HCC 2026
67% Status Update

Team

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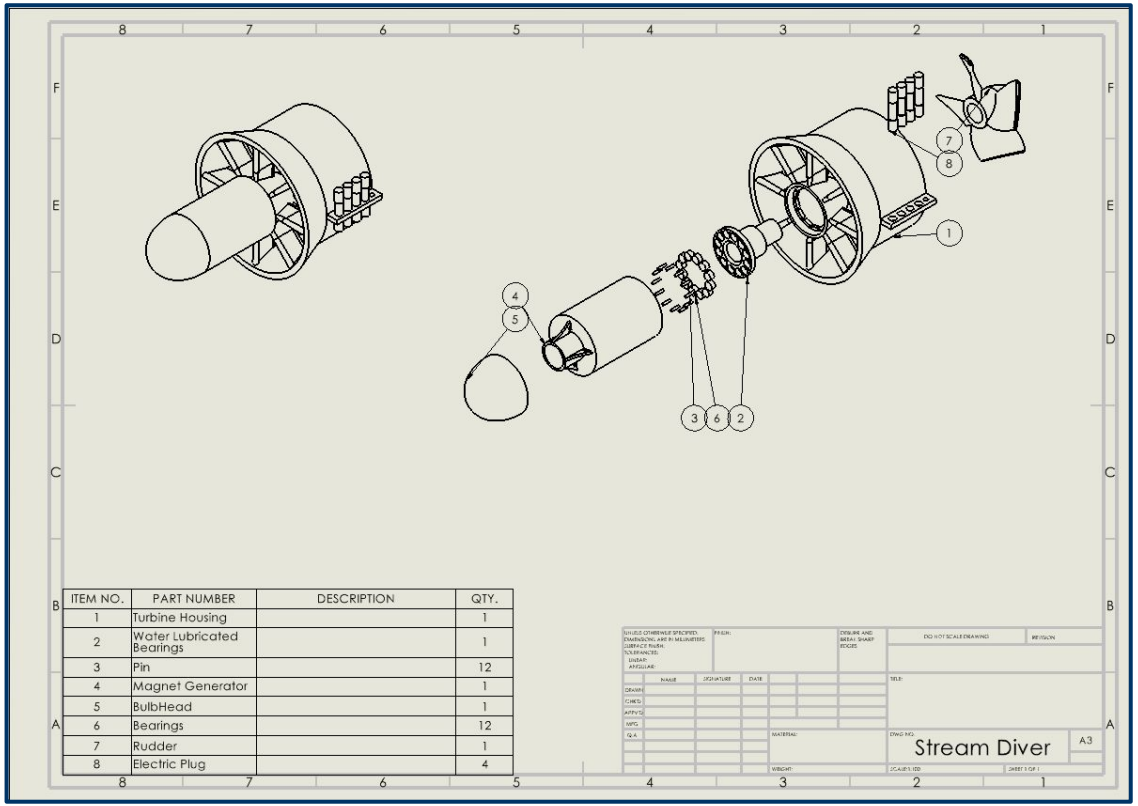
PROJECT OVERVIEW

- **Competition**: DOE Hydropower Collegiate Competition
- **Scope**: Research driven feasibility, modeling, and prototype validation
- **Design Goal**: Develop competition ready hydropower system concepts

DESIGN EVOLUTION & FINAL CONCEPT



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Turbine Housing		1
2	Water Lubricated Bearings		1
3	Pin		12
4	Magnet Generator		1
5	BulbHead		1
6	Bearings		12
7	Rudder		1
8	Electric Plug		4

