PROJECT PLAN

FOR

FEDERAL RAILROAD ADMINISTRATION

RESEARCH LOCOMOTIVE AND TRAIN HANDLING
EVALUATOR

THIS PROJECT PLAN IS SUBMITTED UNDER CONTRACT DOT-FR-9142
By Teledyne Ryan Aeronautical

NOVEMBER 28, 1979

TELEDYNE RYAN AERONAUTICAL

Dynamic Sciences

21 - Freight Operations

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

SECTION

SECTION 1.0
INTRODUCTION

1.0 INTRODUCTION

The Federal Railroad Administration of the United States Department of Transportation has contracted with the Teledyne Ryan Aeronautical Company for the design, fabrication, test, delivery and installation of a Locomotive and Train Handling Evaluator (LATHE). TRA has teamed with Dynamics Sciences, Incorporated as its major subcontractor for this effort. TRA will also issue additional subcontracts for many of the subsystems and components as well as consultation services during the life of this contract.

The Evaluator will be a research tool for providing data on the performance of engine crews during simulated train operation. As a research tool, the Evaluator will have extensive capabilities for collecting data and recording it for evaluation.

This Project Plan displays the interrelationships of the activities to be performed under this contract through Task Network Charts and a Master Work Schedule (Section 3). These documents highlight critical events which are discussed in Section 4.

This is followed by Section 5 on management and reporting procedures. This Program Management section describes our organizations, how costs are controlled and the mechanisms of our technical management.

Section 6 is included to demonstrate through examples of actual project documentation, our understanding of the tasks, and some of the methodology used to accomplish these functions.

In order to provide a stand-alone document which can be a convenient reference for the project, considerable effort has been given to extract summary

1.0 INTRODUCTION (Continued)

information regarding the Program for inclusion into the Appendix. A procedure for the expedious development and control of drawings is also enclosed in the Appendix.

This volume is followed by Volume II: Quality Assurance Plan and Volume III: Documentation Plan.

1.1 APPLICABLE DOCUMENTS

The documents applicable to this Project Plan are listed below:

2.1 Contract: DOT-FR-9142

2.2 Sales Order: 15651

2.3 Contract Statement of Work dated 7 September 1979

2.4 Contract Specification dated 7 September 1979

2.5 D.S.I. Statement of Work dated 7 November 1979

SECTION 2.0
SCOPE

2.0 SCOPE

This Project Plan, the enclosed Quality Assurance Plans (Volume II), and the Documentation Plan (Volume III) are submitted in accordance with the Contract Statement of Work under Contract DOT-FR-9142. All subject matter required by paragraph 2.2 of the S.O.W. has been covered thoroughly.

As required in the S.O.W., this Project Plan will be maintained. As is clear from the Task Network Charts, considerably greater detail is shown over the early months of the program. As better information becomes available, greater detail will be incorpored in these charts.

We expect to work to this Plan and to achieve the cost and calendar objectives.

SECTION 3.0
MASTER WORK SCHEDULES

3.0 WORK SCHEDULE

The accompanying pages of this section contain a series of work flow networks for each of the Evaluator Subsystems plus a Master Work Schedule which provides an overview of significant program events and critical milestones.

3.1 Work Flow Networks

The Work Flow Networks present the sequence of task events in each WBS element as well as illustrate the interrelationship of each task to all other tasks in the Evaluator project. The work to be completed during each task period is identified above the corresponding task line. Completion of the task is indicated by the terminating bubble. The planned time span allowed for each task, in weeks, is shown to the left of the task completion bubble.

Critical tasks are indicated on the Work Flow Network by the addition of an inverted solid triangle figure within the task completion bubble. Section 4.0 includes a brief paragraph containing amplifying information related to each critical task. A key number, shown above or below the task completion bubble of each critical task, relates the critical task to the accompanying paragraph.

Critical paths, which include a sequencial series of critical tasks, are indicated by a heavy dashed line of the Work Flow Network.

3.2 Master Work Schedule

The Master Work Schedule presents key program events related to calendar schedule. The initial heading summarizes the major program milestones. Succeeding headings present a summary work schedule for each WBS element. All critical milestones are shown in each WBS section together with the key number in parenthesis which relates the critical milestone to the discussion paragraph presented in Section 4. The Master Work Schedule is intended to provide a convenient means of relating critical milestones to calendar date.

The final heading on the Master Work Schedule presents other significant milestones including documentation and report submittal dates.

3.3 Task Progress Reporting

Program progress reporting will be related to the Work Flow Networks and the Master Work Schedule to support the maintenance of these charts to reflect current project status. Completed progress may then be related to cost expenditures on a per WBS basis to establish budget progress.

Both the Work Flow Networks and the Master Work Schedule are intended as working documents. The Work Flow Network is presented in much greater detail in the early program phases than in later phases. As greater detail becomes available, the Work Flow Networks will be updated, as required, to support ongoing project management visibility. Also, the critical/non-critical status of events may change as the project advances. The Master Work Schedule will be updated to reflect the current status of the project.

TRAIN EVALUATOR WORK FLOW NETWORK			
REVISION	DATE	PREPARED BY	APPROVED BY
1	1-22-80	E SOLARSKI	[illegible]
2	2-1-80	E SOLARSKI	[illegible]

