Project Progress Report #1

We are modeling a turbine power generation system, with a desire to maintain the power output within certain "safety zones" in order to reduce vibrations on the generator. We control the power output of the system by adjusting the dam gate valve in order to let water flow through. Thus, the input for our process is our valve position, which controls the gate height, and the output is the power produced by the turbine. These two variables are related through a series of equations. The first is:

$$q = A\sqrt{2gh} \tag{1}$$

which calculates our flow (q) based on the height of the water in relation to the turbine entrance (h), and the area of the gate that is available for water to flow through (A). In this situation, h is a variable because the dam level will change seasonally throughout the year, and A will fluctuate with our input. g is the gravitational acceleration constant (9.8 m/s^2). We then plug that equation into our overall energy balance:

$$W = \eta\rho g A\sqrt{2gh}\Delta z \tag{2}$$

where W is our power output, η is our turbine efficiency (which is a constant at 0.8286), Δz is the height of the gate, and ρ is the density of water (assumed to be constant at 998.29 kg/m^3). Our process will be automatically adjusting the valve position to account for the dam level, in order to keep the power output within acceptable ranges.

The current literature outlines the problem and experimental solutions used at the time. The "2009 accident update"[1] gives a detailed look at the background and the "Hydro-turbine governor control: theory, techniques and limitations"[2] outlines PID controller and theories used in power plants.

We are working according to our initial timeline and still plan to be finished with the project by Wednesday, December 10th.

Thank you for your time and consideration,

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1 - Frank A. Hamill, https://static.iahr.org/upload/file/20200703/1593762853369684.pdf
2 - Culberg, https://ro.uow.edu.au/cgi/viewcontent.cgi?referer=&httpsredir=1&article=5426&context=eispapers