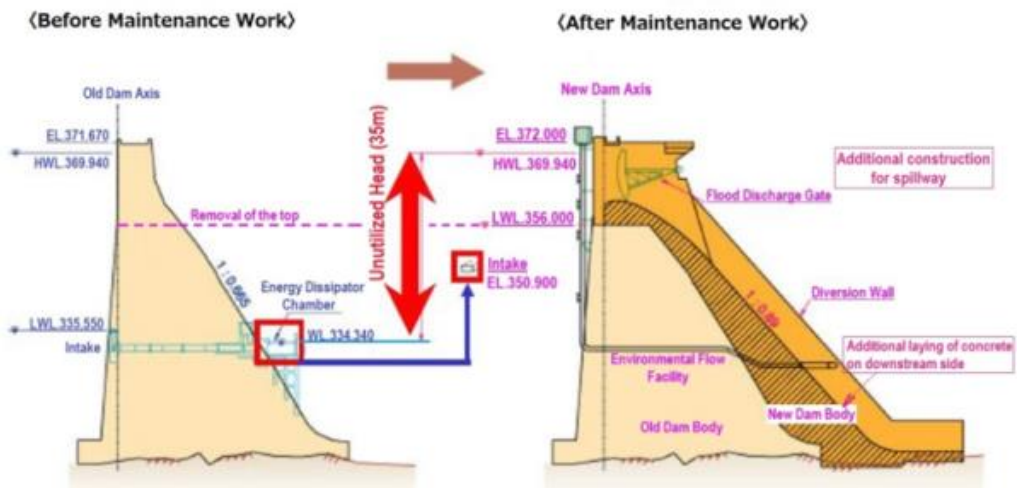


The small hydropower plant is installed to produce the maximum hydropower by utilizing the overflow, occurred approximately 100 days a year from existing dam.

Equipment of Akiha #3 Hydro Power Plant

Turbine	Type	(Main Turbine) Vertical shaft, Francis	(Small Turbine) Horizontal shaft, Francis
	Output	46,500kW	1,800kW
	Unit No.	1	1
Generator	Type	(Main Generator) Vertical shaft, 3 phase Synchronous	(Small Generator) Horizontal shaft, 3 phase Synchronous
	Capacity	47,600KVA	1,700KVA
	Unit No.	1	1

Case 2. Improvement of Dam



Schematic Diagrams of Dam's maintenance work

Item	Before maintenance work	After maintenance work
Type	Concrete gravity dam	Concrete gravity dam
Dam height	62.10 m	62.43 m
Crest length	35.15 m	39.50 m
Dam volume	31,000 m³	45,000 m³
Effective storage capacity	12,995,000 m³	7,490,000 m³
Flood control capacity	720 m³/s	1,610 m³/s
Flood control method	Tunnel-type spillway: 720 m³/s	Tunnel-type spillway: 720 m³/s Overflow-type spillway: 890 m³/s

	Before redevelopment	After redevelopment	
Power plant name	Taishakugawa Power Station	Shin-Taishakugawa Power Station	Taishakugawa Power Station
Name of the water system / river	Taishakugawa River and Fukumasugawa River in the Takahashigawa River system	Taishakugawa River in the Takahashigawa River system	Fukumasugawa River in the Takahashigawa River system
Maximum output	4,400 kW ⇨	11,000 kW	2,400 kW
Maximum discharge	5.7 m³/s	10.0 m³/s	3.1 m³/s
Effective head	95.17 m	129.0 m	95.17 m
Power generation type	Reservoir type / dam canal type	Reservoir type / dam canal type	Run-of-river type / canal type