SHEET 4 OF 4

TRAIN EVALUATOR
WORK FLOW NETWORK

REVISION	DATE	PREPARED BY	APPROVED BY
1	1-22-80	C. SOLARSKI	
2	2-1-80	C. SOLARSKI	

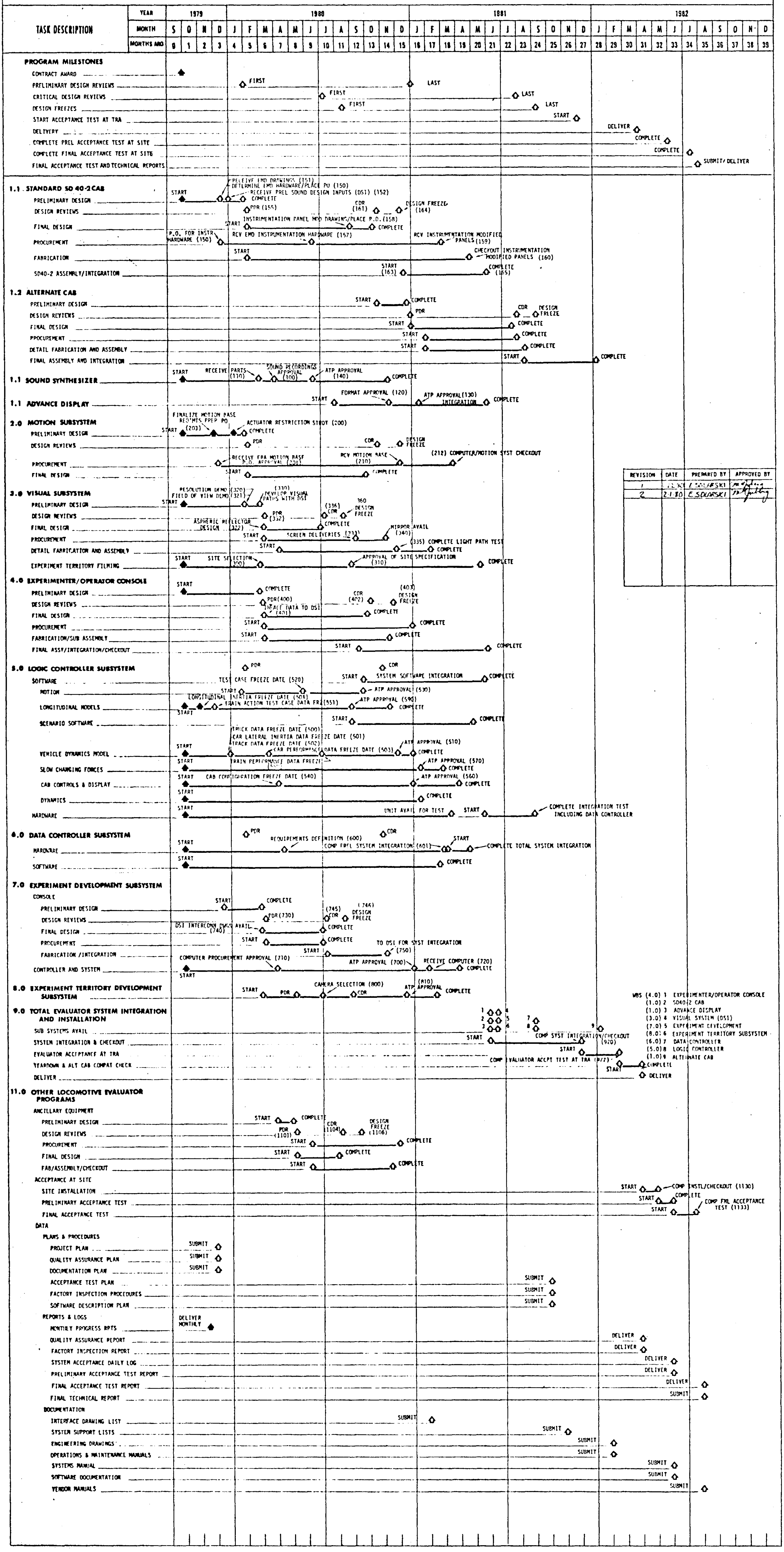
SHEET 3 OF 4

VISUAL SYSTEM 30
ANCILLARY EQUIPMENT 11.0
EXPERIMENTAL DEVELOPMENT CONSOLE 70
EXPERIMENT OPERATORS CONSOLE 40
CONTRACT AWARD
TO SYSTEM INSTALLATION AND CHECKOUT
TRAIN EVALUATOR
WORK FLOW NETWORK
REVISION | DATE | PREPARED BY | APPROVED BY
1 | 1-22-80 | E. SOLARSKI
2 | 2-1-80 | E. SOLARSKI
SHEET 2 OF 4

REVISION	DATE	PREPARED BY	APPROVED BY
1	1-22-80	E. SOLARSKI	
2	2-1-80	E. SOLARSKI	

SHEET 1 OF 4

LATHE PROGRAM MASTER WORK SCHEDULE



SECTION 4.0
CRITICAL EVENTS

4.0 CRITICAL TASKS & SEQUENCES

The Task Networks enclosed in the previous section identify a number of "critical" events, as well as several "zero slack" paths; one of which is identified as The Critical Path.

4.1 Critical Events

A number of events are identified as "critical". These events include FRA approvals of data, PDRs, CDRs, interface definitions, procurement releases and vendor deliveries.

The events are numbered with a reference number. These events are flagged by the solid triangle symbol and its reference number.

These numbers are listed sequentially below, and describe the event briefly.

Highlighting of these events directs our attention to them and causes us to develop tentative back-up for work-around plans.

100 This event is the approval of the specific sound recordings to be simulated by the sound system.

110 This event is identified as critical due to the anticipated long lead time of the computer components to be used in the sound synthesizer system.

120 This event is the final selection of the four operational Advanced Display formats to be delivered with the Evaluator.

130 This event is approval of the Acceptance Test Procedure for the Advanced Display System.

140 This event is the approval of the Acceptance Test Procedure for the Sound Synthesizer.

150 This event is the identification of all hardware item to be purchased from EMD which require extensive modification. The event includes the release of the Purchase Order for these items.

151 This event marks the date after which EMD drawings of the Cab are available at TRA.

152 This event is the establishment of the preliminary sound system inputs from DSI.

155 This event is the FRA approval of the Cab and Motion Base PDR.

157 This event is receipt of the EMD hardware purchased in event 150.

158 This event is the completion of the drawings for the Circuit Breaker, Train Override, Switch/Fuse for the panels.
This event is release of the P.O. for the event 158 panels.

159 This event is the delivery of the event 158 panels.

160 This event is the checkout of the event 158 panels.

161 Cab and Motion Base CDR. Procurement specifications, drawings, schematics complete. Fabrication and Assembly underway.

163 This event is the start of the SD40-2 Cab Integration.

164 Cab and Motion Base Design Freeze. FRA approval of final design package presented at CDR.

165 This event is the completion of the SD40-2 assembly and integration.

200 This event is the completion of a study conducted to establish the physical boundaries.

201 This event is the completion of the P.O. for the Motion Base System.

203 Final Selection of Motion Base Vendor dates finalized; price and delivery confirmed, PR cut, submitted for FRA approval.

210 This event is receipt of the Motion Base System.

212 Computer driven test of Motion Base with Cab attached.

300 This Critical Decision Date marks the selection of the railroad territory to be filmed for the initial Experiment Territory.

310 This document defines the site preparation task required prior to commencement of the filming task. Following FRA approval.

320
321
322 These events mark the final design trade-off tests and analysis review for the optical aspects of the forward view visual system. The review of these items will be the visual system PDR and will determine the design parameters for the Experiment Territory System as well as components of the Visual System and the Logic Controller software.

330 Visual Path determination. Basic parameter needed by TRA/DSI. Determines screen size, placement; defines projector and mirror requirements. Data going into this activity includes motion base travel, locomotive motion, and window sizes.

332 Screen PDR. Visual Path determined; preliminary layouts generated, analyses completed, vendor data verified.

333 Screen Deliveries. These procurement items can become critical problems and are therefore flaged. The front (curved) screen is a particular risk procurement and will be monitored regularly. Additionally, tests will be conducted during the procurement to determine the best pointing and seaming procedures.

335 Proof of light path design using mirror and 100^{o} screen.

336 Screen CDR. Drawing completed, mockup finished, fabrication and assembly underway.

340 Aspherical Mirror (light relay). The mirror is to be delivered to TRA during the 11th month (ARO). This is required in order to ensure proper mounting, vibration isolation, and screen testing.

360 Screen Package Design Freeze. FRA approval of final design package presented at CDR.

400 Experimenter/Operator Console PDR. Requirements defined; preliminary Human Factors and other Studies complete; Preliminary Design accomplished. Mockup available for inspection.

401 Console Interface Data to DSI. This dates requirement critical to software requirements definition phase.

402 Experimenter/Operator Console CDR. Drawings, Schematics, Wire lists complete, fabrication and assembly under-way.

403 Experimenter/Operator Console Design Freeze. Approval by FRA of final design package presented at CDR.

500
501
502
503,504 These freeze dates are the points in time when the data base which describes the locomotive and car properties to be simulated are fixed for purposes of determining the delivered representation of these elements in the Evaluator.

510 This event is the approval of the Acceptance Test Procedure that will be used to demonstrate compliance of the vehicle dynamic model with the performance data check cases.