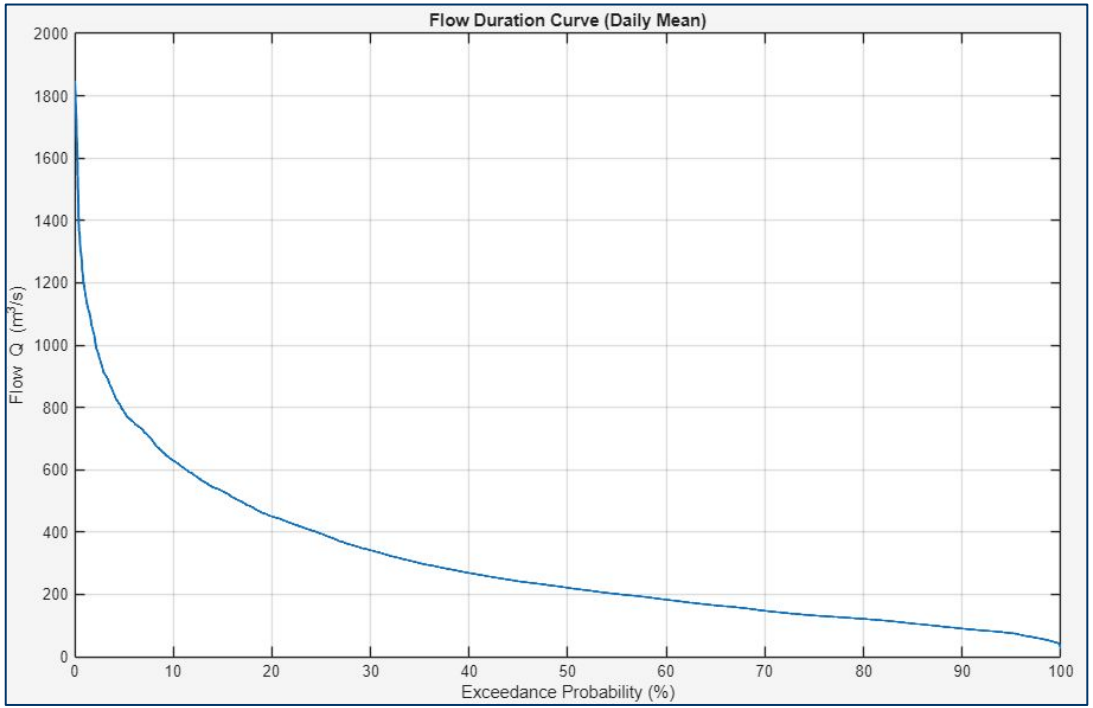
Stream Diver

A3

Updates:

- Adjusting scales for rapid prototyping and testing
- Using a 0.014 scale for Prony Brake
- Updated some tolerances, to make less snug for rpm testing
- Increased size of the magnet generator housing

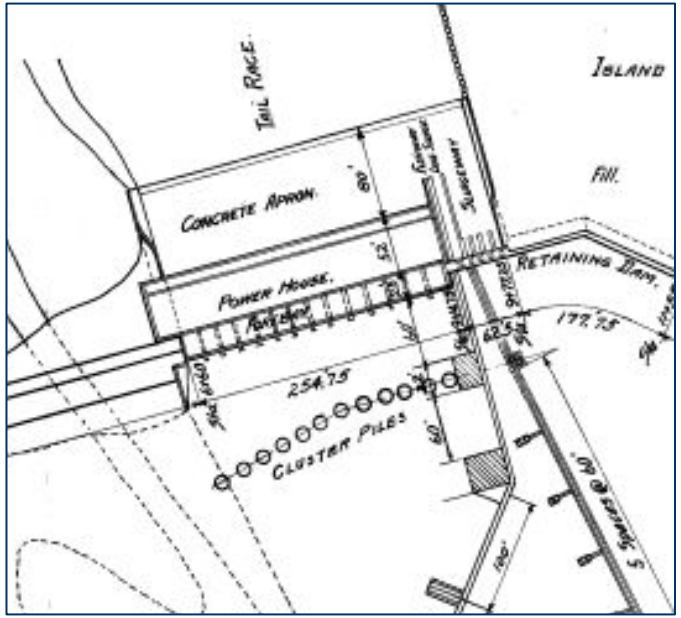
Flow Duration Curve (Daily Mean)



- Q10- 631 m^3/s
- Q50- 220 m^3/s
- Q90- 90 m^3/s
- Q_{min} - 47 m^3/s

Daily discharge exceeds 90 m^3/s 90% of the time, indicating strong base flow reliability for our constraints.

