CO2 Transcritical

Cold Food Storage Facility

Engineering For Complex Meal Production Facility

MEPR, building controls and fire alarm engineering services for a groundbreaking project.

CoolSys Energy Design (CED) made a noteworthy contribution to the rapidly growing field of sustainable buildings and natural refrigeration with its comprehensive engineering services—including MEPR, building controls and fire alarm—for one of the largest industrial kitchens and refrigerated fulfillment centers in North America. The project encompassed a new, 325,000-square-foot, first-of-its-kind facility for processing, cooking, freezing and shipping high-quality meal kits. Located in Goodyear, Arizona, the facility is also notable for its massive CO2 refrigeration system.

Engineering Challenge:

The Sheer Size & Complexity of the Facility

The project was a highly complex undertaking, dwarfing the engineering design requirements for most industrial buildings. About half of the square footage consisted of refrigerated storage space and the other half a sophisticated food preparation and cooking area, requiring the engineering design of not only major appliances, equipment and fixtures but also hundreds of interconnected supply sources, including HVAC, electrical, water and plumbing.

Engineering Solution:

Respond with Numbers and Years of Expertise

CED assembled a multidisciplinary team of its most senior MEPR engineers and designers to lay the groundwork for later construction and installation. The team included lead engineers in each discipline, as well as a large group of engineers and designers working under the supervision of the leads.

Engineering Challenge:

Health and Safety Requirements for a Food Production Facility

The food preparation aspect of the project presented its own engineering challenges. With raw proteins and other ingredients coming into one section of the facility and cooked foods the product of other sections, food safety issues like cross-contamination were a major concern in the design of the rooms.

Engineering Solution:

Precisely Controlling Air Flow to Avoid Contamination

CED engineers designed pressure sensors, exhaust fans and supply fans to balance airflow among the rooms while compensating for air-conditioning, blowers and swinging doors. This ensures that air always flows from cooked to raw throughout the industrial kitchen to avoid contamination via air flow.

Engineering Challenge:

Going Sub-Zero in the Desert

One of the greatest challenges CED faced in designing the meal prep facility was its location. Until recently, it was considered folly to attempt a transcritical CO2 refrigeration system capable of reaching -10˚F—and particularly one the size of this project—in the unhospitable climate of the Arizona desert, where summertime temperatures can reach 120˚ or more. It was widely believed to be impossible to create an energy-efficient transcritical CO2 system in such a hot climate. Those assumptions, however, have been proven wrong.

80° TEMPERATURE VARIATIONS

In contrast to the extreme summer heat, winter temperatures in the Arizona desert can drop to near freezing, requiring equipment that can handle outside temperature variations of 80˚ or more. The working spaces of the industrial kitchen also required air-conditioning that remains consistently in the mid-70s for the comfort of employees and exhaust systems to handle the heat produced by the cooking appliances.

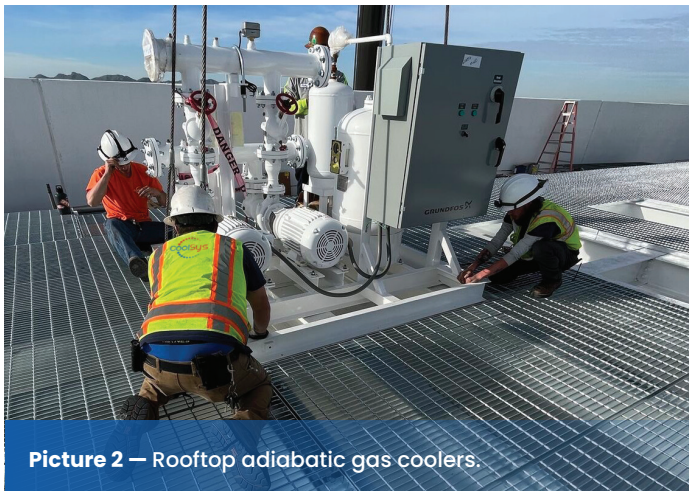
Engineering Solution:

A Refrigeration System That Beats the Heat

In order to keep 18 rooms comprising approximately 160,000 square feet of refrigerated space at the required temperatures, CED designed a system with four transcritical CO2 rack systems, totaling over 16,000 MBH of compressor capacity, in the building's machine room. Each of the four racks utilizes a rooftop adiabatic gas cooler to reject heat as shown in **Picture 1**. In total, the system supplies refrigeration for 78 evaporator coils in the refrigerated sections of the building. CED engineers recommended adiabatic gas coolers for this project to enable efficient refrigeration performance in the desert. Adiabatic systems also use much less water—a precious resource in the harsh Arizona climate—than more conventional evaporative condensers.

