APPLICATION OF MICROWAVE TELEMETRY TO GRADE CROSSING PROTECTION

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PROGRAM PLAN

The Rail Safety Act of 1970 gives the Secretary of Transportation, acting through the Federal Railroad Administration, broad authority and responsibility for promotion of safety in railroad operations and reduction of rail-related accidents. This goal is to be achieved through prescription of rules and regulations, and through conduct of research, development and testing. One major area — explicitly delineated in the Safety Act — is that of grade crossing accidents. These account for nearly two-thirds of rail-associated deaths; each year approximately 1500 people die and more than 3000 are injured in train-motor vehicle collisions. One important contributing factor is the limited installation of automatic warning devices, such as flashing lights and gates. Only 20% of the 225,000 crossings in this country have such protection, the remainder being marked only by passive signs.

The relatively slow rate at which automatic protective systems are being installed (1000-2000 per year) is due in large part to the high associated costs -- a simple flashing light installation can easily require an expenditure of $15,000-$20,000, with gates costing substantially more, and moderately complex installations have a price of as much as $100,000. The expense of such systems is in part due to the very difficult environment in which they typically must operate and the extremely high reliability required when human life is involved. Protection costs are typically composed of three major components: hardware, installation labor, and annual maintenance, and a serious attempt at cost reduction must come to terms with all of these.

The goal of the Transportation Systems Center program, performed under FRA sponsorship, is exploration, development and implementation of new concepts for grade crossing protection, making use of relevant areas of modern technology to bring about lower cost, greater effectiveness, and more widespread installation at a wide variety of crossings.

One early result of this program, illustrating the transfer of NASA and Department of Defense technology to transportation problems, focuses on the most expensive aspect of most installations -- activation of the warnings. A major part of the cost of conventional grade crossing protective systems is associated with the use of track circuits, which necessitate expensive hardware and substantial installation and maintenance costs. A promising alternative approach, now being developed at TSC, utilizes a low-cost, highly reliable microwave telemetry link between the train-sensing point required for adequate warning -- typically 1/2-1/4 mile down track from the crossing -- and the highway signals at the crossing. Very low power consumption is possible, permitting operation from batteries on a yearly replacement schedule, eliminating the need for line-power installation. The final system should contribute to all aspects of protection expense (hardware, labor and maintenance) and holds the promise of 20%-50% reduction in cost.

Such a system also permits communication of more detailed information than simply train presence, allowing more effective protective systems where safety and public convenience warrant the additional cost. Such additional information could include the speed of the approaching train, its length and other descriptive factors that bear on safe operation.

As of June 1971, appropriate preliminary circuits have been designed, constructed and tested in the laboratory, and is indicated in Figure 1. The overall system has been subjected to careful analysis and both feasibility and the likelihood of substantial cost-reduction have been established. An actual installation would appear as seen in Figure 2.

The task of FY72 is to design, construct, and field test more advanced circuits which are optimal with respect to cost, reliability, and power consumption for realistic conditions. The specialized nature of such development makes it appropriate that

the design and fabrication be done under contract. TSC will carry out testing and evaluation. Such an effort should yield optimized engineering prototypes of the necessary hardware, along with a meaningful evaluation of system performance in actual use, in parallel with existing signals. Performance will be recorded. Sites will be selected to cover a spectrum of weather and severe conditions including severe winter, extreme desert, extreme humidity, etc.

Under the schedule originally planned, shown on the attached chart, a contract for four units was to be negotiated by October 1971, with delivery in February and initiation of field tests not occurring until April 1972. This was to be accomplished under a total grade crossing funding (including several other tasks) of $200,000 with 2 man-years of effort at TSC.

The new accelerated program is also shown on the chart. It is budgeted at $370,000 and 3 man-years, calls for signing of a contract by September, with delivery of an engineering model and preliminary testing initiated by November, and delivery of 10-15 engineering prototypes by December so that field tests can begin prior to winter. The expanded number of systems will permit testing in a larger variety of locations and climatic conditions. In addition, improved laboratory models constructed at TSC will be given limited field tests beginning in August to guide development of prototypes and gain insight into desirable test procedures. Implementation of actual demonstrations, with activation of advance warnings, should be possible by late 1972.

The program as planned will result in the field demonstration of the use of modern low-power low-cost solid state microwave technology to simplify and reduce the cost of grade crossing warning devices. Engineering models produced by commercial concerns in accordance with performance specifications developed by TSC will be evaluated for performance, reliability, simplicity,

conformance with railroad requirements, climatic conditions and maintainability. Estimates of cost to manufacture in quantity and to install the units will be obtained. The specifications will be modified in accordance with test experience, to permit quantity procurement of units by the using agencies.