520 This event marks the completion of the motion test cases which will be used to demonstrate the motion system.

530 This event is the approval of the Acceptance Test Procedure for the motion system performance.

540 This event is the selection of the locomotive cab and instruments to be simulated.

550 This event marks the date on which the total train performance data package will be frozen. The simulated train will be tested to this data package.

551 This freeze date fixes the performance data base which will be used to demonstrate the simulation of longitudinal car action.

560 This event is the approval of the Acceptance Test Procedures for locomotive cab system.

570 590 These events mark the approval of the Acceptance Test Procedures which will be used to demonstrate the performance of the entire longitudinal train.

600 This event marks the definition of data I/O requirements.

601 This event marks completion of system integration tasks.

700 This event is the approval of the Acceptance Test Procedure for the Experiment Development System. This system must be available to support the post-production of the Experiment Territory Film and data record.

710 This event is the approval of the computer complex hardware used in the Experiment Development System. The computer complex is expected to be a long lead time procurement item.

720 This event marks the delivery of the computer hardware for the Experiment Development System.

730 Experiment Development Console PDR. Preliminary layout drawings and electrical requirements will be presented.

740 Experiment Development Interface requirements. DSI/TRA joint effort to define computer/console interfaces.

745 Experiment Development Console CDR. Assembly drawing complete, cable and interconnect drawings complete. Fabrication and assembly begun.

746 Experiment Development Console Design Freeze. FRA approval of final design package presented at CDR.

750 DSI Hardware Delivery. The sound synthesizer and the computer equipment are to be delivered to TRA for integration.

800 This event is the completion of the system requirements definition for the Experiment Territory System.

810 This event is the approval of the Acceptance Test Procedure for the Experiment Territory System. The Experiment Territory System is required to support the territory film making.

920 Marks the completion of the total system integration. All sub-systems operating together in all modes.

922 Successful operation of all A.T.P.s at TRA temporary facility. Marks the final phase of the operation at TRA.

1101 This event is the FRA approval of the support equipment PDR. Preliminary Layout complete.

1104 Support Equipment CDR. Assembly Drawings complete equipment lists, design proof calculations completed.

1106 Support Equipment Design Freeze. FRA approval of final design package presented at CDR.

1130 Successful installation at final site. Ready to begin ATPs.

1133 Marks the successful completions of final ATPs. Equipment turned over to FRA.

4.2 Critical Sequences

Several "zero slack" sequences of events have been identified as a result of the development of the Work Flow (Task) Networks. They are marked with a heavy dashed line, and are discussed in turn below.

4.2.1 CAB Instrument Path

Because most of the active instruments to be placed in the SD40-2 cab must be modified for data bus interface, and because of the quoted procurement cycle from EMD, no slack is provided in this path.

The situation may be alleviated by one of several approaches.

The procurement cycle itself may be expedited, as EMD has indicated that a 6 months delivery is conservative. Secondly, some recovery can be effected by adding staff members for the design effort. Thirdly, there are several good vendors who specialize in modifying instruments for simulators, so that a high probability of quick turnaround is expected.

Where choice exists, the most cost effective action will be chosen.

4.2.2 Motion Base Path

This path shows zero slack because of the inordinate delivery guarantees now being offered by all motion base vendors.

4.2.2 Motion Base Path (Continued)

This sequence is being alleviated through the early placement of a purchase order to the vendor. This required an early evaluation of the motion base requirements, and will require expeditious approval by FRA of the purchase.

A secondary consideration is that if the motion base delivery slips, staff will be diverted to cab integration activities so that when the motion base is delivered, the whole staff can be devoted to it.

4.2.3 Logic Controller Software Path

This is a zero slack path because a rather difficult analysis and trade off study must proceed the design development for the math model programming.

Two approaches for expediting these functions have been suggested. The first is to build a much simplified model for the purpose of early integration efforts; the second is to place extra staff on the task. Again, the most cost effective solution will be chosen.

4.2.4 Territory Film Path

This path has been identified as The critical path.

The reason this sequence presents a problem is that several parameters of the camera system must be determined in series e.g. the film format, field of view, etc., only then can the camera be specified.

4.2.4 Territory Film Path (Continued)

A possible method to expedite this development might be to develop the camera control system in parallel with the camera selection. This would require a retrofit of the camera on the mount. Additional staff could hasten the development, but at extra expense.

SECTION 5.0
PROGRAM MANAGEMENT

5.0 PROGRAM MANAGEMENT

5.1 Content and Organization of this Section

This section of the Project Plan is related to Sections 3.0 and 4.0 in terms of how the program is to be managed to achieve those tasks outlined within budget and on schedule. Therefore, the initial part of this section relates the manpower and cost plans necessary to complete the network tasks and to the method of reporting progress. Subsequent sections address the methodology of achieving technical concurrence from the FRA through the formal design reviews, and the program organization and planning of how the organization interfaces, both at TRA and DSI.

5.2 Tracking and Control

All tracking and control of the program are coordinated with the task network and milestone schedule. The manpower and cost plans are generated to coincide with the structure of the network charts which are oriented to CES elements. This insures reporting at the level required by contract.

5.3 Manpower and Cost Plans

The cost plans provided herein depict manpower required to accomplish each task within the CES reporting element on a calendar month basis and the costs related in terms of dollars for those corollary manhours in addition to material and Other Direct Costs (ODC). Again this is provided on a monthly basis per each CES reporting element. Both of these plans are further broken down from the combined TRA and DSI program CES elements into the individual company's efforts. This provides management of both companies and the FRA with the visibility to assess program problems and to take necessary corrective actions.

5.3.1 Manpower Plan - Both TRA and DSI had expected to manage the program in accordance with the manpower plan provided in the negotiated cost proposal. TRA's cost proposal described a functional management approach, however, because of the close TRA/DSI program administration and technical coordination demands, and the need for rapid and precise cost, schedule, and performance control, TRA has formed a single unit projectized management organization. A small and efficient project staff along with assigned engineers, procurement, manufacturing control, etc. personnel are colocated in a dedicated work area. TRA has reviewed the economies of the projectized approach and incorporated these economies along with negotiated descoped items into the manpower plan enclosed in this section. Further, this plan reflects tasks performed early-on after the effective contract date that resulted in additional DSI expenditures and lower TRA expenditures to the post negotiation plan, including budget recovery to the manpower plan.

5.3.2 Cost Plan - The cost plan is a dollar expenditure plan related to the manpower plan and includes other costs as previously stated. The cost plan is stated in dollars and is the original cost proposal (less negotiations) baseline. Revisions from that plan are shown as the scheduled expenditures and take into consideration the under expenditures by TRA in manpower and over expenditures by DSI to date, revised material expenditures

5.3.2 Cost Plan (Continued)

coordinated to the network and master work schedules, and rate changes commensurate with calendar expenditures of manpower.

Note: The rationale as to TRA's and DSI's variance to the negotiated plan along with a description of both companies' approach and schedule to recover to the plan has been included as amendment dated 30 November 1979 to the 15 November Monthly Progress Report.