Photo 1: Before maintenance

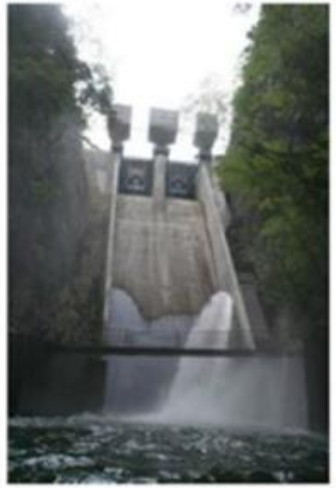
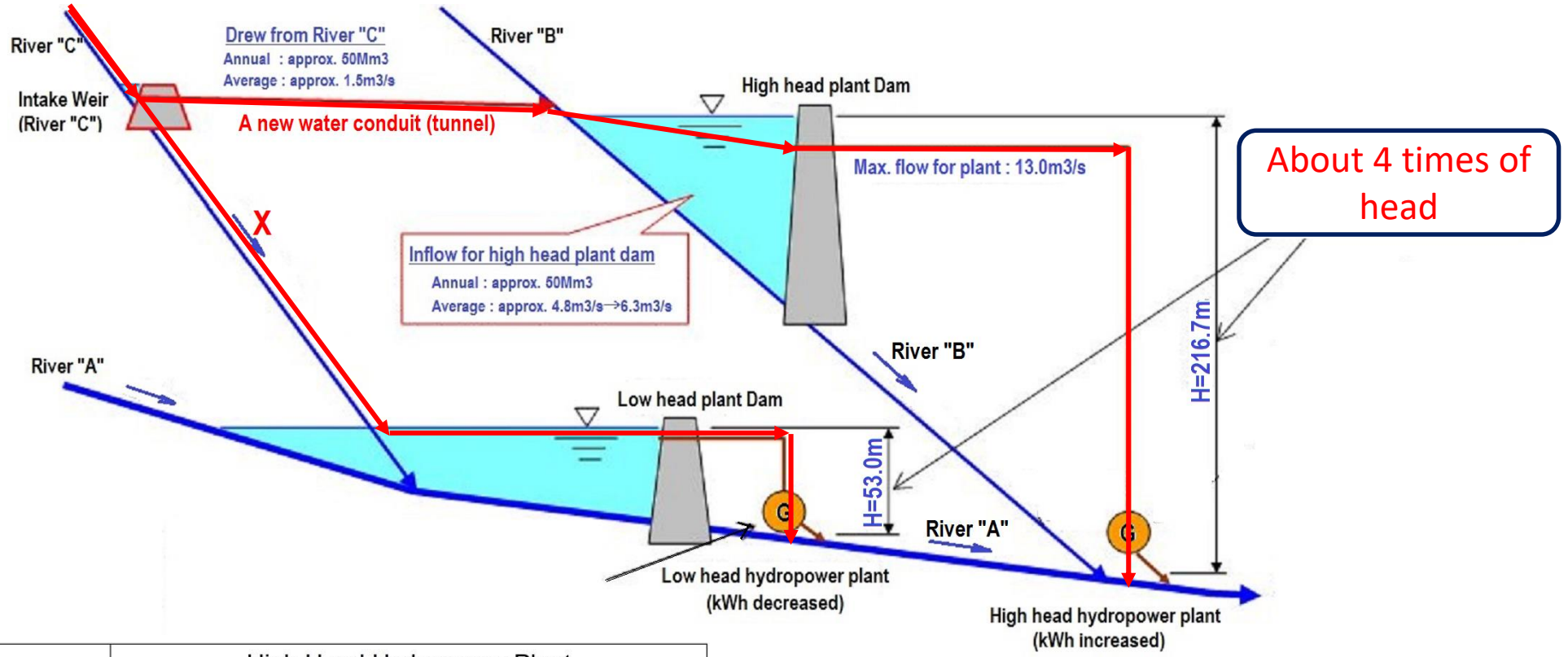


