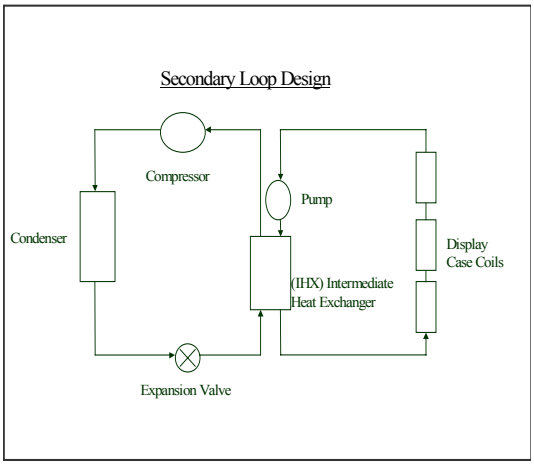
4.3.6 SUPERMARKET REFRIGERATION: HYDROFLUOROCARBON EMISSIONS

Technology Description

Distributed refrigeration technology can be seamlessly integrated into a store.



Secondary-Loop Refrigeration, where an extra pump and internal heat exchanger are added to the equipment used in a conventional design.

To comply with the U.S. Clean Air Act, supermarkets are phasing out the use of ozone-depleting refrigerants. As substitutes, the industry is using hydrofluorocarbons (HFCs), which are potent greenhouse gases. To ensure that food products are kept cold, the typical supermarket design pumps these HFC refrigerants through miles of piping and thousands of joints. Historically, annual emissions of 35% to 50% of the 2,000- to 4,000-pound charge have occurred. As old stores are replaced and new ones built, new technologies can drastically limit greenhouse gas emissions.

System Concepts

- Better equipment design and store layout can lead to a reduction in the amount of refrigerant needed for a given amount of product cooling.
- Additionally, replacing the complex miles of piping with either distributed cooling systems or a single centralized refrigeration plant can reduce the percent of refrigerant emitted annually.

Representative Technologies

- *Distributed Refrigeration* is a technology that puts refrigeration equipment closer to the food display cases, eliminating the need for excessive refrigerant piping throughout the store to reach a mechanical room sited away from the food.
- *Secondary-Loop Refrigeration* segregates refrigerant-containing equipment to a separate, centralized location, and uses a benign fluid to transfer heat from the food display cases.

Technology Status and Applications

- Both concepts have existed for some time but have seen very little adoption in the highly competitive, low-margin supermarket business.
- Only a handful of secondary-loop systems have been installed in the United States, primarily for "medium-temperature" (e.g., dairy products) portions of supermarkets. Very few "low-temperature" (e.g., frozen foods) systems exist in the world.
- Both technologies centralize refrigerants to one or a few locations. This allows for economical installation of leak-detection equipment to alert system operators when HFC refrigerant emissions occur.

Current Research, Development, and Demonstration

RD&D Goals and Challenges

- Continuously improve energy-use performance of these new technologies, investigating various designs, control strategies, and operational techniques.

- Investigate ways to reduce installation and operational costs of new technologies.
- Demonstrate applicability and advantages in various locations, store sizes, and product mixes.
- Educate store designers and builders regarding new technologies and how these technologies can be integrated into new or retrofitted stores at a net savings.

RD&D Activities

- EPA has built a facility to test secondary-loop refrigeration systems. Additional funding from DOE has been provided to support the research and test related products.
- Various manufacturers and supermarkets are conducting their own proprietary research on these technologies.

Recent Progress

- Existing systems have proved relatively easy to operate and maintain. Minimal refrigerant leakage has provided an economic benefit for the storeowner as well as an environmental benefit for society.
- Under the U.S./Australia Climate Action Partnership, the possibility of building and monitoring a typical and secondary-loop store is being explored. This will allow verification of potential benefits.

Commercialization and Deployment Activities

- The most opportune time to implement these technologies is during new store construction or during major overhaul and retrofit of existing stores. There are more than 30,000 supermarkets in the United States, and this is likely to grow with a growing population. Because many stores are currently switching from ozone-depleting refrigerants, there is a high potential to introduce these new technologies quickly if technical, economical, and educational challenges are met.

Market Context

- High competition in design and construction of supermarkets creates unwillingness to explore newer, unfamiliar technologies despite potential benefits.
- Low-margin business creates "chicken-and-egg" situation where supermarkets are unwilling to install new technologies until the benefits are proven, but benefits cannot be proven until supermarkets install new technologies.