5.4 Monthly Progress Report

The combined TRA/DSI Program Monthly Progress Reports will be submitted on the 15th of each month following the previous month's end. The Monthly Progress Reports will summarize highlights of monthly technical effort on the overall work being performed under the Contract, comparing the actual schedule, cost performance, and manhours of each CES Element with the Project Plan, Master Work Schedule, the Cost Plan, and the Manhours Plan. The Progress Report will contain a brief narrative describing:

a) current versus planned status, as well as projections for meeting major objectives and milestones,

b) significant accomplishments for the reporting period,

c) technical, cost or schedule problems and a recommended corrective action plan (includes dates),

d) detailed description of the work planned for the next three months.

The following PEDD printout for the period 10 September through 25 November 1979 is presented in an interim format as stipulated in the TRA LATHE Monthly Progress Report for the period 28 September through 2 November 1979. The following is provided to assist in understanding the data as presented on the printout:

(1) WBS/TSO # relates to the WBS or CES item and TSO # is a PEDD file number/computer program address.

(2) Package Description is the WBS/CES item title.

(3) Package Number is a sequential number which will vary dependent on the number of specific tasks within a WBS element by performing organization.

(4) Performing Organization Code - is a number representing a particular organization (i.e. 86 = mechanical design, 87 = electrical design, etc.). For the interim PEDD, TRA is represented by Performing Organization 90 and DSI by 95.

(5) Department Code is either TRA or DSI.

(6) Responsibility Code (RESP) is utilized to identify Planned, Scheduled and Actual Manhours as follows:

01 = TRA Planned Manhours
02 = TRA Scheduled Manhours
03 = TRA Expended Actual Manhours
04 = DSI Planned Manhours
05 = DSI Scheduled Manhours
06 = DSI Expended Actual Manhours

The printout permits comparing Planned or Scheduled vs. Actual Manhour Expenditures by:

a) WBS TRA
b) WBS DSI
c) Total TRA
d) Total DSI
e) Total Program

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS	TSO #	Package Description	Pkg No.	Perf Org	Dept	Resp		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
1.0	0001	Cab/Alt Cab Structure S/S	000	90	TRA	01	Labor										554	475	458	1487	1487
1.0	0002	Cab/Alt Cab Structure S/S	000	90	TRA	02	Labor										554	467	130	1151	1151
1.0	0003	Sound System	000	95	DSI	03	Labor											64	50	114	114
1.0	0004	Sound System	000	95	DSI	04	Labor											32		32	32
2.0	0005	Motion Subsystem	000	90	TRA	01	Labor										46	96	136	278	278
2.0	0006	Motion Subsystem	000	90	TRA	02	Labor										46	72	64	182	182
3.0	0007	Visual Subsystem	000	90	TRA	01	Labor										30			30	30
3.0	0008	Visual Subsystem	000	90	TRA	02	Labor										30		24	54	54
3.0	0009	Visual Subsystem	000	95	DSI	03	Labor										77			77	77
3.0	0010	Visual Subsystem	000	95	DSI	04	Labor										77		40	117	117
4.0	0011	Experimental/Operator Console	000	90	TRA	01	Labor										333	348	190	871	871
4.0	0012	Experimental/Operator Console	000	90	TRA	02	Labor										333	301	66	700	700
5.0	0013	Logic Controller S/S	000	95	DSI	03	Labor										2510	1160	930	4600	4600
5.0	0014	Logic Controller S/S	000	95	DSI	04	Labor										2511	1274	204	3989	3989
6.0	0015	Data Controller S/S	000	95	DSI	03	Labor										952	286	230	1468	1468
6.0	0016	Data Controller S/S	000	95	DSI	04	Labor										952	323	160	1435	1435

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
7.0 0017	Experiment Development S/S 000 90 TRA 01 Labor										40			40	40
7.0 0018	Experiment Development S/S 000 90 TRA 02 Labor										40		24	64	64
7.0 0019	Experiment Development S/S 000 95 DSI 03 Labor										624	320	250	1194	1194
7.0 0020	Experiment Development S/S 000 95 DSI 04 Labor										624	368	95	1087	1087
8.0 0021	Experiment Territory Dev. S/S 000 95 DSI 03 Labor										160	184	145	489	489
8.0 0022	Experiment Development S/S 000 95 DSI 04 Labor										160	192	100	452	452
9.0 0023	Total Eval Sys Integ & Instl 000 90 TRA 01 Labor										188	407	260	855	855
9.0 0024	Total Eval Sys Integ & Instl 000 90 TRA 02 Labor										188	398	161	747	747
9.0 0025	Total Eval Sys Integ & Instl 000 95 DSI 03 Labor														
9.0 0026	Total Eval Sys Integ & Instl 000 95 DSI 04 Labor														
11.0 0027	Other Loco. Eval Progr Efforts 000 90 TRA 01 Labor									645	742	557	400	2344	2344
11.0 0028	Other Loco. Eval Progr Efforts 000 90 TRA 02 Labor									645	742	548	396	2331	2331
11.0 0029	Other Loco. Eval Progr Efforts 000 95 DSI 03 Labor										808	424	340	1572	1572
11.0 0030	Other Loco. Eval Progr Efforts 000 95 DSI 04 Labor										768	536	240	1544	1544

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
	01									645	1933	1883	1444	5905	5905
	02									645	1933	1785	865	5228	5228
	03										5131	2438	1945	9514	9514
	04										5092	2725	839	8656	8656
	01 + 03									645	7064	4321	3389	15419	15419
	02 + 04									645	7025	4510	1704	13884	13884

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
1.0 0001	Cab/Alt Cab Structure S/S 000 90 TRA 01 Labor	579	788	1024	1583	976	1113	1506	772	747	846	604	340	10878	12365
1.0 0002	Cab/Alt Cab Structure S/S 000 90 TRA 02 Labor														1151
1.0 0003	Sound System 000 95 DSI 03 Labor	240	320	280	240	240	240	200	160	160	123	128	128	2459	2573
1.0 0004	Sound System 000 95 DSI 04 Labor														32
2.0 0005	Motion Subsystem 000 90 TRA 01 Labor	193	125	85	113	131	122	129	81	91	110	227	317	1724	2002
2.0 0006	Motion Subsystem 000 90 TRA 02 Labor														182
3.0 0007	Visual Subsystem 000 90 TRA 01 Labor	212	226	251	265	290	354	413	238	118	110	83	41	2601	2631
3.0 0008	Visual Subsystem 000 90 TRA 02 Labor														54
3.0 0009	Visual Subsystem 000 95 DSI 03 Labor	840	840	1280	575	575	575	535	574	495	520	520	520	7849	7926
3.0 0010	Visual Subsystem 000 95 DSI 04 Labor														117
4.0 0011	Experimental/Operator Console 000 90 TRA 01 Labor	325	300	250	288	186	384	311	466	400	417	394	407	4128	4999
4.0 0012	Experimental/Operator Console 000 90 TRA 02 Labor														700
5.0 0013	Logic Controller S/S 000 95 DSI 03 Labor	1200	1600	1800	1250	1249	1256	1423	1383	1390	1544	1371	1419	16885	21485
5.0 0014	Logic Controller S/S 000 95 DSI 04 Labor														3989
6.0 0015	Data Controller S/S 000 95 DSI 03 Labor	360	400	440	745	706	682	696	656	655	340	280	280	6240	7708
6.0 0016	Data Controller S/S 000 95 DSI 04 Labor														1435