Photo 2: After maintenance

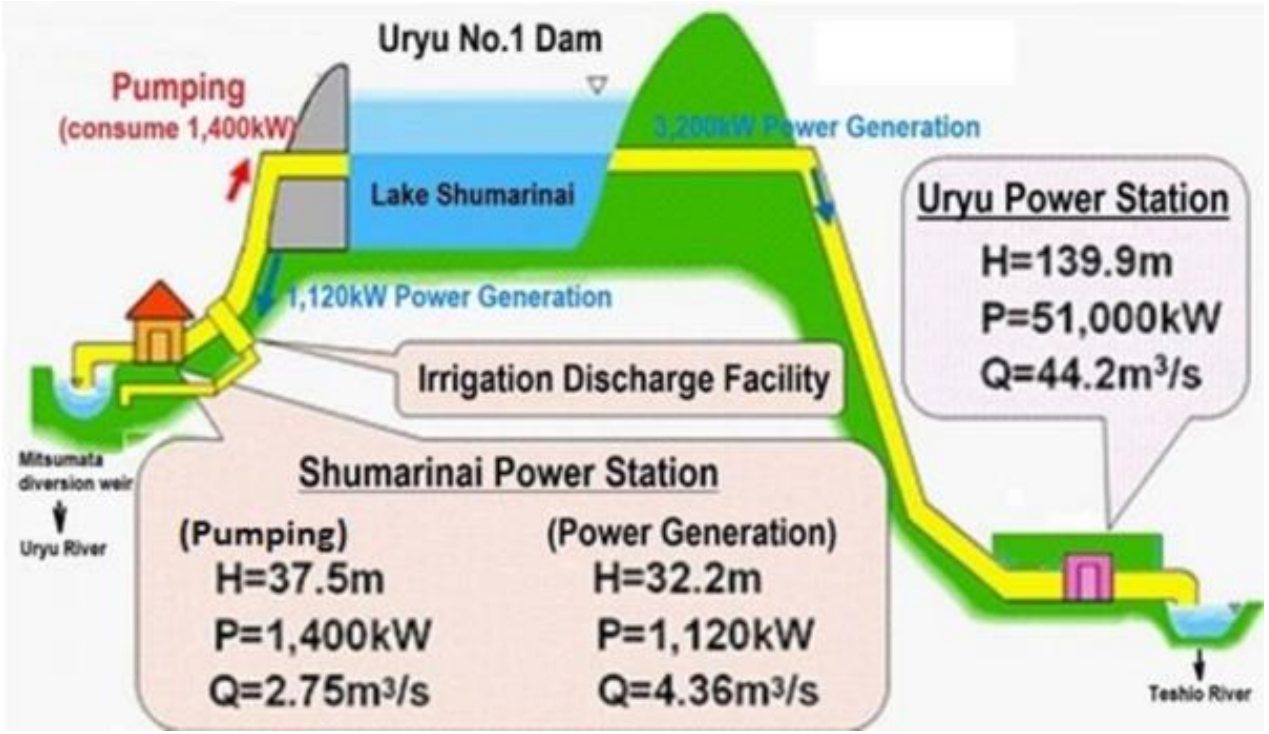
Case 3. Increased output from existing hydropower plants based on raised water levels or changes



Items	High Head Hydropower Plant	
	Original	After providing a new water tunnel
Max. Output(kW)	24,200	24,200
Max. Turbine Flow (m^3/s)	13.0	The same flow with original (Max. drawing flow from "River C": 5.6m^3/s)
Effective Head(m)	216.7	216.7
Annual Power Generation (GWh)	Approx.71	Approx.94 (Increased GWh : approx.17)

Increased power generation for high head hydropower plant
Approx. 17GWh
(Before : approx. 71GWh, After : approx. 94GWh)

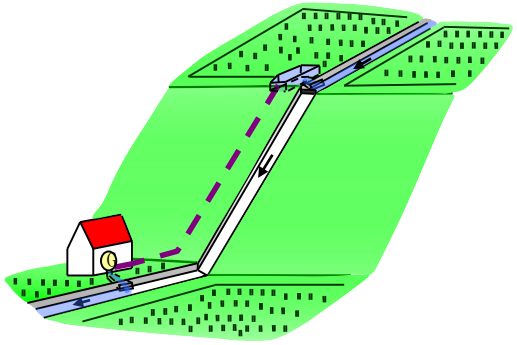
Case 4. Optimized output by water diversion between existing hydropower plants



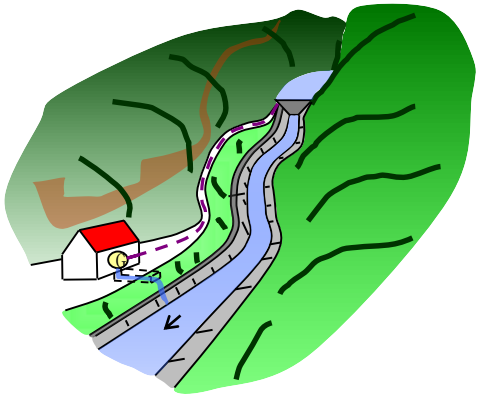
- The Shumarinai Power Plant generates the power by utilizing the irrigation discharge from the upper dam(Shumarinai Lake) during the irrigation period.
- In the non-irrigation period, the river water flowing into the lower dam is pumped to the upper dam and is fed to Uryu Hydropower Plant having a higher potential energy than Shumarinai Power Plant.

