IGEM Grant Report

☐ Progress (due January 1) ☐ Annual (due July 31) ■ Final (due August 31)

IGEM Grant ___IGEM26-004_____ Principal Investigator: Prof. Amir Ali _____
Name/Full Title of Project: Advanced Compact and Efficient Heat Exchanger Tech.____
Submission Date__08/30/2026_____ Primary Institution: Idaho State University___

Instructions: Complete each section of this report directly on this template. Completed reports must be limited to 1 page for Progress Reports and 2 pages for Annual or Final Reports in 12 pt Arial or similar font, excluding the expenditure report. Simple and concise answers will be appreciated, and even bullet lists of information will be sufficient. Reports that do not follow these requirements will be returned for revision. Submit reports by the appropriate due date to HERC@edu.idaho.gov.

Section 1: Project and its goals

The project's main objective is to numerically design and optimize, and experimentally evaluate, a compact heat exchanger utilizing oval-twisted tubes for efficient energy applications.

Section 2: Summary of accomplishments and future plans

- Initial numerical design and optimization of the proposed heat exchanger, including analyses of oval-twisted and baseline circular-tube configurations, have been completed.
- A baseline circular-tube unit has been fabricated (delayed from original schedule) and integrated with the experimental facility, which has been modified to accommodate the new test unit. The facility was ready in July (a failed pump delayed the testing) for testing, subject to student staffing and available funding in the near term.
- Fabrication of the oval-twisted-tube prototype has been deferred while the team pursues an advanced AI-assisted optimization process in collaboration with the Idaho National Laboratory (INL) team. Following completion of this optimization, the team plans to seek additional funding for fabrication and testing of the optimized oval-twisted-tube prototype.

Section 3: Summary of budget expenditures

- The major expenditures were faculty summer salary ($40,837.00); student stipend and tuition ($22,003.00); fringe benefits ($5,832.97); travel for the faculty member and student to the American Nuclear Society (ANS) conference ($4,565.56); and heat-exchanger fabrication, materials and supplies, and installation services ($33,910.00).
- Based on these listed amounts, total expenditures were $107,148.53 against the original $125,000 budget, leaving $17,851.47 unspent (originally assigned for the delayed oval-twisted prototype fabrication). The final amounts should be reconciled with the institutional expenditure report (section 7 of this report).

Section 4: Economic development/impact

- The project's numerical results were presented at the American Nuclear Society (ANS) meeting in June 2026.
- A surrogate AI optimization model is currently under development to improve the flexibility of the heat-exchanger design for different engineering applications. The model will be trained using the initial numerical results and further evaluated using extended CFD analyses to support selection and fabrication of an optimized twisted-tube prototype.
- The AI model and optimization results are also planned for dissemination through a peer-reviewed journal article, subject to completion and review.
- All research outputs are expected to support a future patent application, as appropriate, and the development of external funding proposals targeting 2027 federal funding opportunities.

Section 5: Participants

- The principal investigator, Prof. Amir Ali, leads the numerical design and optimization activities. One graduate student conducts CFD analyses and optimization under the PI's supervision and has also contributed substantially to the modification of the experimental facility. The graduate student presented the numerical analysis of the technology at the June 2026 American Nuclear Society (ANS) meeting. The AI-assisted optimization effort currently involves Prof. Ali and Dr. Ahmed Hamed, an INL collaborator identified in the IGEM proposal.

Section 6: Long-term sustainability plan

- Long-term activities will focus on completing and validating the AI surrogate model for multi-variable optimization of the heat-exchanger design (oval-twisted tube configuration). The optimized designs will be evaluated through additional CFD analyses before fabrication of a performance-optimized oval-twisted-tube prototype. The existing baseline circular-tube unit and, subject to funding, future twisted-tube prototypes will be experimentally tested to evaluate thermal-hydraulic performance and identify potential design improvements.
- Following validation, the team plans to assess patent opportunities, engage potential local industry partners as appropriate, and pursue external funding to continue technology development and commercialization activities.

Section 7: Expenditure Report

A separate expenditure report showing expenditures against the original project budget is attached.

IGEM Adv Compact Heat Exchngr Tech (AHRC53) FY26 expenditure summary

Acct	Title	Annual Adjusted Budget	Jun-2026	YTD Actual	Budget Available
Labor Expenses					
610	Salaries	40,837.00		0.00	40,837.00
620	Irregular Help	16,000.00		62,840.06	-46,840.06
630	Fringe Benefits	6,358.00		5,832.97	525.03
	Subtotal	**63,195.00**		**68,673.03**	**-5,478.03**
Operating Expenses					
700	Travel	6,000.00		4,565.56	1,434.44
720	Services	0.00		1,945.00	-1,945.00
730	Supplies	15,805.00		3,822.34	11,982.66
800	Capital Expense	40,000.00		28,142.66	11,857.34
	Subtotal	**61,805.00**		**38,475.56**	**23,329.44**
	Total All Expenses	**125,000.00**		**107,148.59**	**17,851.41**

Source:
Finance Reporting - Summary by Hierarchy - Current Year (Data as of 08-12-2026 05:24:38 AM)
Period Jun-2026 (Year End) | By Acct | Budget Annual Adjusted Budget | Chart = 9 | Fund = 110000 ISU General Clearing | Orgn = 630053 IGEM Adv Compact Heat Exchngr Tech (Closed) | Acct <> 8951 Administrative Recovery Assessment | Prog = 04ORO Organized Research on Campus