Note: TRA Resp 01=Scheduled; 02=Actuals   LATHE Program   DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
7.0 0017	Experiment Development S/S 000 90 TRA 01 Labor	57	49	77	106	137	94	109	107	151	194	70	36	1187	1227
7.0 0018	Experiment Development S/S 000 90 TRA 02 Labor														64
7.0 0019	Experiment Development S/S 000 95 DSI 03 Labor	180	140	100	254	253	253	254	253	283	174	173	173	2490	3684
7.0 0020	Experiment Development S/S 000 95 DSI 04 Labor														1087
8.0 0021	Experiment Territory Dev. S/S 000 95 DSI 03 Labor	140	130	130	333	333	334	333	333	254	173	173	174	2840	3329
8.0 0022	Experiment Territory Dev. S/S 000 95 DSI 04 Labor														452
9.0 0023	Total Eval Sys Integ & Instl 000 90 TRA 01 Labor	554	516	416	539	526	614	891	960	952	923	365	378	7634	8489
9.0 0024	Total Eval Sys Integ & Instl 000 90 TRA 02 Labor														855
9.0 0025	Total Eval Sys Integ & Instl 000 95 DSI 03 Labor														
9.0 0026	Total Eval Sys Integ & Instl 000 95 DSI 04 Labor														
11.0 0027	Other Loco. Eval Progr Efforts 000 90 TRA 01 Labor	479	402	402	718	574	593	686	601	610	778	470	429	6742	9086
11.0 0028	Other Loco. Eval Progr Efforts 000 90 TRA 02 Labor														2331
11.0 0029	Other Loco. Eval Progr Efforts 000 95 DSI 03 Labor	420	400	380	500	500	500	500	500	500	525	525	525	5775	7347
11.0 0030	Other Loco. Eval Progr Efforts 000 95 DSI 04 Labor														1544

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS TSO #	Pkg No. Perf Org Package Description Dept Resp		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
		01	2399	2406	2505	3612	2820	3274	4045	3225	3069	3378	2213	1948	34894	40799
		02														5228
		03	3380	3830	4410	3897	3856	3840	3941	3859	3737	3399	3170	3219	44536	54050
		04														8656
		01 + 03	5979	6236	6915	7509	6676	7114	7986	7084	6806	6777	5383	5167	79430	94849
		02 + 04														13884

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals Page 1

Run 12/20/79 (11:00)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
1.0 0001	Cab/Alt Cab Structure S/S 000 90 TRA 01 Labor	510	456	261	329	289	236	483	379	429	355	260	70	4057	16422
1.0 0002	Cab/Alt Cab Structure S/S 000 90 TRA 02 Labor														1151
1.0 0003	Sound System 000 95 DSI 03 Labor	128	128	168										424	2997
1.0 0004	Sound System 000 95 DSI 04 Labor														32
2.0 0005	Motion Subsystem 000 90 TRA 01 Labor	468	428	268	316	405	44	20	31	30	15	9	10	2044	4046
2.0 0006	Motion Subsystem 000 90 TRA 02 Labor														182
3.0 0007	Visual Subsystem 000 90 TRA 01 Labor	360	312	664	880	427	51	70	51	25	45	20	20	2925	5556
3.0 0008	Visual Subsystem 000 90 TRA 02 Labor														54
3.0 0009	Visual Subsystem 000 95 DSI 03 Labor	520	520	520	520	520	520	500						3620	11546
3.0 0010	Visual Subsystem 000 95 DSI 04 Labor														117
4.0 0011	Experimental/Operator Console 000 90 TRA 01 Labor	697	385	359	448	248	76	61	34					2308	7307
4.0 0012	Experimental/Operator Console 000 90 TRA 02 Labor														700
5.0 0013	Logic Controller S/S 000 95 DSI 03 Labor	1327	1154	1099	560	560								4700	26185
5.0 0014	Logic Controller S/S 000 95 DSI 04 Labor														3989
6.0 0015	Data Controller S/S 000 95 DSI 03 Labor	240	280	287	280	280								1367	9075
6.0 0016	Data Controller S/S 000 95 DSI 04 Labor														1435

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
7.0 0017	Experiment Development S/S 000 90 TRA 01 Labor	86	65	65	193	98	210	120						837	2064
7.0 0018	Experiment Development S/S 000 90 TRA 02 Labor														64
7.0 0019	Experiment Development S/S 000 95 DSI 03 Labor	174												174	3858
7.0 0020	Experiment Development S/S 000 95 DSI 04 Labor														1087
8.0 0021	Experiment Territory Dev. S/S 000 95 DSI 03 Labor				160	160	160	160	151					791	4120
8.0 0022	Experiment Territory Dev. S/S 000 95 DSI 04 Labor														452
9.0 0023	Total Eval Sys Integ & Instl 000 90 TRA 01 Labor	783	684	455	516	411	768	978	823	798	1024	723	613	8576	17065
9.0 0024	Total Eval Sys Integ & Instl 000 90 TRA 02 Labor														855
9.0 0025	Total Eval Sys Integ & Instl 000 95 DSI 03 Labor										624	623	626	1873	1873
9.0 0026	Total Eval Sys Integ & Instl 000 95 DSI 04 Labor														
11.0 0027	Other Loco. Eval Progr Efforts 000 90 TRA 01 Labor	592	489	507	520	407	396	391	318	300	425	336	295	4976	14062
11.0 0028	Other Loco. Eval Progr Efforts 000 90 TRA 02 Labor														2331
11.0 0029	Other Loco. Eval Progr Efforts 000 95 DSI 03 Labor	525	525	525	400	400	400	400	400	400	320	320	320	4935	12282
11.0 0030	Other Loco. Eval Progr Efforts 000 95 DSI 04 Labor														1544

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals Page 3

Run 12/20/79 (11:00)

WBS TSO #	Pkg No.	Perf Org	Package Description Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
			01	3496	2819	2579	3202	2285	1781	2123	1636	1582	1864	1348	1008	25723	66522
			02														5228
			03	2914	2607	2599	1920	1920	1080	1060	551	400	944	943	946	17884	71934
			04														8656
			01 + 03	6410	5426	5178	5122	4207	2861	3183	2187	1982	2808	2291	1954	43607	138456
			02 + 04														13884

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals

Run 12/20/79 (11:00)

WBS TSO #	Pkg No. Perf Org Dept Resp Package Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
1.0 0001	Cab/Alt Cab Structure S/S 000 90 TRA 01 Labor	55	30											85	16507
1.0 0002	Cab/Alt Cab Structure S/S 000 90 TRA 02 Labor														1151
1.0 0003	Sound System 000 95 DSI 03 Labor														2997
1.0 0004	Sound System 000 95 DSI 04 Labor														32
2.0 0005	Motion Subsystem 000 90 TRA 01 Labor	40	40											80	4126
2.0 0006	Motion Subsystem 000 90 TRA 02 Labor														182
3.0 0007	Visual Subsystem 000 90 TRA 01 Labor	40	35											75	5631
3.0 0008	Visual Subsystem 000 90 TRA 02 Labor														54
3.0 0009	Visual Subsystem 000 95 DSI 03 Labor														11546
3.0 0010	Visual Subsystem 000 95 DSI 04 Labor														117
4.0 0011	Experimental/Operator Console 000 90 TRA 01 Labor														7307
4.0 0012	Experimental/Operator Console 000 90 TRA 02 Labor														700
5.0 0013	Logic Controller S/S 000 95 DSI 03 Labor														26185
5.0 0014	Logic Controller S/S 000 95 DSI 04 Labor														3989
6.0 0015	Data Controller S/S 000 95 DSI 03 Labor														9075
6.0 0016	Data Controller S/S 000 95 DSI 04 Labor														1435

