



# Consultancy for the Review of Worley Report Afobaka HPP and Brokopondo Reservoir - Hydraulic Reservoir Operation Review from January to May 2022

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## 1. Introduction

The National Power System (NPS) consists of seven isolated power networks served by the state-owned electric utility (EBS) based on hydro and thermal generation. Energievoorziening Paramaribo (EPAR) is the largest network, serving around 143,485 customers, with peak demand of around 203 Megawatts (MW). EPAR has mainly depended on power supply from the Afobaka hydropower plant, which generates about 50% of total electricity consumed in Suriname. The Afobaka hydropower plant was recently transferred (December 2019) to SPCS (a subsidiary company of Staatsolie Maatschappij Suriname N.V. in charge of power generation).

Between January 2022 and May 2022, Suriname River experienced above the average inflows, recording the highest flows in the 57 years of records, resulting in inflows which were 284% higher than the long-term average for this period. These high inflows are likely associated with the La Niña meteorological event that has been registered in this period. It should also be noted that five (05) of the ten (10) largest floods of the Suriname River occurred in La Niña year.

Energy Authority Suriname (EAS) has approached Worley to provide a cold review of the recent operation of the Brokopondo Reservoir performed by SPCS (Staatsolie Power Company Suriname) between January 2022 and May 2022 and requested to IADB for an independent 3<sup>rd</sup> opinion regarding the operation of SPCS.

### 1.1. Objective

The general objective of this consultancy is to review the report prepared by Worley and recommend additional studies to be carried out in order to improve the hydraulic operation of the Brokopondo Reservoir.

### 1.2. Information Used

The following information has been reviewed:

#### *Provided Files*

- Afobaka HPP & Brokopondo Reservoir – Review of the hydraulic reservoir operations desde January to May 2022 – Report . prepared By Worley ;
- Power Point File “ Afobaka Levels V4”;
- Excel file “2022\_Spill\_May”;
- Excel file “ Hydro Shift Log 04-27-2022\_Crew4\_B shift”;
- Excel file “ NH\_kwh\_daily ”;
- Excel file “ Hydro - Pizeta Data - May 24, 2022”;
- Excel file “SPCS- Afobaka Lake Elevation readings on HourlyBases\_2022 ”;
- Excel file “Lake Elevation 2022\_April”; and a
- Excel file “ long term hydrodata ”.

#### *Other documents reviewed*

- Climate change impacts on hydropower and electricity demand in Suriname / María San Salvador del Valle, Kepa Solaun, Gerard Alleng , Adrián Flores, Jordi Abadal . p. cm. — (IDB Technical Note; 2466)
- Technical Guide on Dam Safety No. 7. Monitoring of Dams and their Foundations

- Technical Guide on Dam Safety No. 8. Exploitation of Dams and Reservoirs. Risk analysis applied to the safety management of Dams and Reservoirs.

## 2. Review Results

From the review of the report prepared by Worley and the files provided, the following aspects can be mentioned:

- It is evidenced that, in the first five months of 2022, the Suriname River experienced flows above average, registering the highest flows in the 57 years of records for the period between January and April, resulting in flows that were a 284% higher than the long-term average for this period. These high flows are probably associated with the La Niña meteorological event.
- During the operation of the reservoir, flows greater than 35,000 cfs are expected to occur downstream of Afobaka. Flows greater than 40,000 cfs produce flooding in areas near the dam.
- The operation of the reservoir was based on the guide curve, and even the O&M team acted preventively when flows increased, trying to reduce flood peaks while minimizing risks downstream, as flows continued to increase.
- The decisions made by the SPCS operation and maintenance (O&M) team, on May 4, 2022, when they increased the output flow to 55,000 cfs, could have been based on some other information and even on their own experience, trying to avoid higher outlet peaks and consequently greater downstream damage, since inlet flows could increase for a longer period.
- There is a need for the operation of the reservoir and HPP to respond to an operation manual that considers the management of the water level of the Brokopondo reservoir and the Afobaka spillway, as well as serving to identify and communicate with the actors and communities and define actions to minimize the impacts of possible situations that could cause flooding upstream or downstream of the dam.