Coon Rapids PDC Estimate

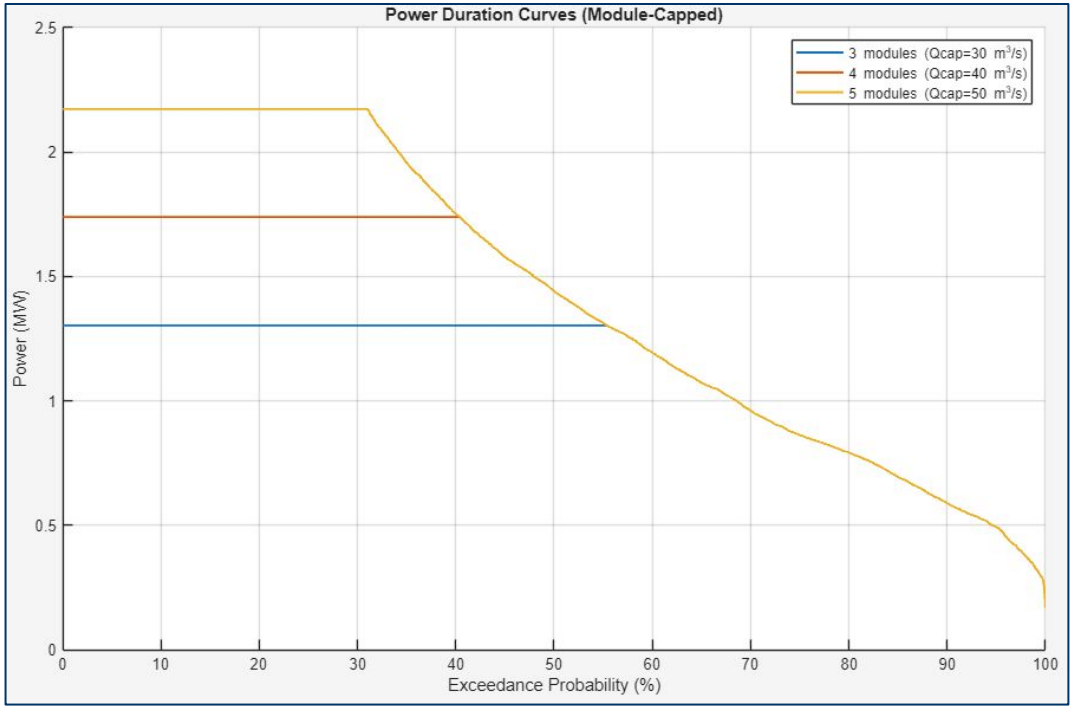


- 7 unused turbine housings
- Using already existing Powerhouse
- This screening simulates taking advantage of about 15% of flows
  - 10 m^3/s flow per turbine standard(Voith).
  - option for more turbines, this is a general screening using a max of 5 generation units.
  - Site not governed by head(5.8m), generous flows

Coon Rapids PDC Estimate

Current options based on assumptions, more info to update next week.

- Low power based on # of units(10m^3/s per unit)
- modeled over 15% usage
- Best case- 4 units, .75CF, better LCOE compared to 5 units, safer cushion compared to 3 units.
- Needs some sort of copower/option to validate at this stage.