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals Page 2

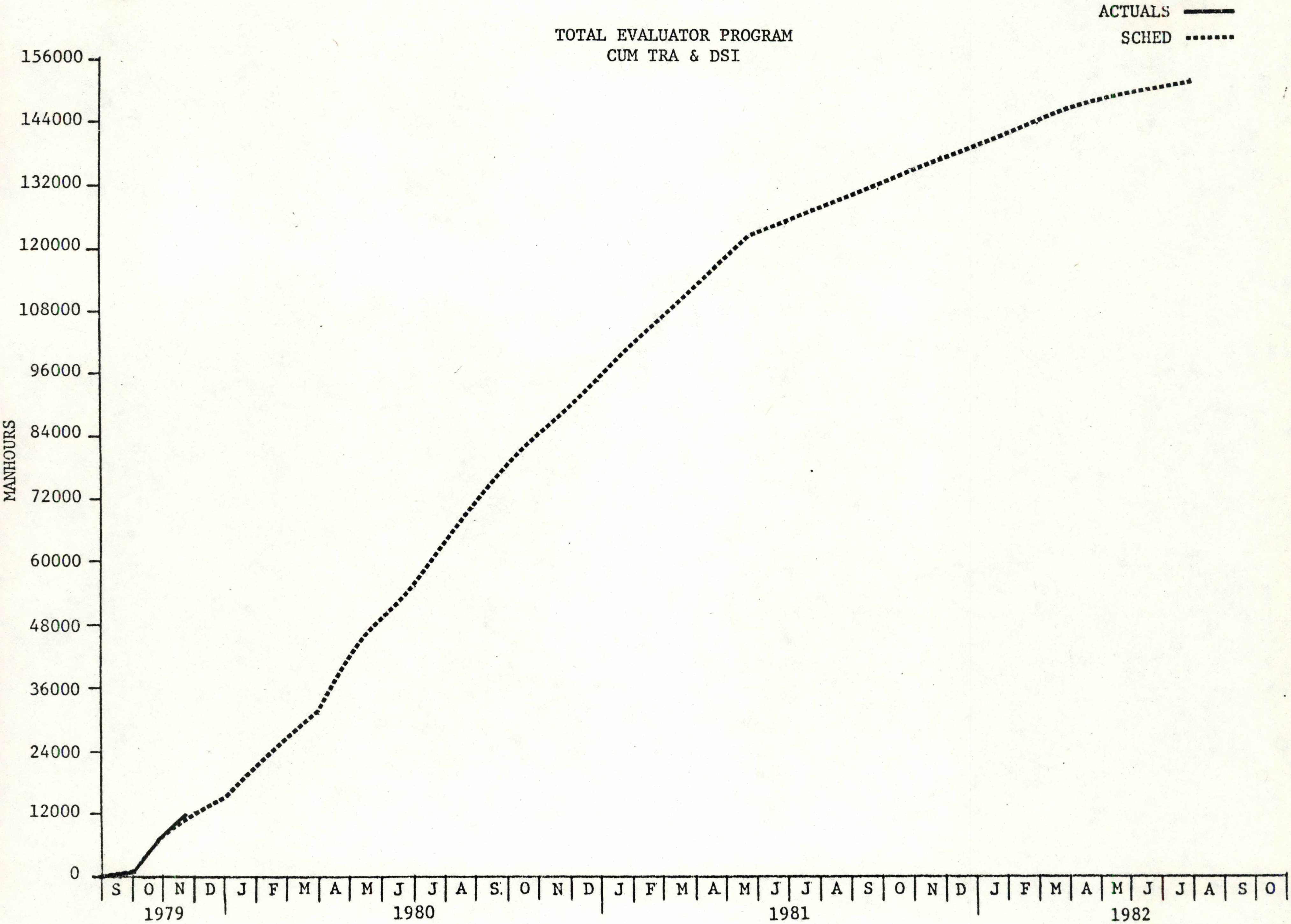
Run 12/20/79 (11:00)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
7.0 0017	Experiment Development S/S 000 90 TRA 01 Labor														2064
7.0 0018	Experiment Development S/S 000 90 TRA 02 Labor														64
7.0 0019	Experiment Development S/S 000 95 DSI 03 Labor														3858
7.0 0020	Experiment Development S/S 000 95 DSI 04 Labor														1087
8.0 0021	Experiment Territory Dev. S/S 000 95 DSI 03 Labor														4120
8.0 0022	Experiment Territory Dev S/S 000 95 DSI 04 Labor														452
9.0 0023	Total Eval Sys Integ & Instl 000 90 TRA 01 Labor	1403	929	705	360									3397	20462
9.0 0024	Total Eval Sys Integ & Instl 000 90 TRA 02 Labor														855
9.0 0025	Total Eval Sys Integ & Instl 000 95 DSI 03 Labor	623	623	626	623	623	626	623						4367	6240
9.0 0026	Total Eval Sys Integ & Instl 000 95 DSI 04 Labor														
11.0 0027	Other Loco. Eval Progr Efforts 000 90 TRA 01 Labor	390	460	452	180	588	670	370						3110	17172
11.0 0028	Other Loco. Eval Progr Efforts 000 90 TRA 02 Labor														2331
11.0 0029	Other Loco. Eval Progr Efforts 000 95 DSI 03 Labor	320	320	320	60	60	60	60						1200	13482
11.0 0030	Other Loco. Eval Progr Efforts 000 95 DSI 04 Labor														1544

Note: TRA Resp 01=Scheduled; 02=Actuals LATHE Program DSI Resp 03=Scheduled; 04=Actuals Page 3

Run 12/20/79 (11:00)

WBS TSO #	Pkg No.	Perf Org	Package Description Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
			01	1928	1494	1157	540	588	670	370						6747	73269
			02														5228
			03	943	943	946	683	683	686	683						5567	77501
			04														8656
			01 + 03	2871	2437	2103	1223	1271	1356	1053						12341	150770
			02 + 04														13884