Picture 1 — Four gas coolers

In addition, the engineering plans called for two adiabatic fluid coolers on the roof as shown on **Picture 2**, that provided condenser water to condensing units for eight blast chillers in the food preparation area of the facility. The pump skids that circulate water to each condensing unit are in the foreground of **Picture 3**.



Picture 2 — Rooftop adiabatic gas coolers.

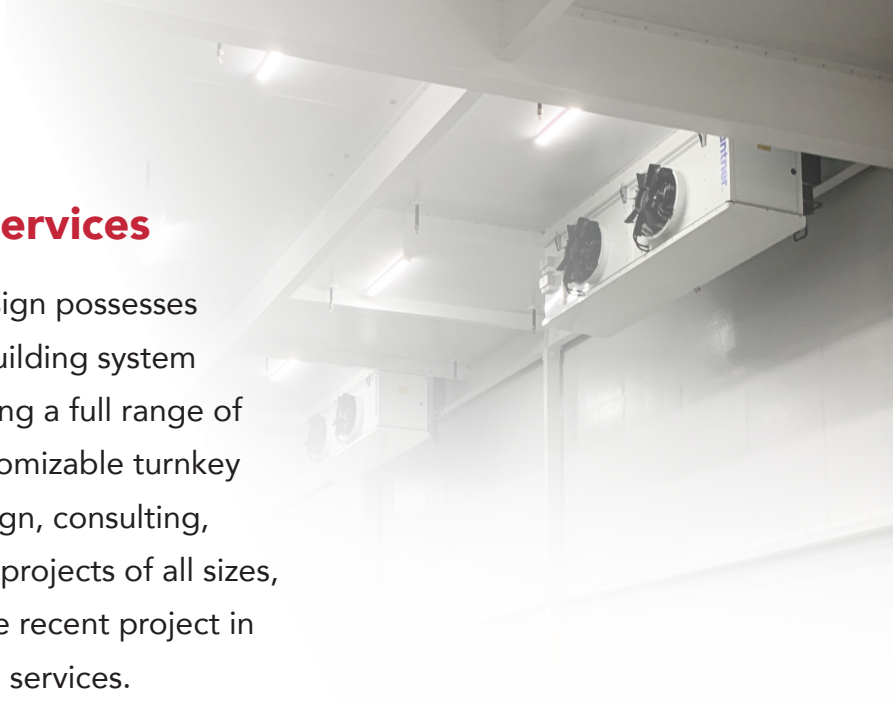
Picture 3 — Rooftop pump skids.

To handle the enormous refrigeration requirements of the facility, CED engineers designed the refrigerated areas with a total of 78 evaporator coils as shown in **Picture 4**.

In addition to the rooftop systems and evaporator coils, CED designed a system of packaged CO2 condensing units and associated piping for two food processing spiral chillers, as well as stainless steel piping, a building control system—including complete refrigeration system energy management—and leak detection in each refrigerated space.

In food preparation areas, CED designed an exhaust system capable of venting many thousands of cubic feet per minute of heat radiating from hundreds of linear feet of cook-top.

Picture 4 — The team installs evaporator coils.



Comprehensive Engineering Services

Licensed in all 50 states, CoolSys Energy Design possesses the expertise and experience to handle all building system engineering design tasks, conveniently offering a full range of engineering specialties under one roof. Customizable turnkey services encompass facility engineering, design, consulting, project management and commissioning for projects of all sizes, including massive, single-site facilities like the recent project in Arizona to coordinated multi-state, multi-site services.

Project Highlights

Impressive results from a job well done.

- First-of-its-kind facility
- Sustainable building design
- Complex air flow control to avoid contamination.
- Centralized solution with 4 transcritical CO2 rack systems with over 16,000 MBH compressor capacity.

ONE OF THE LARGEST TRANSCRITICAL CO2 SYSTEMS IN THE U.S.

5 3,000A, 480/277V ELECTRICAL SERVICES

325,000 SqFt
TOTAL FOOTPRINT

160,000 SqFt
REFRIGERATED SPACE

64,000+ CFM
KITCHEN EXHAUSTS

85,000+ CFM
OUTDOOR AIR

18 ROOMS

40 PACKAGED HVAC UNITS

78 EVAPORATOR COILS