# CRYOGENIC RAILCAR RESEARCH PROJECT

By
B. Hunt Ashby
Office of Transportation, USDA

## Problem Addressed

Increasing replacement and operation costs are leading to a shortage of refrigerated railcars for transporting frozen foods. The current supply of refrigerated railcars is estimated at around 18,000, but this is expected to dwindle to about 5,000 cars by 1990. The American Frozen Food Institute (AFFI) and the International Association of Refrigerated Warehouses sponsored a task force to explore alternatives to the expensive and high maintenance requirements of diesel/mechanical refrigerated railcars. Additional resource involvement and equipment contribution were provided by the USDA's Office of Transportation and the Burlington Northern Railroad.

## Methodology Used

The task force determined that cryogenic refrigeration offered the most promising alternative. The research was planned in two phases. Phase I was to determine the feasibility of using liquid $CO_2$ as an alternative refrigeration system to diesel fuel powered mechanical systems. A 54-ft long foam insulated mechanically refrigerated railcar was modified for cryogenic refrigeration. Seven 1800-mile test shipments, mainly with frozen french-fried potatoes and peas, were conducted over a 1-year period. Refrigeration was provided by spraying 11,000 to 20,000 pounds of liquid $CO_2$, depending on outside temperatures over the load at origin. The liquid $CO_2$ sublimed into snow upon injection. The snow took about 2 days to melt and lowered the average product temperature to about -40°F. At destination, after 6 to 7 days transit period, the product temperature had warmed back up to the origin temperature of 0°F.

For Phase II, a prototype $CO_2$ refrigerated car is under construction. The prototype car will be equipped with an onboard thermostatically controlled refrigeration system, and the liquid $CO_2$ supply will be carried under the floor. This prototype car will be available to frozen-food shippers on a test basis in early 1983.

## Major Findings and Their Significance to Food Distribution

Based on the results of the Phase I tests, shipping frozen foods in insulated railcars charged with $CO_2$ snow appeared both technically and economically feasible. The average cost per year for $CO_2$ refrigerant was about the same as current refrigeration service charges which are scheduled for increase. $CO_2$ for refrigerating railcars may be even more feasible in the future, considering that the prototype onboard system should reduce $CO_2$ consumption by 1/2 and require little maintenance since it has no moving parts. Furthermore, diesel fuel costs have risen 7 times faster than $CO_2$ in recent years, and $CO_2$ gas is a byproduct of a number of industrial processes.