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3 modules | Qcap=30.0 m^3/s | Rated=1.30 MW | Avg=1.09 MW | CF=0.84
4 modules | Qcap=40.0 m^3/s | Rated=1.74 MW | Avg=1.30 MW | CF=0.75
5 modules | Qcap=50.0 m^3/s | Rated=2.17 MW | Avg=1.45 MW | CF=0.67
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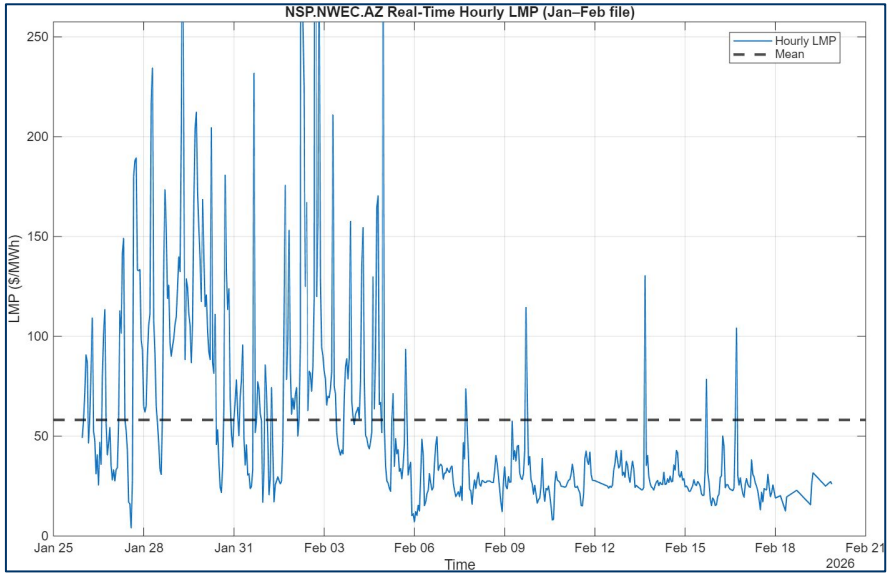
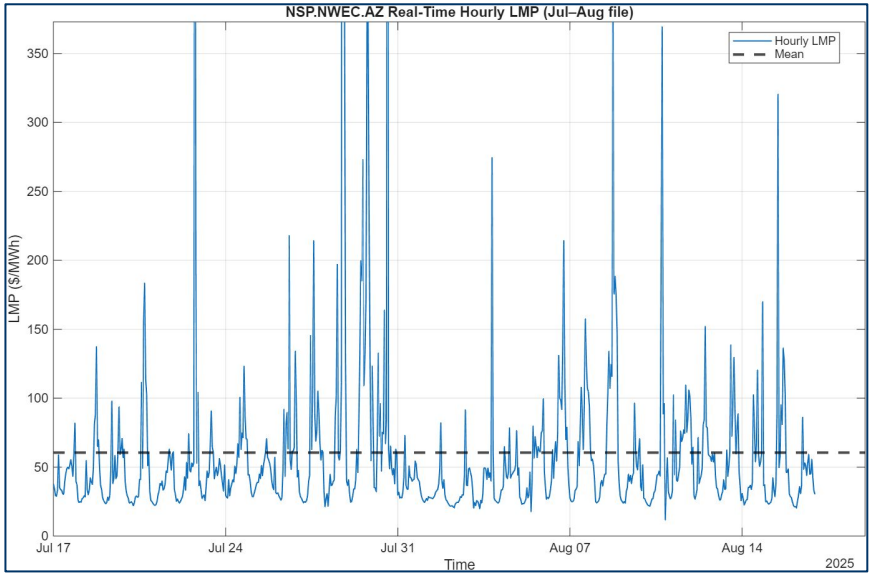
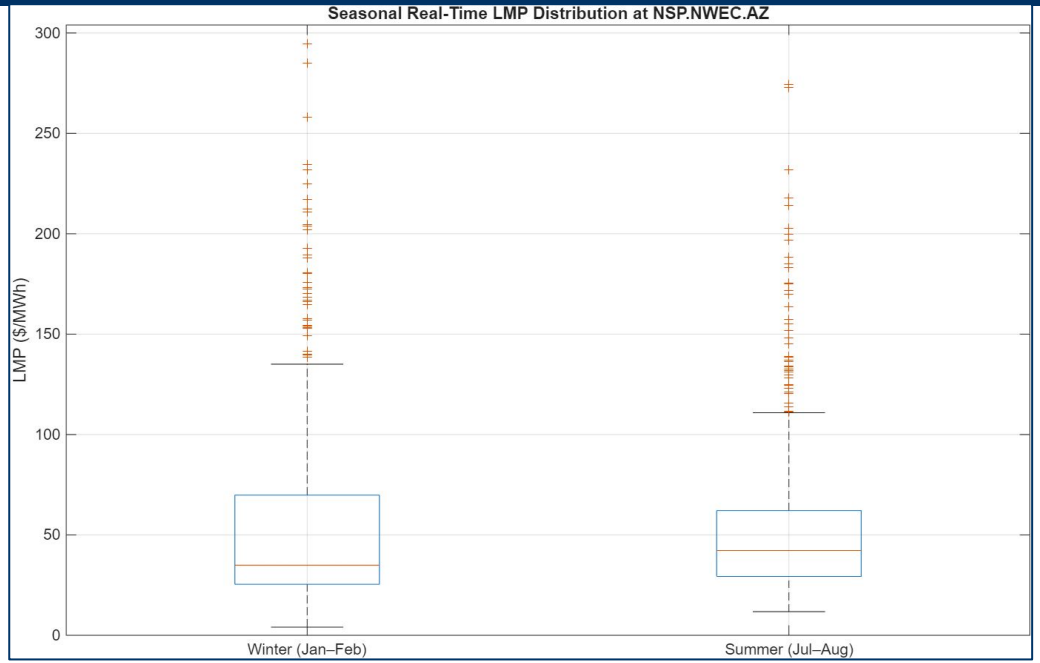
Coon Rapids LMP Proxy Estimate