3. Case Studies for Subtask.3 in Japan

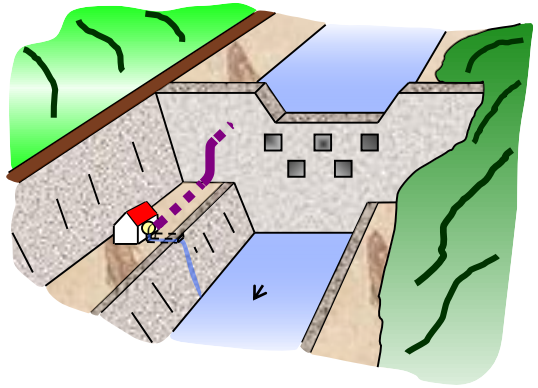
Subtask.3 Adding Power to “Non-powered Dams” and Water Management Facilities



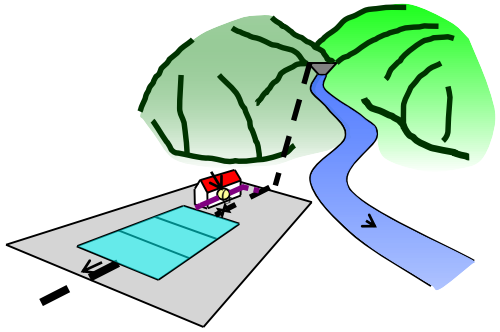
Case 1. Irrigation Waterways



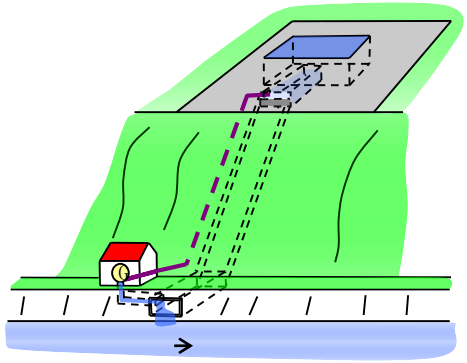
Case 2. Water Flow from Agricultural & Multi-purpose Dams



Case 3. Water Flow from Check Dams

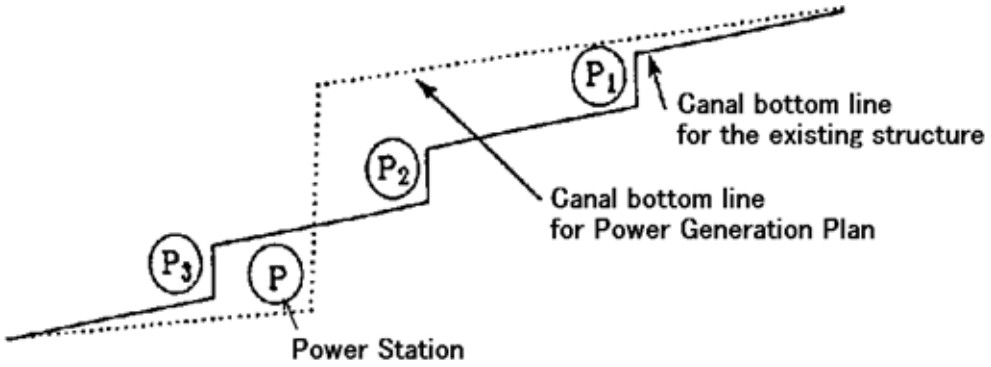


Case 4. Water Works



Case 5. Sewage Plants

Case 1. Cascade Micro Hydro Generating System in Irrigation Waterways



Items	Specification
Flow	Irrigation period : 2.4 m^3/s Non-irrigation period : 1.3 m^3/s
Head	2.0 m
Turbine Type	Kaplan, Vertical
Max. Output	30kW/Unit

