

**Key Issues:** 10- Landscape and Cultural Heritage  
11-Benefits due to Power Generation

**Climatic Zone:**

Cf: Temperate humid climate

**Subjects:**

- Landscape designing in harmony with the surroundings

**Effects:**

- Harmony with the surroundings

**Project Name:** Six Power Plants in the Kurobe River

**Country :** Toyama Pref., Japan (Asia)  
(N 36° 54' E 137° 32')



**Implementing Party & Period**

- **Project:** Hokuriku Electric Power Company  
1990 (Commencement of construction) -
- **Good Practice:** Hokuriku Electric Power Company  
1990 -

**Keywords:**

Redevelopment of hydroelectric generating plants, Landscape design, harmony, GOOD DESIGN AWARD

**Abstract :**

Hokuriku Electric Power Company implemented a design of powerhouses on redevelopment of 6 hydropower plants the Kurobe River in harmony with the surroundings. As a result, we got "The GOOD DESIGN AWARD " for the Kokutou Power Plant No. 3.

**1. Outline of the Project**

Hokuriku Electric Power Company closed six power plants, the Kurobe River Power Plant No. 1 to No. 6, located along the Kurobe River in the Kurobe River system, and carried out a redevelopment project, which involved the new construction of the Kokusei Power Plant No. 1 to No. 3 and the Kokutou Power Plant No. 1 to No. 3.

The Project located in the lower reaches of the Kurobe River, used the main irrigation channel that conveyed water taken in from the Aimoto Dam located approximately 14 km upstream from the estuary.

The special features of the recent redevelopment project include;

- 1) The combined maximum output of six power plants increased by about 5,000 kW from 28,230 kW to 33,200 kW, for example, to the revision of the maximum discharge and improved turbine efficiency.
- 2) While six power plants used a total of 13 units of equipment including water wheels and generators, the new plants use a single power plant each (thus, six units in total), which helped reduce the cost.
- 3) The design of each power plant building focused

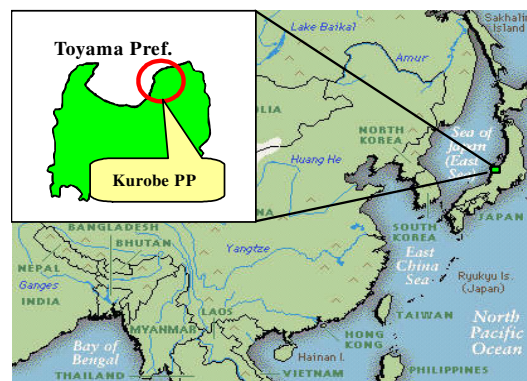


Fig. 1 Locations of Downstream Power Plants in the Kurobe River

on harmony with the surrounding landscape  
The Project was construed in 1990 and was completed in 1993 to coincide with the full-scale renovation of the main irrigation water channel undertaken by the Hokuriku Agricultural Administration Office of the Ministry of Agriculture, Forestry and Fisheries.  
Fig. 1 shows the locations of power plants, Fig. 2 shows the conditions around the project site, and Table 1 shows main specifications for old and new power plants.

Table 1 Main Specifications for Old and New Power Plants

**Old power plants (Combined output: 28,230 kW)**

Power plant	Left bank						Right bank					
	Kurobe Power No. 4	River Plant	Kurobe Power No. 5	River Plant	Kurobe Power No. 6	River Plant	Kurobe Power No. 3	River Plant	Kurobe Power No. 1	River Plant	Kurobe Power No. 2	River Plant
Maximum discharge (m <sup>3</sup> /S)	18.64		8.90		11.13		52.87		35.06		33.95	
Effective head (m)	41.52		21.21		13.93		12.12		27.27		23.03	
Maximum output (kW)	6,300		1,490		1,210		5,140		7,760		6,330	

**New power plants (Combined output: 33,200 kW)**

Power plant	Left bank						Right bank					
	Kokusei Power No. 1	Plant	Kokusei Power No. 2	Plant	Kokusei Power No. 3	Plant	Kokutou Power No. 1	Plant	Kokutou Power No. 2	Plant	Kokutou Power No. 3	Plant
Maximum discharge (m <sup>3</sup> /S)	18.64		13.00		13.00		52.87		43.00		36.00	
Effective head (m)	43.50		20.80		13.20		12.10		28.80		23.80	
Maximum output (kW)	6,800		2,200		1,300		5,300		10,400		7,200	

