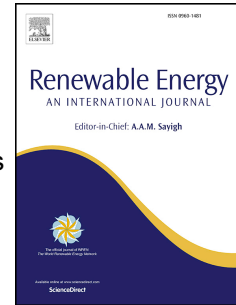


# Accepted Manuscript

Numerical analysis of the hydraulic transient response in the presence of surge tanks and relief valves

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## Highlights

- Performance of surge tanks and relief valves on the unsteady flow in the penstock is studied.
- A CFD model based on the dynamic friction is proposed to investigate the unsteady flow problem.
- Surge relief valves can be used in place of surge tanks to improve the transient response.
- Herein, the turbine over speed is 155% of the nominal speed when no protective device is installed.

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