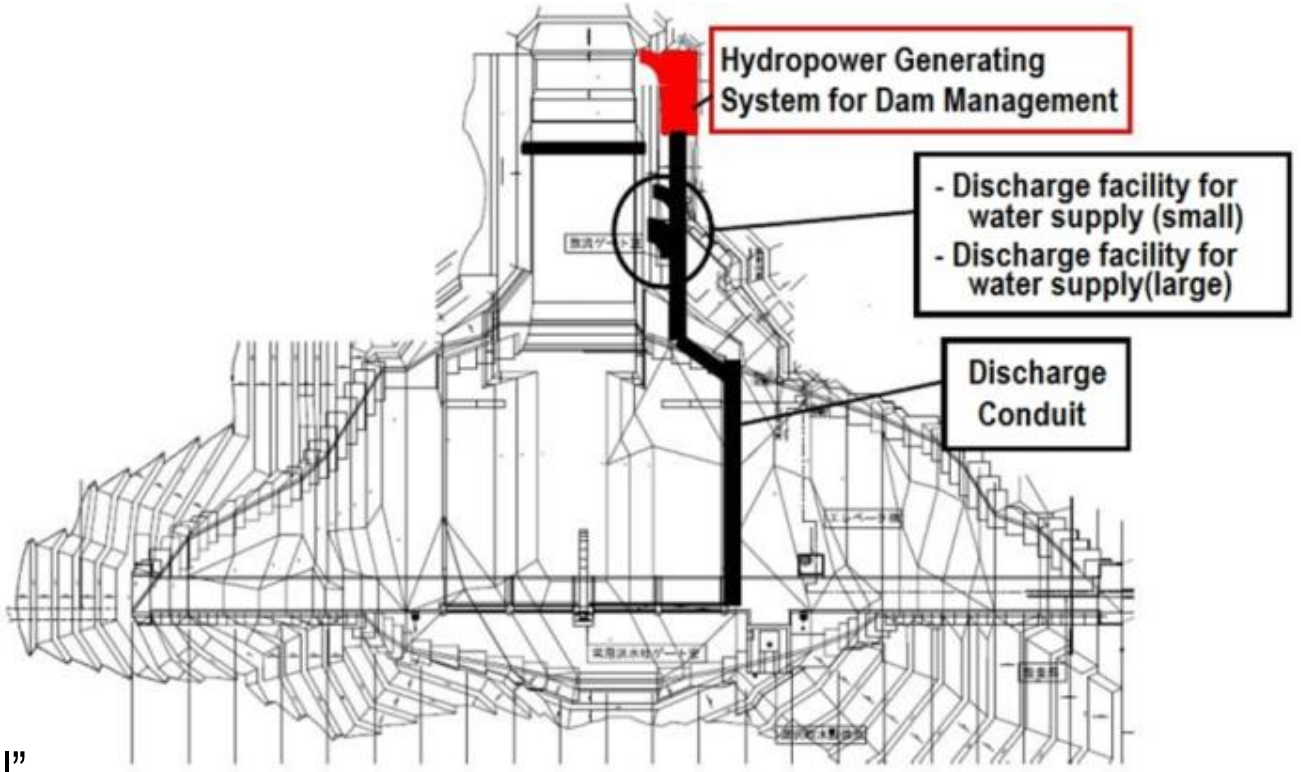
4 units are installed on the same irrigation waterways without changing the structure of the irrigation waterways.

Case 2. Small Hydropower Plant installed in Water Supply Dam

Yunishikawa Dam
Dam height : 119m
Crest length : 320m
Storage capacity : 75million m^3

Yunishikawa Dam is used for “water supply “, “flood control”, "maintenance for function of flow".

At Yunishikawa Dam, the environmental flow of 0.54 m^3/s flow must be discharged constantly in order to maintain the normal function of river water.
Environmental flow is used to generate the hydropower for dam management.