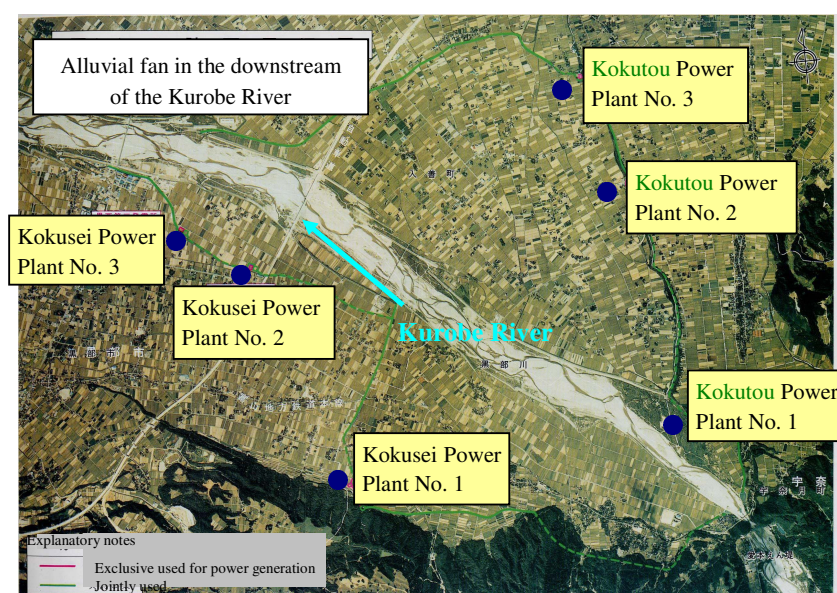


Fig. 2 Area around the Project Site

## 2. Features of the Project Area

The Kurobe River, which originates in Mt. Washiadake (2,924 m) located in the center of the North Japan Alps, flows through the eastern part of Toyama Prefecture and pours into the Toyama Bay, is one of the largest rivers in the Hokuriku region, with a catchment area of 682 km<sup>2</sup> and a total channel length of 85 km. The river runs between the steep Tateyama Mountain Range and Ushiro Tateyama Mountain Range, gathering numerous tributaries, and reaches a plain at the Aimoto Dam point, approximately 14 km upstream from the estuary, and forms an alluvial fan while it flows further downstream.

The area around the project site is made up of alluvial and diluvial deposits formed by the Kurobe River. A typical dissected fan of almost 60 degrees with a radius of 12 to 14 km, has its apex in Aimoto in Unazuki-machi. Here, the Kurobe River runs wide and extensive paddy fields are dotted with rural settlements.

Since the project area spreads across three municipalities, the Kurobe City, Unazuki-machi and Nyuzen-machi, consultation and coordination with many groups including local governments and communities and bodies representing land improvement zones were necessary prior to project start. Since peaceful flatland farming areas were selected as the locations for the power plants, unlike hydroelectric power plants constructed in mountains, much design effort was put into creating harmony with the surroundings, while ensuring consideration for the surroundings during construction work, for example, by minimizing the emission of noise, dust and turbid water.

## 3. Major Impacts

Hokuriku Electric Power Company carried out environmental impact assessment on vegetation, animals, water quality and other relevant items prior to the start of the redevelopment project. The results of the assessment indicated that since the redevelopment involved no large-scale renovations, the project would have little effect on animals and plants in the area around the project site.

All the power plants are set in rural landscape, surrounded by arable lands, and the powerhouse buildings, over 60 plus years since the start of operations, have come to blend well with the surrounding landscape. The redevelopment of these power plants, therefore, took into consideration the characteristics of the landscape surrounding each power plant shown in Table 2, in order to ensure the preservation and harmony with the surrounding landscape.

Table 2 Characteristics of the Landscape Surrounding Each Power Plant

Power plant	Characteristics of the landscape surrounding each power plant
Kokusei Power Plant No. 1	• Cultivated paddy fields are dotted with gable-roofed or Japanese tile-roofed private houses.
Kokusei Power Plant No. 2 and No. 3	• Located amidst cultivated paddy fields, away from private houses, neighbored by a national highway and the Hokuriku Expressway
Kokutou Power Plant No. 1	• Backed by a monotonous terraced forest, surrounded by a sports park and neighbored by the park's management office
Kokutou Power Plant No. 2	• Neighbored by the Kurobe Electric Power Office (electric power management office) and a switching station
Kokutou Power Plant No. 3	• The neighboring Kurobe River Power Plant No. 2 will be left as it is

## 4. Mitigations Measures

The design of each power plant building focused on harmony with the surrounding landscape. The following points were noted for each power plant.

### 4.1 Kokutou Power Plant No. 3

The Kokutou Power Plant No. 3 was developed next to the Kurobe River Power Plant No. 2. Since it had been planned by the local Nyuzen-machi municipality to use the old power plant building as a museum, the exterior of the new power plant building was made to resemble that of the old power

plant building to create an impression as if the two buildings were built as a pair. More specifically, effort was spent on reproducing, as closely as possible, the shapes of the roof (gabled monitor roof) and external wall of the old building.

The brick masonry external walls of the old power plant have the appearance of having been worn and stained naturally over many years. However, building brick masonry walls is extremely difficult today due to a sharp increase in construction cost and lack of workmanship. These circumstances made it necessary to use a spraying finish to produce what appear to be brick-wall joints on the external walls of the new power plant made of reinforced concrete. The selection of the finish color involved the selection of seven basic colors of bricks used for the old power plant, the preparation of mixed color samples, the open exposure of these samples for a few months, and the selection of the color that most resembled the brick color of the old power plant building. The ornaments at roof corners, shapes of external openings and shapes of columns were also made to resemble those of the old power plant building. The Kokutou Power Plant No.3 was completed in 1993.