-Summer median pricing exceeds winter median
-Winter Scarcity brings high value hours
-Summer peak demand brings consistent pricing

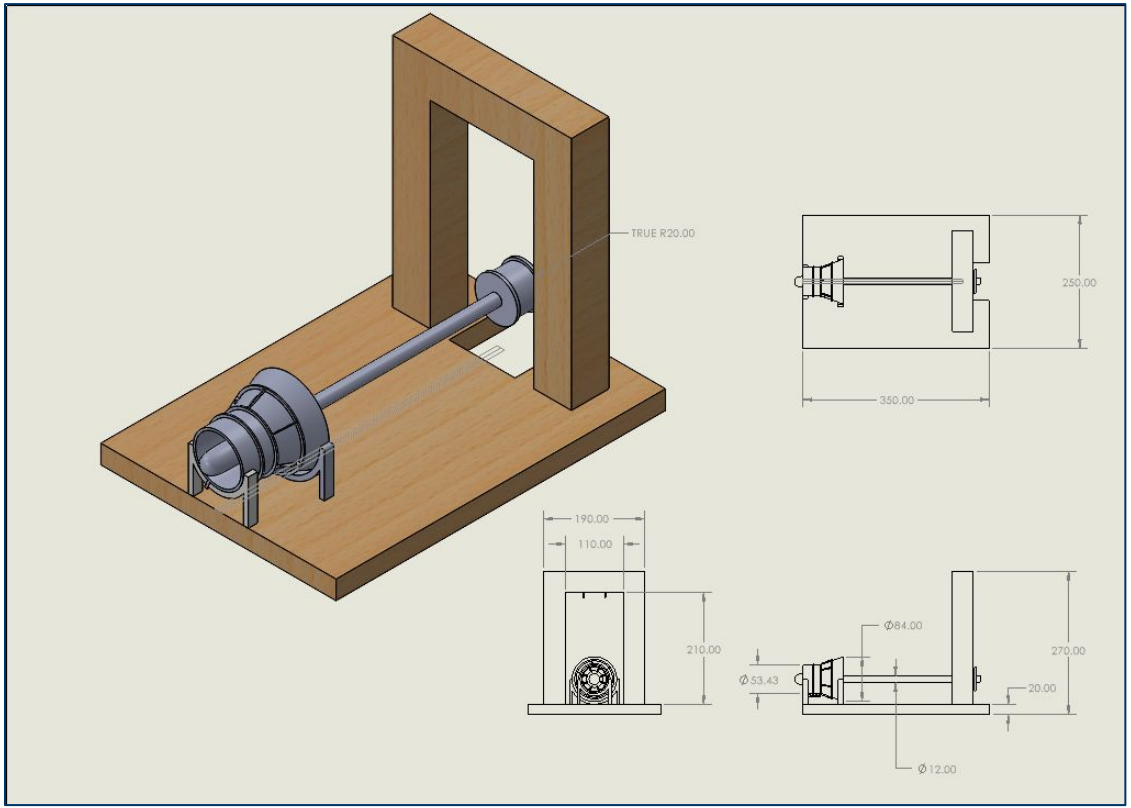
Coon Rapids LMP Proxy Estimate



Season	Mean ($/MWh)	Median ($/MWh)	P95 ($/MWh)
"Winter (Jan-Feb)"	"$58.2"	"$34.9"	"$163.7"
"Summer (Jul-Aug)"	"$60.5"	"$42.2"	"$134.8"

- Summer median pricing exceeds winter median, indicating stronger typical peak demand value
- Winter exhibits higher upper-tail volatility(P95) due to scarcity events
- Hydro production aligns with both seasonal peak demand and high-value scarcity hours.

Prony Brake Design Analysis

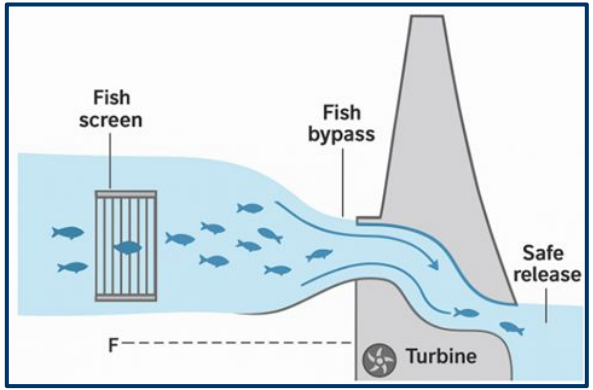


- Wood Frame
- 3D printed turbine
- Stainless Steel Shaft
- Aluminum Machined Drum
- Sensors
- Dyneema Cord
- Dead Weight

ENVIRONMENTAL ANALYSIS

Used ORNL's Environmental Decision Toolkit

- Active Fishery - Fish screens can prevent entry into turbine system
- Invasive Carp* - Need to prevent upstream spread
- Water Oxygenation - Impact should be minimal or nonexistent



OAK RIDGE National Laboratory

*Carp may have already passed through the dam

Non-Dimensional Analysis

- Based on the Hydropower Equation to compare results
- Equations to scale down our project so that we accurately test our prototype
- Modified to be able to work with a garden hose or similar flow

$$D_p = D_m \sqrt{\frac{Q_p}{Q_m}} \sqrt{\frac{H_m}{H_p}} \quad (4)$$

Plugging in the variables to solve for D_p.

$$D_p = 1.3 \sqrt{\frac{0.0024}{13}} \sqrt{\frac{8}{1}} = 0.0297\text{m} \cong 3\text{cm}$$

The result isn't limited by the 3D Printing area which is 400mm x 400mm x 400mm. Using equation (1) we can predict the power output to be 0.87 MW or 870,000 W. Setting Pm= 870,000W in equation (3) results in Pp= 20.5W.