From the review of the document “Climate change impacts on hydropower and electricity demand in Suriname”, the following aspects can be mentioned:

- It mentions that the climate change may affect hydropower generation, regarding the Afobaka Hydroelectric power plant, a strong correlation between precipitation and inflow was found, based on historical data.
- The future decrease in inflow was quantified from variations in precipitation. Short-, medium- and long-term analyses were carried out. The results were annual inflow reductions starting at 5 percent and, by the end of the century, ranging from 10 to 14 percent depending on the scenario. Reductions are higher under a more intense climate scenario and in the long term.
- Global warming, “El Niño” and “La Niña” events cause variations in predicted rainfall.

### 3. Conclusions

The following is concluded:

- The Report prepared by Worley reasonably presents the review of the operation of the Brokopondo reservoir carried out by SPCS (Staatsolie Power Company Suriname) between January 2022 and May 2022.
- The report prepared by Worley provides an opinion on the operation adequacy, on potential issues and recommends the following actions, which are summarized below:
  - Implement or review a solid procedure (Manual) for the operation and management of the Brokopondo Reservoir water level and Afobaka Spillway.
  - the large riverbed or floodplains of the Suriname River should not have any permanent occupation, as from time to time, even with proper reservoir management, the natural inflows of the Suriname River shall cause the need for large discharges at Afobaka HPP.
- The events that occurred in the first half of 2022 show that extraordinary events may occur (affected by the La Niña phenomenon) that will force a reservoir operation in which discharges greater than 35,000 cfs are required, this should prompt changes in the rules of operation, maintaining the optimization of the power generation, to avoid severe effects downstream. It would be advisable to develop a forecast model to help improve discharge plans.

## 4. Recommendations

Considering: i) the importance that the Afobaka Hydroelectric Power Plant and the Brokopondo Reservoir represent for Suriname, in terms of electricity supply, flood damping, tourism and other uses; ii) these works already exceed 57 years of exploitation; iii) discharges made during the first half of 2022; and iv) the difference between current engineering knowledge and that existing when these works were designed and built; The following studies and actions are recommended to improve its operation:

- **Operation Manual:** Review and update the operational standards that must be followed for the operation of the reservoir and HPP. This operation manual must include the operation during the occurrence of extraordinary floods, and other critical situations, and its objective is to preserve the safety of the dam and its facilities, as well as the safety of the riverside populations located downstream and upstream of the dam site.
- **Auscultation of the Dam:** Know the status and behavior of the dam-reservoir system, after analyzing the effect of external variables on the internal conditions of the dam infrastructure, through a monitoring, surveillance and inspection program of the Afobaka dam and HPP.
- **Risk Analysis of the Dam:** Carry out the risk analysis of the dam, HPP Afobaka and Brokopongo Reservoir, taking into account the constraints of the exploitation of the dam, dedicated to the generation of electrical energy, the operating procedures and the risks associated with the exploitation must be studied of the reservoir in normal conditions, in extraordinary conditions and in emergency conditions, considering that the floods are the fundamental factor to take into account for the study of possible effects in situations of exploitation, which allows to know in different hypotheses the possible effects both by backwater as by flooding downstream, even in situations of possible functional or structural failure of the dams. The risk analysis must also be able to capture the impact of non-structural measures and must adjust its scope so that it is sufficient to provide the necessary level of confidence for the type of decisions that must be made.
- **Flood Risk Management Plan (FRMP):** Review and update the FRMP, to achieve coordinated action by all stakeholders, to reduce the risks of flooding and reduce the negative consequences of flooding, based on the programs of measures that each must apply within the scope of their powers to achieve the intended objective, under the principles of solidarity, coordination, cooperation and respect for the environment. It must incorporate studies of the possible effects of climate change on the management of flood risks, the revision of the Flood Hazard and Risk Maps, and the delimitation of flood zones, public hydraulic domain and preferential flow zone.