Photo 1 Area around the Kokutou Power Plant No. 3 (Old Power Plant Building on the Left and New Power Plant Building on the Right)

#### 4.2 Kokusei Power Plant No. 1

Since the old power plant (Kurobe River Power Plant No. 4 ) has been popularly known for its gabled roof in the local community, the style was re-created using gabled roof and Japanese tiled roof to ensure design that is compatible with the private houses in the surrounding area. The Kokusei Power Plant No.1 was completed in 1992.



Photo 2 Area around the Kokusei Power Plant No. 1



Photo 3 Kokusei Power Plant No. 1



#### 4.3 Kokusei Power Plant No. 2 and No. 3

Since these power plants are situated in locations that can be viewed from the Hokuriku Expressway and other roads in the area, a stripe design was painted on the surge tank to ensure harmony with the power plant building. With regard to the power plant building, on the other hand, design effort was put into creating an enlivened image, using large windows high up in the building and a simple flat roof. The Kokusei Power Plant No.2 and No.3 were completed in 1992.



Photo 4 Kokusei Power Plant No. 2



Photo 5 Kokusei Power Plant No. 3

#### 4.4 Kokutou Power Plant No. 1

A streamlined design was used for the building to create a sense of unity with the neighboring park management office (with a flat roof). (The power plant building is pointed with an arrow.) The Kokutou Power Plant NO.1 was completed in 1993.



Photo 6 Area around the Kokutou Power Plant No. 1

#### 4.5 Kokutou Power Plant No. 2

A neat building exterior was created to achieve an overall balance with other structures including the old power generating facilities and to serve as the local symbol. (The power plant building is pointed with an arrow.) The Kokutou Power Plant No.2 was completed in 1993.

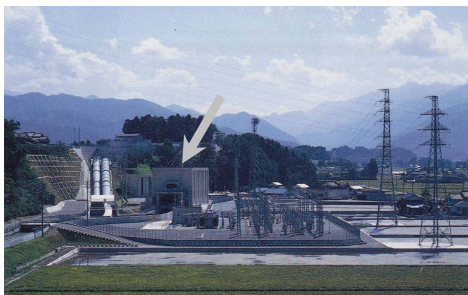


Photo 7 Area around the Kokutou Power Plant No. 2



Photo 8 Kokutou Power Plant No. 2

## 5. Results of Mitigation Measures

The power plant building in each location is considered to be successfully harmonizing with the surroundings. Particularly regarding the Kokutou Power Plant No. 3 neighbored by the old power plant (Kurobe River Power Plant No. 2), the new and old buildings, creating a sense of unity, blend perfectly with the surrounding landscape. Moreover, penstocks at new and old power plants as well as head tanks and other facilities in the back of new and old power plant sites are respectively located next to each other, thus looking as if the old power plant that reached the end of its service life is watching over the new power plant.

The local Nyuzen-machi municipality rebuilt the interior of the old power plant to use the building as the Nizayama Forest Art Museum (Nyuzen-machi). The gallery houses water wheels, generators and control panels and other equipment used in the old power plant, thus capturing the atmosphere of what it was like in the old power plant. The coexistence of the new power plant and the old power plant used by local communities seems an excellent example of hydroelectric redevelopment.

The Kokutou Power Plant No. 3 received the GOOD DESIGN AWARD for its facility design in 1994 from the then Ministry of International Trade and Industry.

## 6. Reasons for Success

A major factor for success is considered to be building designing in consideration of the landscape at each power plant point from an early design stage.

The success of the redevelopment of the Kokutou Power Plant No. 3 is attributed to two factors; first, the local municipality was committed to the vision of redeveloping and effectively using the entire old power plant, instead of simply regarding the hydroelectric redevelopment project as something that only concerns the electric power company, and second, the electric power company showed sincerity in responding to the request from the local municipality and made sure that the request be reflected on the project from the planning stage.

## 7. Outside Comments

The GOOD DESIGN AWARD (P facility class in 1994) of the then Ministry of International Trade and Industry was granted (Award No. 94P0880). The award was the recognition of the excellent design that created a strong sense of unity between the two facilities.

### GOOD DESIGN AWARD

The GOOD DESIGN AWARD established in 1957 by the then Ministry of International Trade and Industry is the only system in Japan for general design assessment and recommendation that was developed from the Good Design Product Selection System. The candidate products for the GOOD DESIGN AWARD are extremely diverse, ranging from products for personal and home use to production and energy related facilities at plants and training centers. The awarded products are allowed to use the G-Mark. G-Mark -- a recognition of high quality, user friendliness or an excellent sense of balance achieved by a product -- is socially regarded highly.

## 8. Further Information

### 8.1 References

- 1) Takashi INAMOTO and Hideaki WAKABAYASHI: Overview of New Construction of the Kokusei Power Plant No. 1 to No. 3 and the Kokutou Power Plant No. 1 to No. 3, Japan Electric Power Civil Engineering Association, January 1992
- 2) Home page address of the Nizayama Forest Art Museum, Nyuzen-machi : <http://www.town.nyuzen.Toyama.jp/nizayama/>

### 8.2 Inquiries

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