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# Water quality

## Yacyretá Power Scheme, Argentina & Paraguay

Timely changes to spillway operation protocols at the Yacyretá Power Scheme on the Argentinean/Paraguayan border provided short-term alleviation from the acute impacts of dissolved gas supersaturation until modifications to spillway geometry were complete.

### Overview

The Yacyretá scheme is located approximately 1000 km north of Buenos Aires on the Paraná River, on the border of Argentina and Paraguay and was principally designed and constructed for power generation. The project includes a navigation lock, migratory fish transfer structures and irrigation intakes.

The Paraná River branches at the dam site to form the Yacyretá island, hence the spillway is comprised two structures, one either side of the island. The main spillway has a capacity of 55 000 $m^3/s$ through 18 bays controlled by tainter gates. The secondary spillway is on the Aña Cua branch, and has a capacity of 40,000 $m^3/s$ controlled by 16 tainter gates. Flows that exceed the generation capacity of the scheme are spilled via the Aña Cua spillway, providing environmental flows in that branch and minimising tailwater fluctuations in the main branch.

The first stage of the power plant contains 20 Kaplan turbines, each with a discharge capacity of 800 $m^3/s$. With a head of 22m and an installed capacity of 3100 MW the project generates approximately 20,000 GWh/year.

**Dam name**

**Scheme operator**
Entidad Binacional de Yacyreta

**Size of scheme (MW)**
3100

**Country**
Argentina and Paraguay

**Catchment area**
$10^6$ $km^2$

**River**
Parana

**Effective reservoir capacity**
26 $x10^9$ $m^3$

**Construction years**
1994

**Reservoir size**

**External recognition**
Nil

## Details

During August 1994 a massive fish kill was observed downstream of the main spillway at Yacyréta Dam. This phenomenon coincided with a change in spillway operation from asymmetrical discharge through totally opened gates to symmetric flow through partially opened gates. The fish species affected (catfish, skate and some salmon species) were found to have suffered gas bubble disease, the result of dissolved gas supersaturation (DGS). Spillway operation was changed within 10 days to avoid further critical supersaturation issues.

In October 1994 a smaller fish kill was observed at the Aña Cua spillway and spillway operations were again changed to prevent further mortalities. On both occasions, fish mortalities occurred during a period when power units were under construction and not yet serviceable. This resulted in extraordinary spillway discharges, with resulting dissolved gas supersaturation.

In response to these events, measures to minimise the impacts on downstream migratory fish species were undertaken. These included:

- Investigation of the effect of spillway operating protocols (partial/full gate opening and number of gates open) on total dissolved gas (TDG) levels, discharge and tailwater depth.
- Field studies to test the tolerance of fish of known age and condition to exposure to gas supersaturation.

These investigations led to structural modifications including crest deflectors, and to more appropriate operating rules for the spillway gates. Ongoing monitoring of the TDG levels downstream of the wall indicate that this strategy has been successful. Lack of fish mortalities since the initial incidents in 1994 confirms the success of the strategies employed.

## Other Aspects

Social Impact Assessment, Community Engagement and Acceptance and Population displacement
The International Rivers Network website (http://www.irn.org/programs/latamerica/yacireta.subm.html.) raises concerns about social aspects of this scheme, with specific mention of flooding of downstream residences, pollution and waterbourne disease.

Environmental Assessment and Monitoring
The incidence of a significant fish kill during the construction/commissioning phase was swiftly addressed through an intensive monitoring program focusing on gas saturation levels under various spillway operating regimes. This was complemented by a research program to determine the tolerance limits of fish exposed to the tailrace water, enabling the development of appropriate spillway operating rules. The monitoring program has continued during the operational phases of the project.

Passage of Aquatic Species
The Yacyretá Dam was designed and constructed with structures to facilitate the passage of migratory fish species.

Multiple use benefits
In addition to its power generation functions, the Yacyretá Dam provides water for irrigation of agricultural crops, has flood management functions and is equipped with navigation locks to enable the passage of vessels.

## Further information

Source: Hydropower Good Practices Workshop, Annex VIII - Examples for Good Practice Report, Villach, Austria, October 2005. International Energy Agency.