ACTUALS
SCHED
TOTAL EVALUATOR PROGRAM
CUM TRA & DSI
MANHOURS
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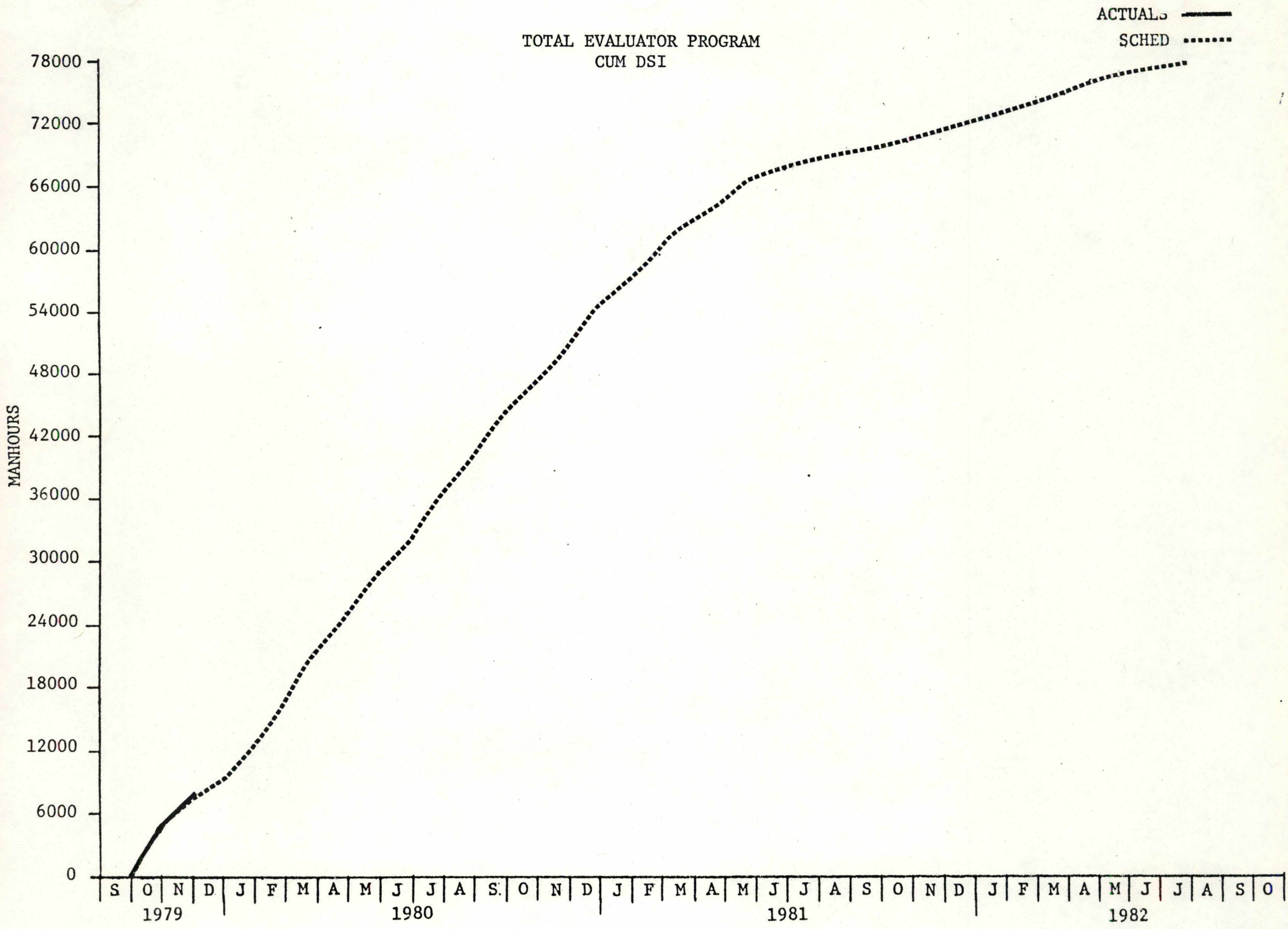
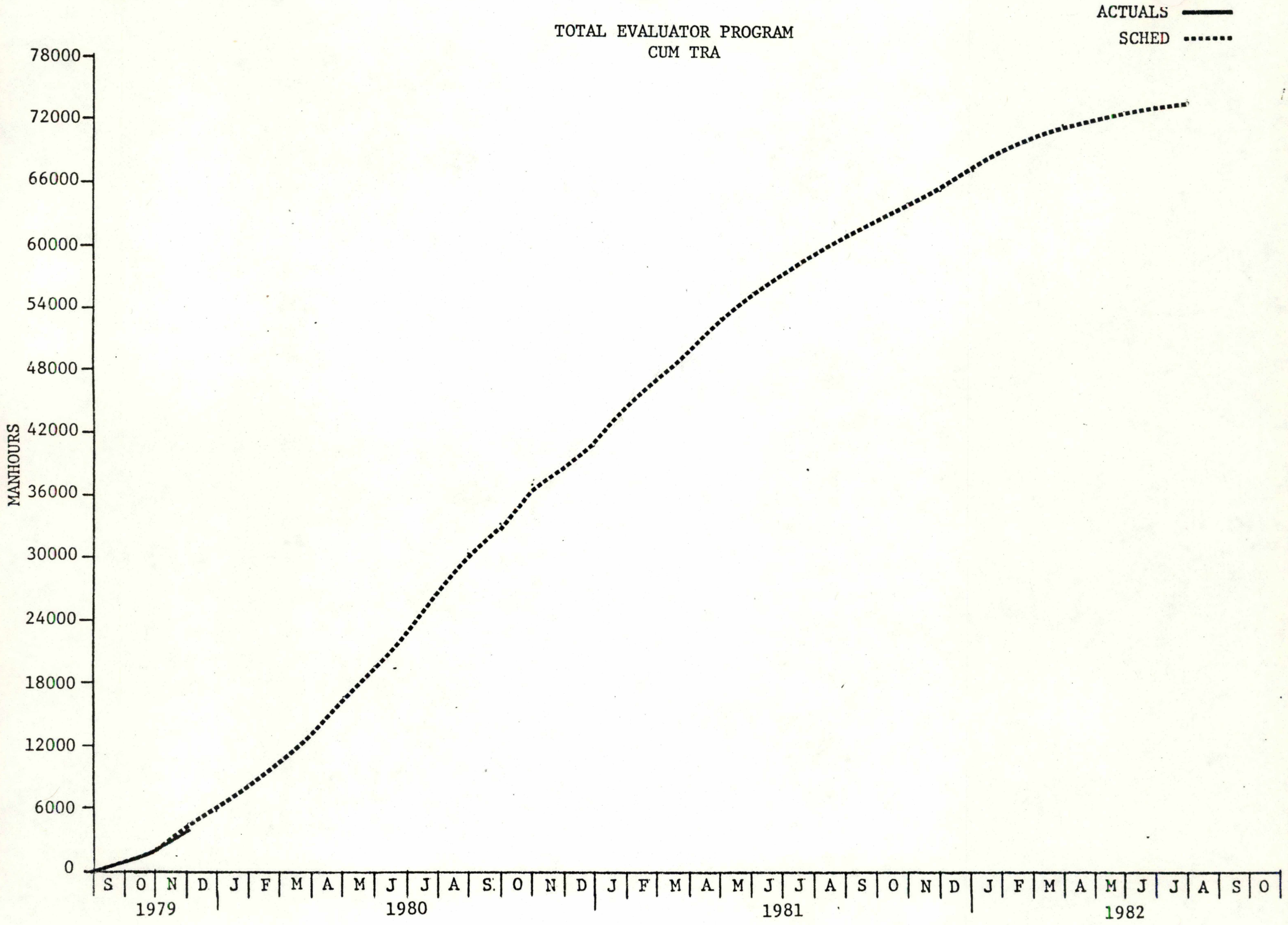
