Assistance to San Francisco transit authorities exemplifies NASA's community service effort designed to promote technology awareness

New Life for the Cable Cars

More than a hundred years ago, Scottish inventor Andrew Hallidie devised a horseless public conveyance pulled along by a moving underground cable. In 1873 he rode the prototype down San Francisco's Clay Street and that was the beginning of the city's famed cable car system.

This relic of the Victorian era is still going strong today. At nine and a half miles per hour, some 40 cars rattle and clang their way along several routes, carrying 10 million passengers a year over the city's hilly terrain. Parts have been repaired and replaced hundreds of times, but most of the cable cars are the same vehicles that were operating before the turn of the century. Over the years there have been many proposals to abolish the antique railway in the interests of safety or cost-effectiveness. Each time San Franciscans have risen wrathfully to defeat the proposal; to them the cable railway is a venerable symbol of San Francisco's colorful past, a landmark as much a part of the city's character as the precipitous hills or the scenic bay.

Now the San Francisco Municipal Railway, or "Muni," has launched a program to update the system by applying 20th century technology to a 19th century concept. The idea is to extend the service life of the cable cars while retaining their historic flavor. The basic principle of locomotion—in which a "gripman" in the car operates a long-handled gripping device to grasp the moving cable—will remain the same. The cars, some new, some rebuilt, will look exactly like the originals. But modern technology will be applied in areas not visible to the passengers, in order to upgrade the system's safety and efficiency. NASA technological expertise is playing a part in the rejuvenation effort.

Muni requested NASA input through the NASA Technology Application Team at SRI International, Menlo Park, California. Accordingly, Ames Research Center assigned an engineering/safety group to conduct a study and make recommendations as to how advanced technology might improve the system.

NASA-Ames' major recommendations involved ways of extending cable life in the interests of safety and economy. Other recommendations included redesign of the cable-gripping device, substitution of modern braking mechanisms, improvements in cable pulleys and other components, and new inspection and repair procedures.

Ames followed up by designing and installing new equipment to lengthen cable life, which averages only about two months. These cables—four of them for four different car routes—are endless belts, like ski lift cables, running from the downtown car barn to the end of each line. When a cable is installed, the loop is closed by splicing the ends together in a 72-foot-long splice. The splice is the weakest part of the cable and a source of problems. When the car operator applies his grip while over a splice, the resulting friction sometimes causes the splice to "unbraid" and fail; this means shutting down the line until the splice can be repaired. Even when unbraiding does not occur, gripping a splice shortens cable life by friction wear. Worn cables are a safety hazard and must be replaced, which is expensive at $1.60 a foot for 10,000 to 20,000 feet of cable.

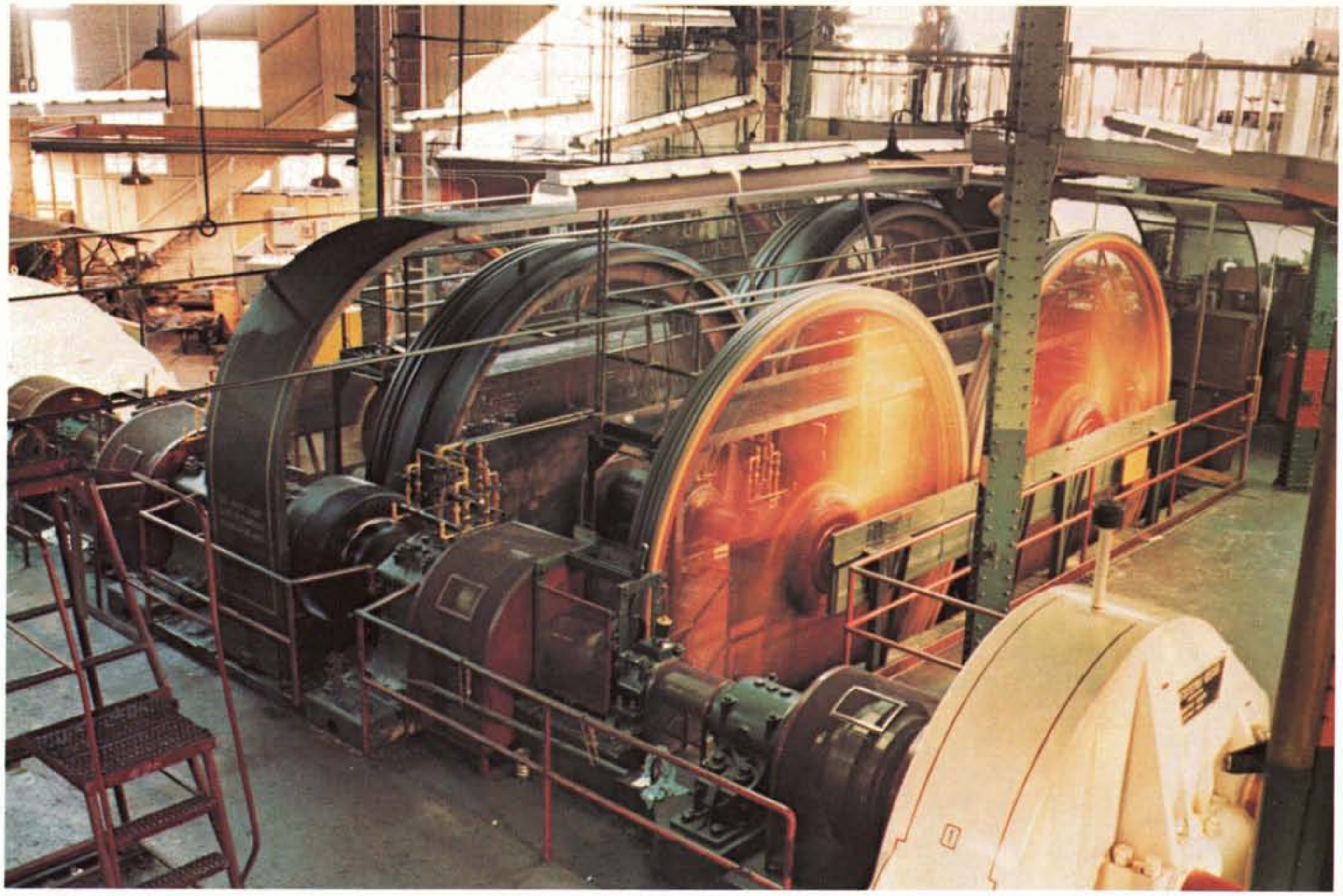
These problems occur because the gripman does not know when his car is over a splice, so the Ames team devised and installed a prototype system which alerts him. Applying magnetometer technology developed for space programs, Ames magnetized a section of the cable in an area just ahead of the splice. A magnetism sensor was mounted on the operator's gripping device. As the spliced segment of the moving cable approaches a cable car, the sensor detects the magnetic field ahead of it and triggers a whistle-like signal to the gripman for the several seconds it takes the splice to pass by. Thus, the gripman can delay gripping until the warning signal stops, thereby curbing the unbraiding problem and generally