$$P_p = 870,000 \left(\frac{.03}{1.3}\right)^2 \left(\frac{1}{8}\right)^{3/2} = 20.5\text{W}$$

To verify the calculations, we can check the new flow rate with equation (1), and see if the results are consistent.

$$P = 1000\, kg/m^3 \times 9.81\, m/s^2 \times 1\, m \times 0.0024\, m^3/s \times 0.85 = 20\text{W}$$

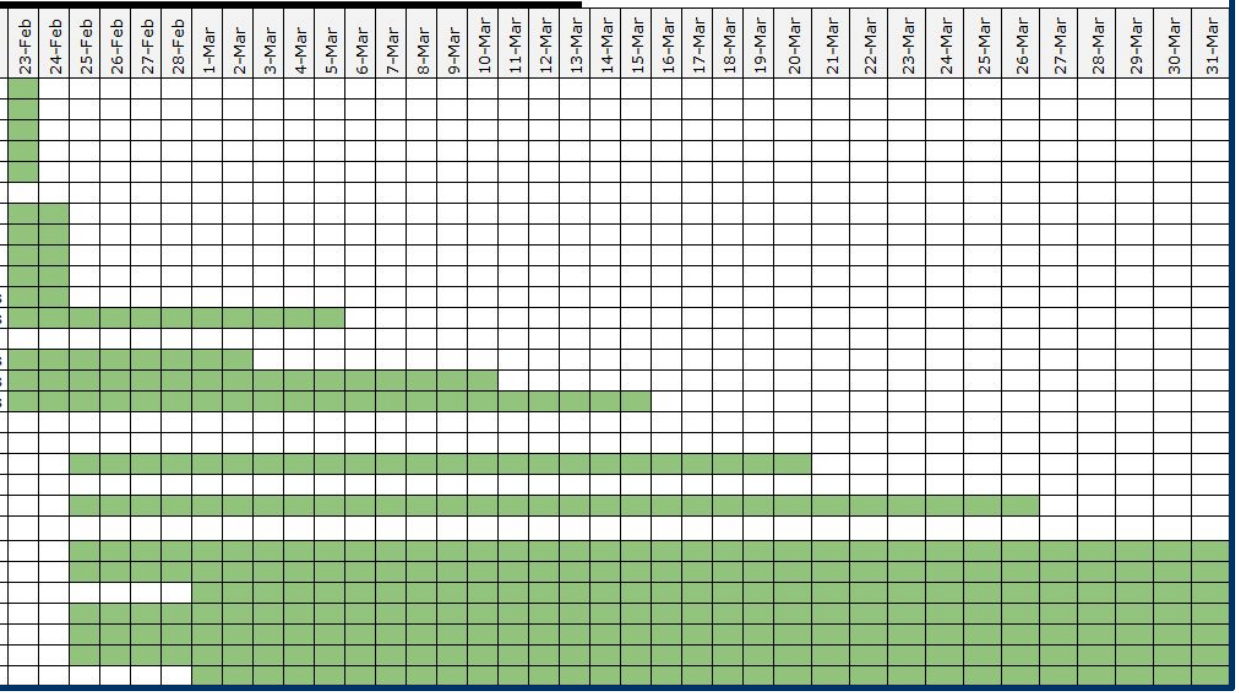
The difference is 0.5W or a 2.5% margin of error. This is less than 5%, this is an acceptable result.

