



## Background

Our Idea is a clean energy solution that harnesses continuous water flow processes within pipelines to recover wasted energy without impacting the processes., the product operates 24/7 by utilizing existing water infrastructure, it enhances operations' efficiency and sustainability. providing a sustainable and reliable source of clean energy.

### Constraints

- Regulatory Compliance
- Compatibility
- Safety Standards
- Integration

### Specifications

- Generation Capacity (1-10 kWh)
- Consistent Output (24/7)
- Efficiency Rating (60%)
- Lifespan (10 years)
- Pay Back Period (4-6 Years)

## Important Calculations

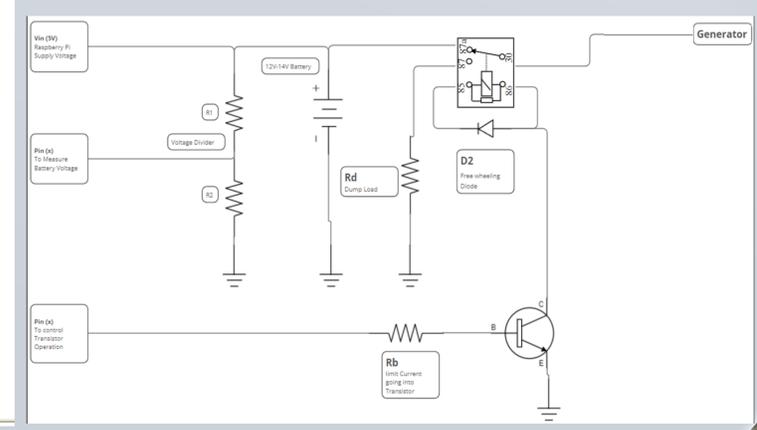
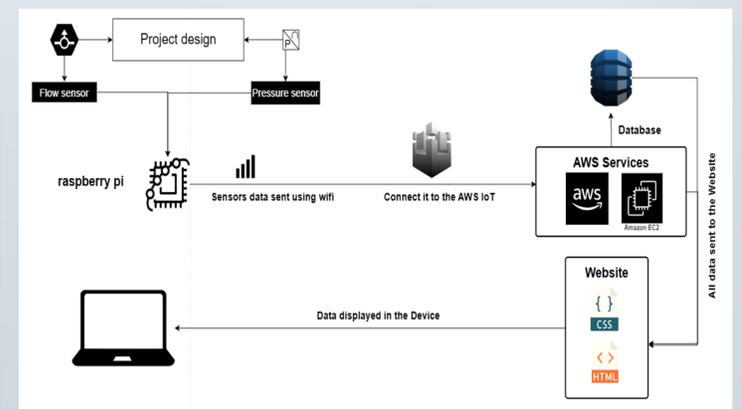
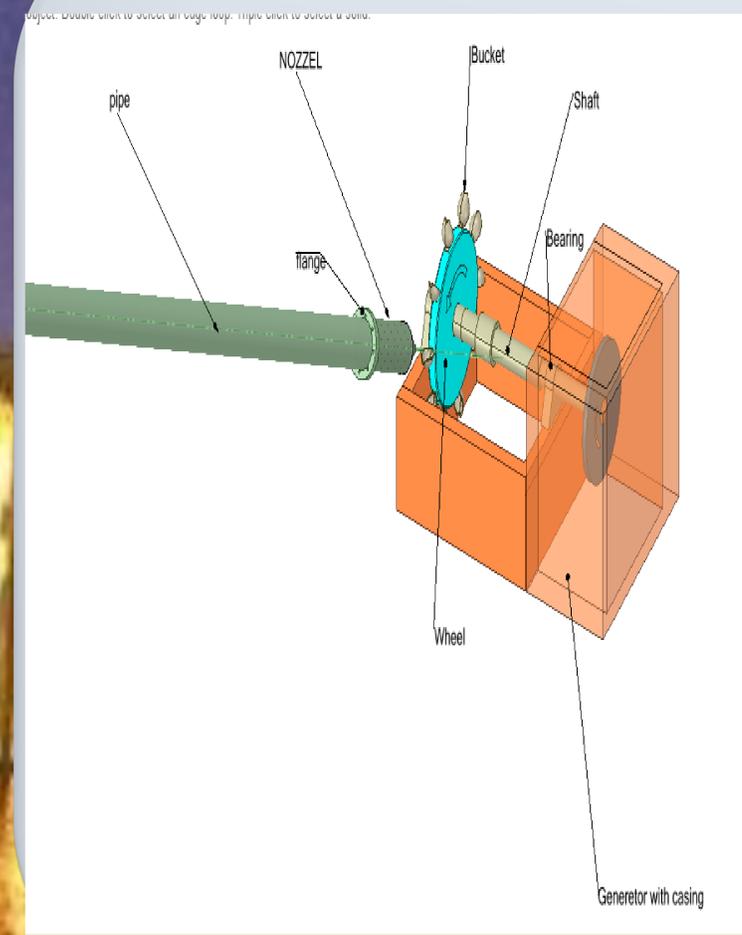
$$P_{\text{hydraulic}} = \eta * \rho * Q * g * H, \quad D = \sqrt{\frac{4 * Q}{\pi * V}}$$

$$h_f = f * \frac{L}{D} * \frac{V^2}{2g}, \quad N = \frac{60 * v_{\text{bucket}}}{2\pi * r}$$

$$\tau = \frac{P_{\text{mechanical}}}{\omega}, \quad T = \frac{\pi * \tau * d^3}{16}$$

$$d = \sqrt[3]{\frac{16 * T}{\pi * \tau}}$$

## Conceptual Design



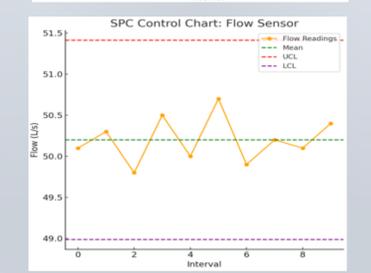
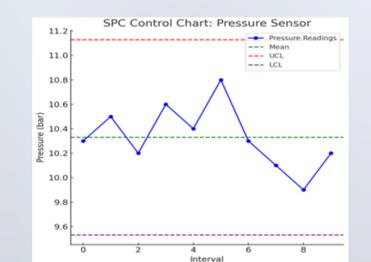
## Control System

Objective: Monitor pipeline performance using pressure and flow sensors to ensure stability.

### Key Metrics

Pressure Sensor: Mean: 10.38 bar, UCL: 10.77 bar, LCL: 9.99 bar  
 Flow Sensor: Mean: 50.2 L/s, UCL: 50.5 L/s, LCL: 49.9 L/s  
 Results Both sensors show stable readings within control limits, ensuring system is stable operations.

### Control Chart



## Testing / Validation

- Generation Capacity (1-10 kWh) ✓
- Consistent Output (24/7) ✓
- Efficiency Rating (60%) ✓
- Lifespan (10 years) ✓
- Pay Back Period (4-6 Years) ✓

## Prototype



## Conclusion

Our project showcases the potential of hydro power as a sustainable and reliable energy source. By designing and prototyping an innovative turbine system, we demonstrated its ability to generate continuous power while adhering to safety and utility standards. This project enhanced our understanding of hydroelectric systems and engineering principles, laying the groundwork for future advancements in clean energy technologies