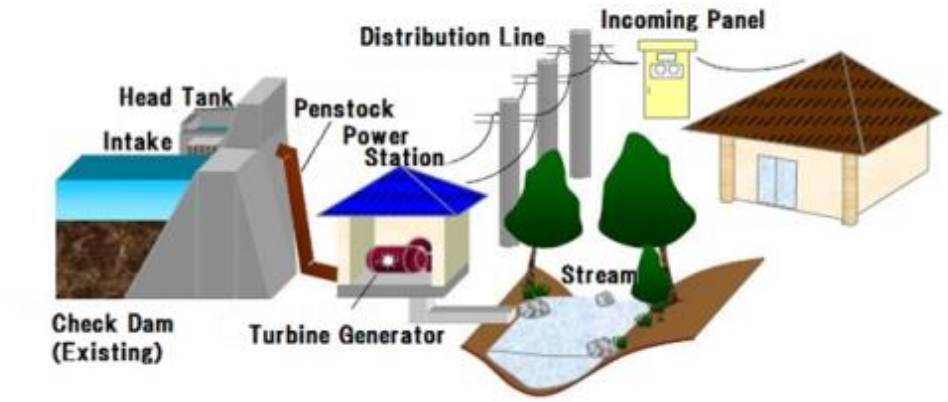


(Source) Kanto Regional Development Bureau, MLIT

Case .3 Hydropower Plant Installed in Check Dams

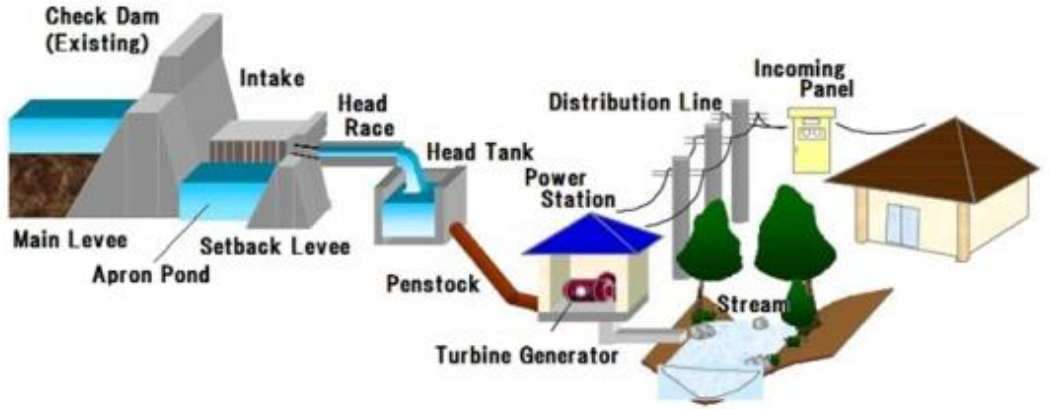
Power Generation Method

(A) Installed beside Check Dam

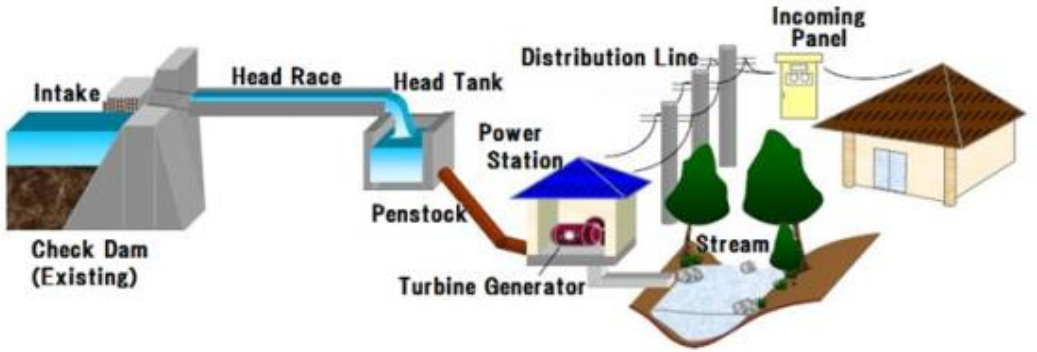


(B) Conveyed by Head Race