Corbin Davis- Non-dimensional Analysis

SCHEDULE

ME486C - HCC26 Gantt

Task name	Stard date	End date	Assigned	Status
February Competition Submissions	12-Jan	23-Feb	ME Team	Done
Siting Challenge	13-Jan	23-Feb	ME Team	Done
Design Challenge	14-Jan	23-Feb	ME Team	Done
Community Connections	15-Jan	23-Feb	ME Team	Done
Build and Test	16-Jan	23-Feb	ME Team	Done
67% Build	4-Feb	24-Feb	ME Team	Done
Validating Manufactured Components	4-Feb	24-Feb	ME Team	Done
Validating Subsystem Integration	4-Feb	24-Feb	ME Team	Done
Cost Models Refined using as-built	4-Feb	24-Feb	ME Team	Done
Environmental and Operational Check	4-Feb	24-Feb	ME Team	In process
Prony Brake Build and Test	4-Feb	5-Mar	ME Team	In process
New Site Analyses/Feasibility	20-Feb	2-Mar	ME Team	In process
Interviews of Industry Problems	20-Feb	10-Mar	ME Team	In process
Design Track	20-Feb	15-Mar	ME Team	In process
Finalized Testing Plan	25-Feb	20-Mar	ME Team	Open
100% build	25-Feb	26-Mar	ME Team	Open
Final Poster and Final PPT	25-Feb	10-Apr	ME Team	Open
Final siting and technical design repo	25-Feb	12-Apr	ME Team	Open
Final Product Demo Multiplier	1-Mar	16-Apr	ME Team	Open
Final Report (Capstone)	25-Feb	17-Apr	ME Team	Open
Metrics Report	25-Feb	19-Apr	ME Team	Open
Final Website Check	25-Feb	21-Apr	Nathaniel	Open
Design and Siting Poster	1-Mar	27-Apr	ME Team	Open



BUDGET STATUS

No.	Date	Department	Purposes	Demand detail				Procurement details			Handler	State
				Product	Model	Unit	Quantity	Date	Price	Amount		
1	2026/02/25	Mechanical	Prony Brake	PGN Bearings	12x28x8 mm	***	2	2026/03/10	$7.00	14.00	PNGBearings	In Process
2	2026/02/25	Mechanical	Prony Brake	Neiko 20713A Digital Laser Tachomet	Neiko 20713A	***	1	2026/03/10	$30.00	30.00	Autozone	In Process
3	2026/02/25	Mechanical	Prony Brake	Digital Push Pull Force Gauge	AMF-50N	***	1	2026/03/10	$50.00	50.00	Friday Parts	In Process
4	2026/02/25	Mechanical	Prony Brake	Dyneema cord	UHMWPE Braided Cord	***	1	2026/03/10	$18.00	18.00	Amazon	In Process
5	2026/02/25	Mechanical	Prony Brake	Stainless Steel shaft	12mm, 303 stainless steel, corrosion resistant, 1ft/300mm lengtl	***	1	2026/03/10	$32.00	32.00	McMaster	In Process

State	Amount	Ratio
In Process	194.00	100%
Complete	-	0%

What are our expenses to date?		
Description		Expense amount
3d Printer	Artizan snapmaker 3D 3in1 printer	$2,882.94
Machined metal shaft	7 inch metal shaft	$10.00
Team Shirts	Team shirts x8	$125.00
PGN Bearings	12x28x8 mm bearings x2	$14.00
Neiko 20713A Digital Laser Tachometer	Neiko 20713A	$40.00
Digital Push Pull Force Gauge	AMF-50N	$50.00
Dyneema cord	UHMWPE Braided Cord	$18.00
Stainless Steel shaft	12mm, 303 stainless steel, corrosion resistant, 1ft/300mm length	$32.00
Total Expenses		$3,171.94
True remaining balance		$14,828.06

Moving Forward

Design Challenge

- Model Capex and nodal grid data to track economic feasibility
- Finalize copower opportunities (Solar, Recreation)
- Finalize turbine intake setup/placement following meeting with Site advisors
- Construct build drawings of proposed concepts

Community Connections

- Planning more outreach events (schools/energy club involvement)
- Meet with Coon Rapids Dam

Build & Test

- Build and test aspects generator/prony brake
- Finalize purchasing plan & manufacturing plan
- Planning more outreach events (schools/energy club involvement)

THANK YOU!

NORTHERN ARIZONA UNIVERSITY