San Francisco's century-old cable car system is being modernized and NASA is participating in the rejuvenation program. The cable car effort is an example of NASA's work with communities, which involves demonstrations of beneficial technology applications.

reducing wear in the most vulnerable part of the cable.

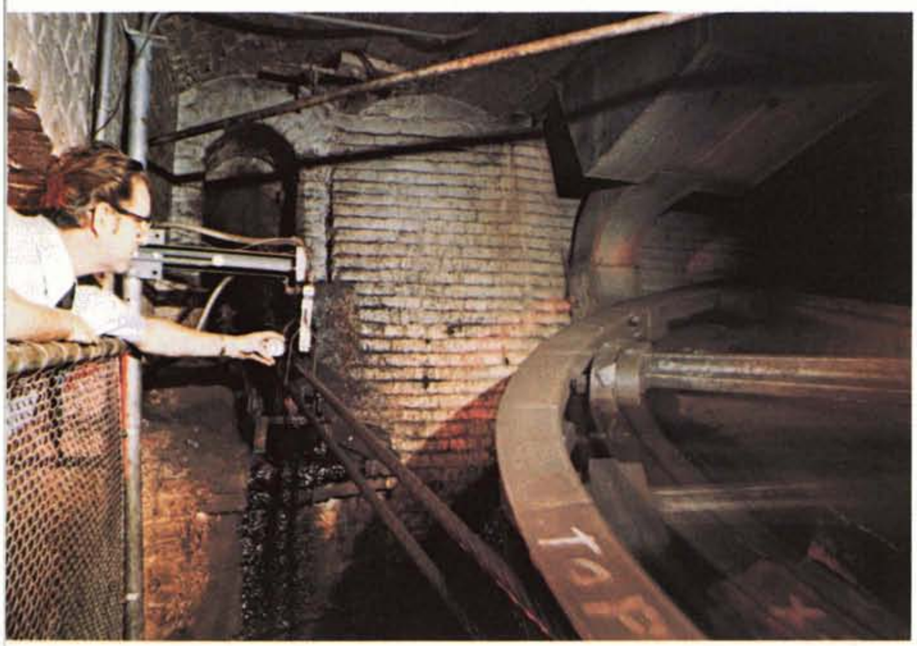
In addition, Ames installed similar sensors—one for each of the four cable lines—at the cable-winding facility in the car barn. When a spliced section approaches the winding drum, the sensor actuates a bell to notify maintenance personnel; a light signal tells them which line to watch. In this manner, Muni technicians can make periodic inspections of the splices without constantly standing at the winding facility waiting for a splice to appear. Ames is continuing to monitor these improvements and is working on another, a new, friction-easing grip in which the cable slides easily through rollers rather than through the "nutcracker" clasping mechanism currently in use.

The cable car project exemplifies a special area of NASA's technology utilization effort: service to communities through demonstrations of advantageous technology. In the interests of broadening technology awareness, NASA provides technological assistance to community groups, state and local governments, medical institutions and other organizations. In this type of work, NASA seeks to show how the application of new technology may help solve major problems or produce better ways of meeting public needs. Development of equipment for demonstrations may later result in some product spinoff, but that is not the primary goal. The principal aim is to inspire community sponsorship of beneficial technology applications. The following pages contain other examples of NASA community service projects.



The large spools in the upper photo are cable winding drums in the Muni car barn. Each of the four cable lines passes through the winding facility, where Muni technicians make periodic inspections of the cable splices. But since the cables are two to four miles long, waiting for a splice to appear is a time-consuming process. To eliminate long waits and make better use of technicians' time, NASA-Ames installed a sensory alert system, shown undergoing a check-out in the lower photo. Sensors—one for each of the four lines—detect the approach of a splice and actuate a bell to notify maintenance personnel, simplifying the visual inspection process. In developing sensors for both the winding facility and the cable car grip, NASA-Ames applied magnetometer technology originally developed for space programs.

In the cable car barn, through which the moving cables pass, an Ames Research Center engineer is testing a magnetism sensor, part of a NASA-designed system for reducing cable wear. A similar sensor on the car operator's grip detects magnetism in spliced areas of the cable and warns the gripman to delay gripping, thus easing friction on the most vulnerable part of the cable.



In the photo, technicians of the San Francisco Municipal Railway—"Muni"—are exchanging a cable car's grip, used by the operator, or "gripman," to clasp the moving cable which pulls the car along. NASA's Ames Research Center is improving the grip design.