(B-1) Water taken from Apron Pond

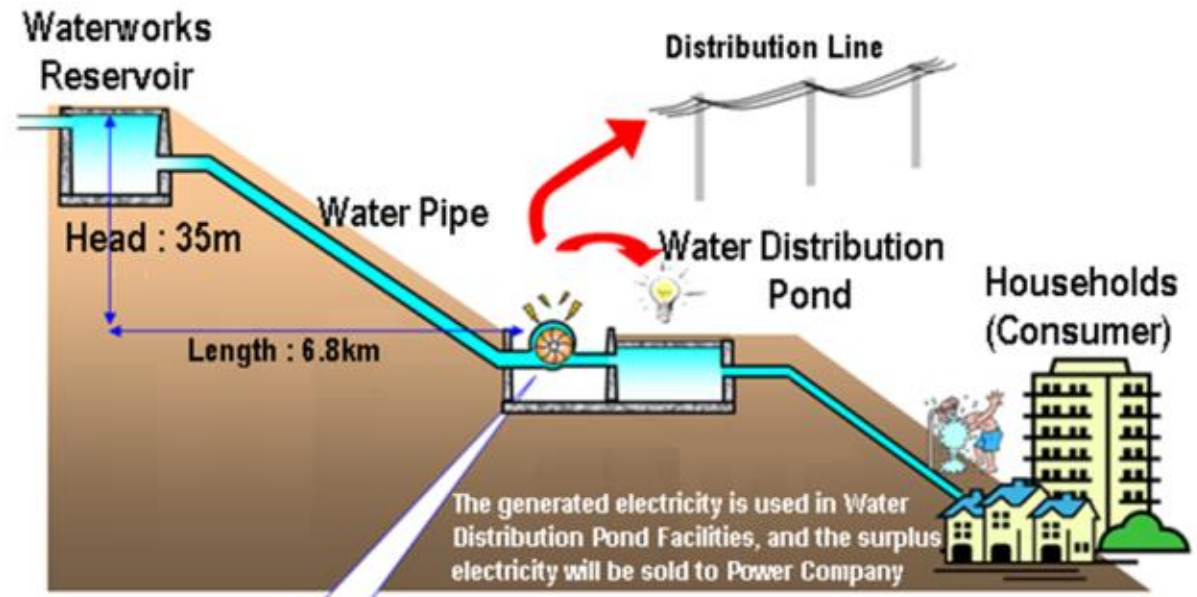


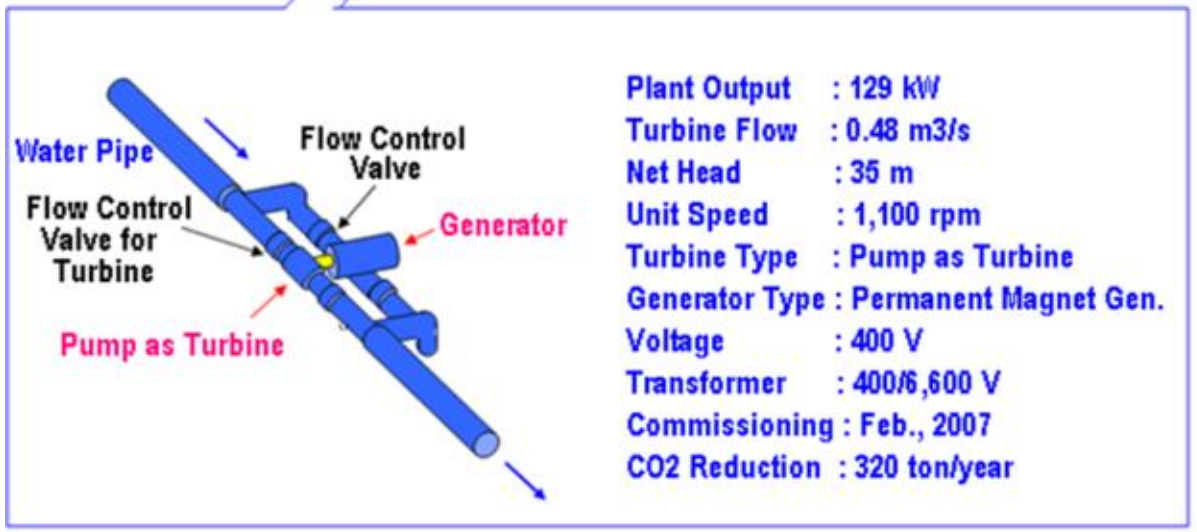
(B-2) Water taken from Main Bank

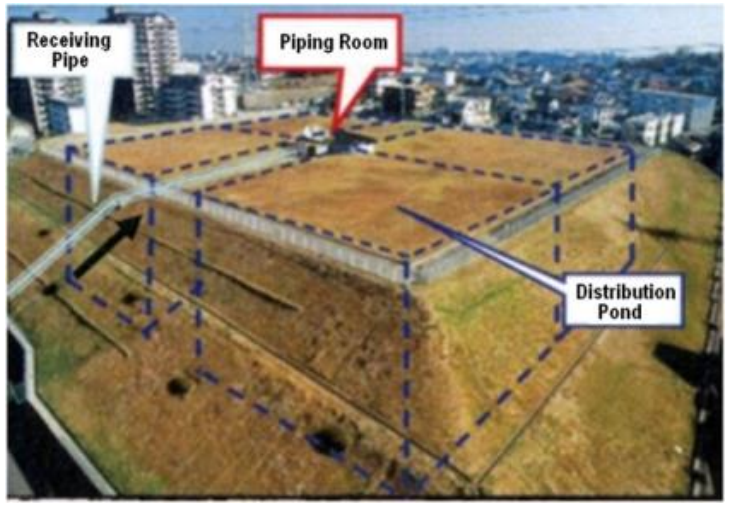


(Source)Guide line of small hydropower generation utilizing existing check dam (Ministry of Land, Infrastructure, Transport and Tourism)