Grade Crossing Protective Systems

RR202

FY72

Resource Requirements

	Orig. Sch. (2 MY)	Acc. Sch. (3 MY)
Salaries, indirect, etc.	92 K	138 K
Equipment (incl. antennas)	32	42
R&D Contracts	70	180*
Other	6	10
TOTAL	200 K	370 K

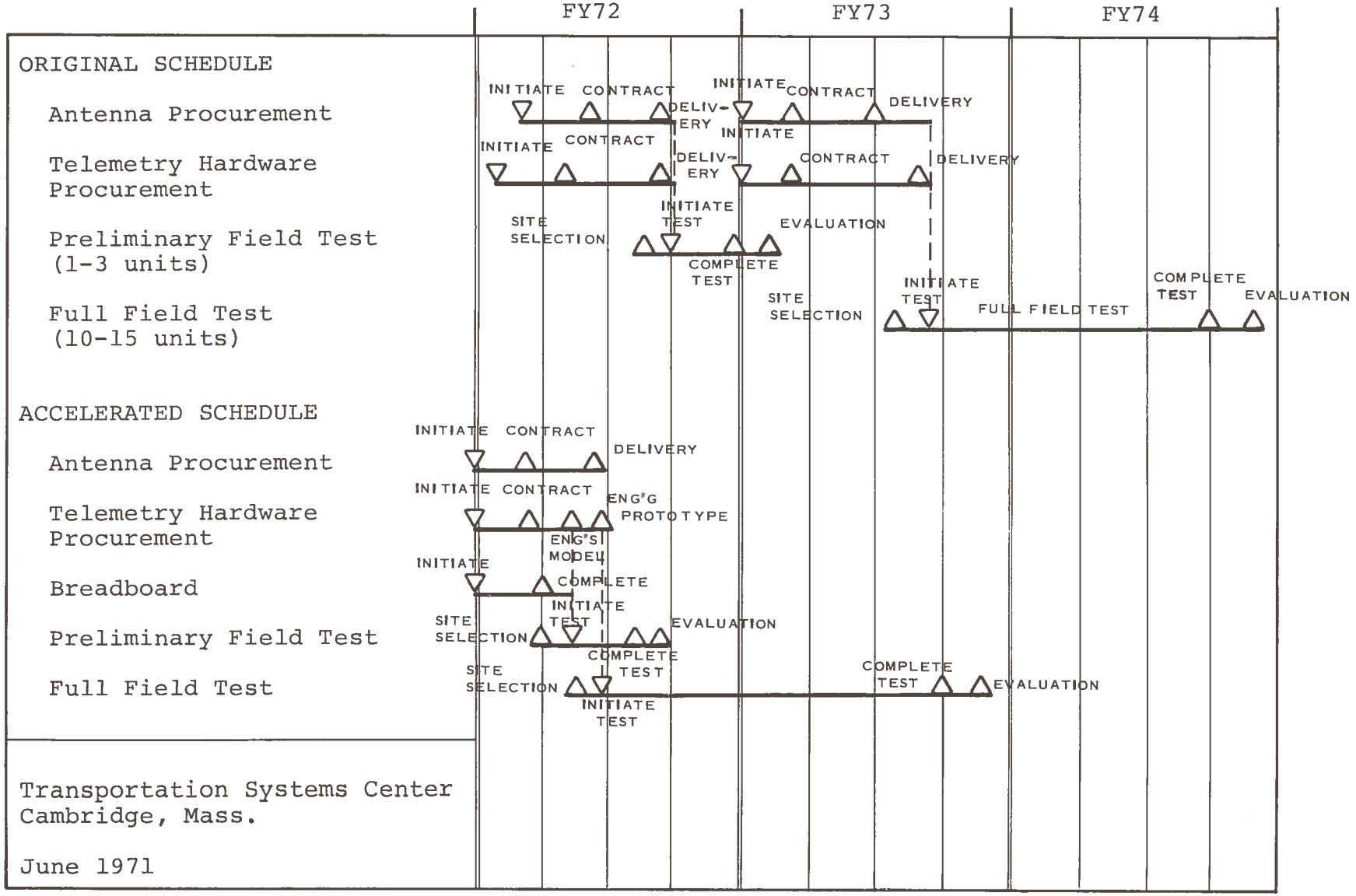
*Contracts under Accelerated Schedule:

Telemetry Hardware	100 K
Radar	60 K
Sensors	20 K

Figure 1

Figure 2

COMPARISON OF ORIGINAL AND ACCELERATED DEVELOPMENT AND TEST SCHEDULES
FOR THE GRADE CROSSING MICROWAVE TELEMETRY SYSTEM



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