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Fluid Mechanics Ambiguous
Yet 99% of Electricity Storage in Water Reservoirs

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Abstract

Basic Fluid Mechanics' Navier-Stockes equations are approximate; solutions simplified; input data uncertain; mathematical and real instabilities always present. Blood vessels (veins and arteries) are a hydraulic system. Low power pulsations can destroy the structure with resonance and instability! Yet, only mature verified and now applied, storing 99% of electricity is hydro storage, waiting new technologies to develop verify and mature. Therefore, hydro plants safety must follow modern clean variable sources. Clean, intermittent, unmanageable, uncertain sources must be backed up by storage able to accumulate surplus, and return energy when consumers demand it. Hydro storage is of dominant significance as the most reliable and affordable clean storage of surplus of wind, solar, nuclear, thermal, and run-of-river energies. Hydroelectric plants and hydraulic auxiliary systems, present in all plants, continually experience dynamic transients and oscillations which threaten from extreme water hammer pressures and resonant oscillations. However, as there are no simple hydraulic solutions for such complex systems, this article emphasizes that the analyses of hydraulic schemes are always difficult. Difficulties that are compounded when the phenomena are non-linear (water hammer), dynamic (involving wave interaction, standing waves, and resonance) thus may lead to high economic and safety challenges and consequences. As hydraulic transient and vibration analyses are simplified applied fluid mechanics for practical applications, computational fluid dynamics (CFD), and other solutions only roughly describe the flow. Multiphase and transient models are not similar to the site. Therefore, all calculations and similarities must be carefully verified on site. Mathematical instabilities, which could be resolved by experienced experts, and real physical unavoidable instabilities, make software application by experts not educated and experienced in subject extremely dangerous: bad things can happen if one can't distinguish inaccurate unrealistic results from reasonably good ones. More than 50% of hydraulic systems have trouble in operation. Few examples here just introduce methodology pointing out the importance for update and modernization.

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