Case 4. Micro Hydropower Unit in Water Distribution Line



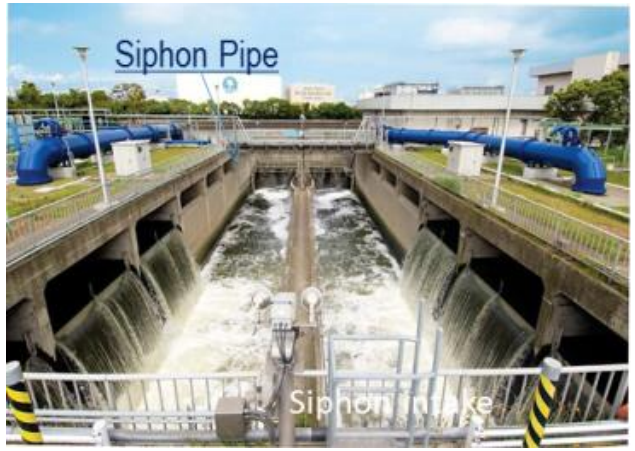




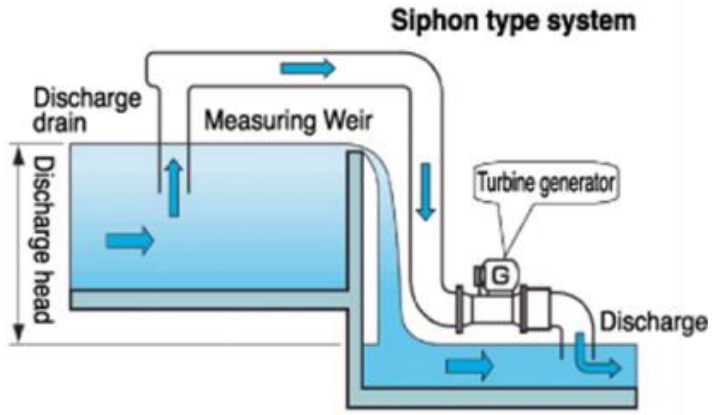
Outline of Distribution Pond

Out view of Piping Room (Generating Room)

Case 5. Micro Hydro Unit in Sewage Water Treatment Center



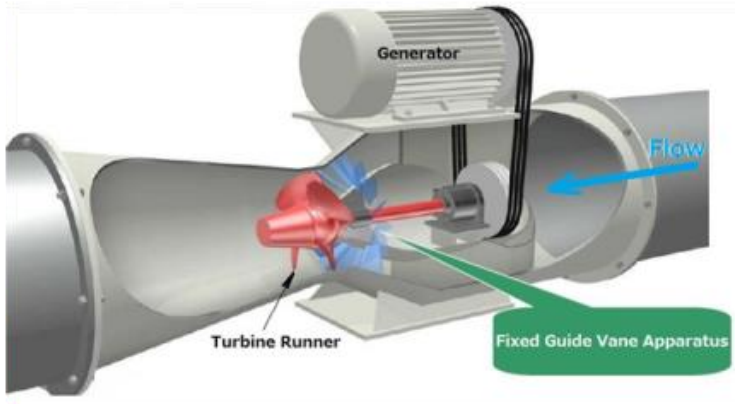
Siphon type Intake System for turbine installed on Discharge Drain



Skeleton of Micro Hydro Unit

Hg=2.5(m), Q=2.5(m^3/s), P=47.5(kW), 2 Units

Hg=2.0(m), Q=0.3(m^3/s), P=4(kW), 1 Unit



Turbine Construction

Annual Output : 800,000(kWh), Annual CO_2 Gas Reduction : 300(tons)

(Source) Bureau of Sewerage Tokyo Metropolitan Government

Thank you for your kind attention

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