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Most Recent Lifespan Estimate for the Itaipu Hydroelectric Power Plant Computed by Using Borland and Miller Method and Mass Balance in Brazil, Paraguay

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Abstract : Itaipu Hydroelectric Power Plant is settled on the Paraná River, which is a natural boundary between Brazil and Paraguay; thus, the facility is shared by both countries. Itaipu Power Plant is the biggest hydroelectric generator in the world, and provides clean and renewable electrical energy supply for 17% and 76% of Brazil and Paraguay, respectively. The plant started its generation in 1984. It counts on 20 Francis turbines and has installed capacity of 14,000 MWh. Its historic generation record occurred in 2016 (103,098,366 MWh), and since the beginning of its operation until the last day of 2016 the plant has achieved the sum of 2,415,789,823 MWh. The distinct sedimentologic aspects of the drainage area of Itaipu Power Plant, from its stretch upstream (Porto Primavera and Rosana dams) to downstream (Itaipu dam itself), were taken into account in order to best estimate the increase/decrease in the sediment yield by using data from 2001 to 2016. Such data are collected through a network of 14 automatic sedimentometric stations managed by the company itself and operating in an hourly basis, covering an area of around 136,000 km² (92% of the incremental drainage area of the undertaking). Since 1972, a series of lifespan studies for the Itaipu Power Plant have been made, being first assessed by Sir Hans Albert Einstein, at the time of the feasibility studies for the enterprise. From that date onwards, eight further studies were made through the last 44 years aiming to confer more precision upon the estimates based on more updated data sets. From the analysis of each monitoring station, it was clearly noticed strong increase tendencies in the sediment yield through the last 14 years, mainly in the Iguatemi, Ivaí, São Francisco Falso and Carapá Rivers, the latter situated in Paraguay, whereas the others are utterly in Brazilian territory. Five lifespan scenarios considering different sediment yield tendencies were simulated with the aid of the softwares SEDIMENT and DPOSIT, both developed by the author of the present work. Such softwares thoroughly follow the Borland & Miller methodology (empirical method of area-reduction). The soundest scenario out of the five ones under analysis indicated a lifespan foresight of 168 years, being the reservoir only 1.8% silted by the end of 2016, after 32 years of operation. Besides, the mass balance in the reservoir (water inflows minus outflows) between 1986 and 2016 shows that 2% of the whole Itaipu lake is silted nowadays. Owing to the convergence of both results, which were acquired by using different methodologies and independent input data, it is worth concluding that the mathematical modeling is satisfactory and calibrated, thus assigning credibility to this most recent lifespan estimate.

Keywords : Borland and Miller method, hydroelectricity, Itaipu Power Plant, lifespan, mass balance
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