CompRex, LLC
partnered with
Argonne National Laboratory (ANL)

GA-17AN020103, High-Efficiency Heat Exchanger for High-Temperature and High-Pressure Applications

YEAR AWARDED: 2016

TOTAL PROJECT VALUE: $375K (DOE funds awarded, $300K; awardee cost share, $75K)

STATUS: Completed

PRINCIPAL LAB INVESTIGATORS: James Sienicki (sienicki@anl.gov)

DESCRIPTION: CompRex, LLC specializes in the design and manufacture of compact heat exchangers and heat exchange reactors for high-temperature and high-pressure applications. Its vision is to commercialize its compact technology and become the leading provider of compact heat exchangers and heat exchange reactors for various applications, including Brayton cycle supercritical carbon dioxide (sCO_2) systems. Under this Gateway for Accelerated Innovation in Nuclear voucher, Argonne National Laboratory researchers evaluated different heat exchanger designs specified by CompRex using a lab-developed Fortran code to model heat exchange and pressure drop performance. The code was used to compare the performance of the CompRex designs for the AFR-100 sCO_2 Brayton cycle power converter with that of more common Printed Circuit Heat Exchanger type designs. The model confirmed the targeted benefits of the CompRex design, and samples of both the optimized and non-optimized heat exchangers were subsequently fabricated for comparison.

BENEFIT: CompRex went on to receive a Small Business Innovation Research Phase I grant from the Department of Energy (DOE) to develop the manufacturing process for commercial-scale compact heat exchangers needed for next generation power plants. In 2020, CompRex was awarded a $1.76 million project from DOE's Advanced Research Projects Agency-Energy to develop new approaches and technologies for the design and manufacture of high temperature, high pressure, and highly compact heat exchangers and components.

IMPACT: By using advanced metal and ceramic composite material, developing a new simplified manufacturing approach, and optimizing the heat exchanger design based on the new material and manufacturing process, CompRex's solution could not only satisfy the performance requirements of next generation power cycles but also significantly lower costs of production and scale-up by as much as 40% compared with existing state-of-the-art heat exchangers.

NEXT STEPS: CompRex's compact heat exchanger technology is directly applicable to the sCO_2 Brayton cycle under development by DOE's Office of Nuclear Energy. The sCO_2 Brayton cycle eliminates the need to accommodate sodium-water reactions thereby enhancing sodium-cooled fast reactor (SFR) safety as well as improving economic competitiveness. The new heat exchangers can also be utilized for sodium-to-sodium intermediate heat exchangers for SFRs or recuperators and helium coolers for high-temperature gas reactors. The technology is also applicable to other energy technologies where compactness or high efficiency is a benefit. The sCO_2 Brayton cycle is also being developed by DOE for fossil energy and solar energy applications.