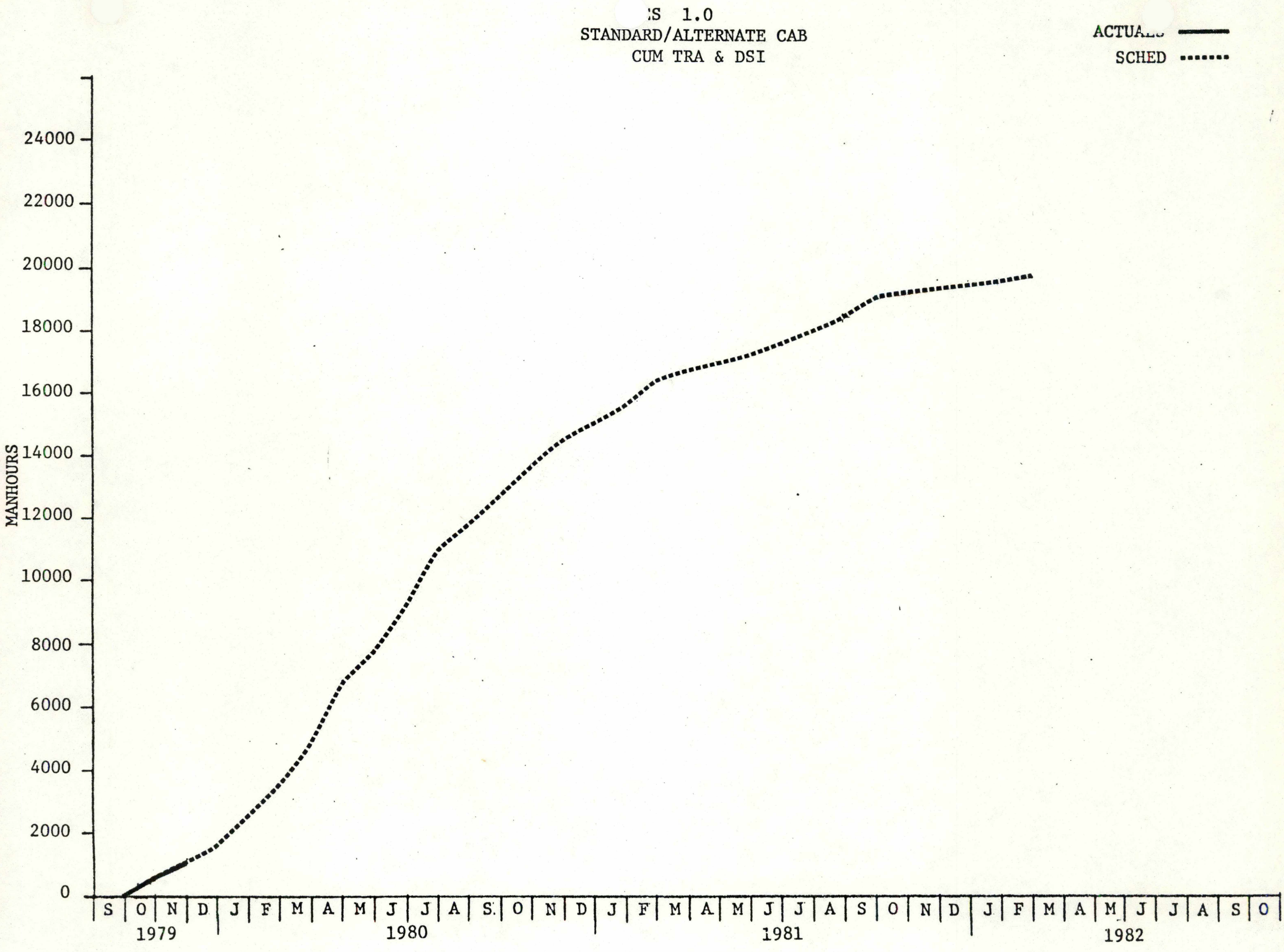
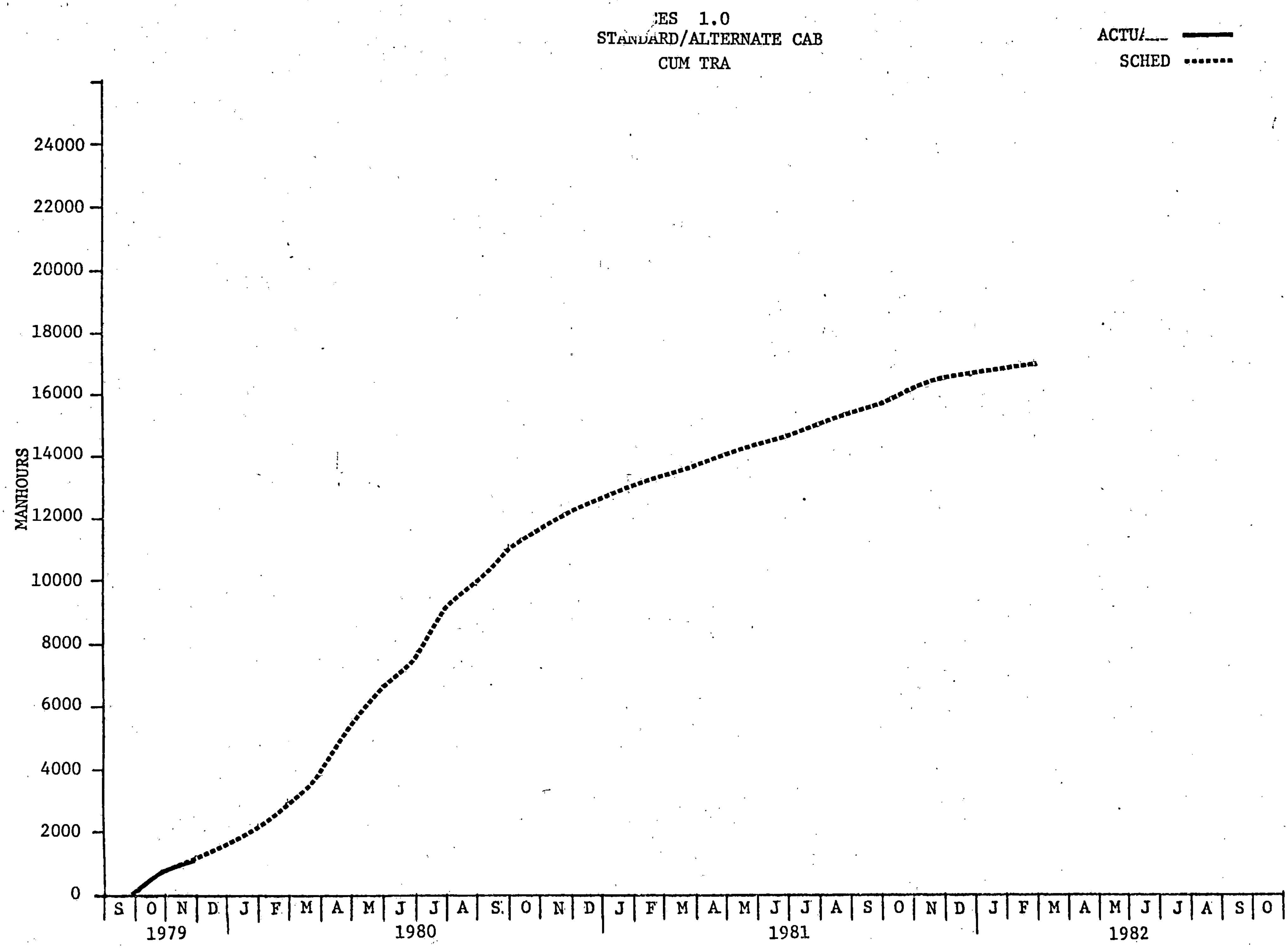
144000
132000
120000
108000
96000
84000
72000
60000
48000
36000
24000
12000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982



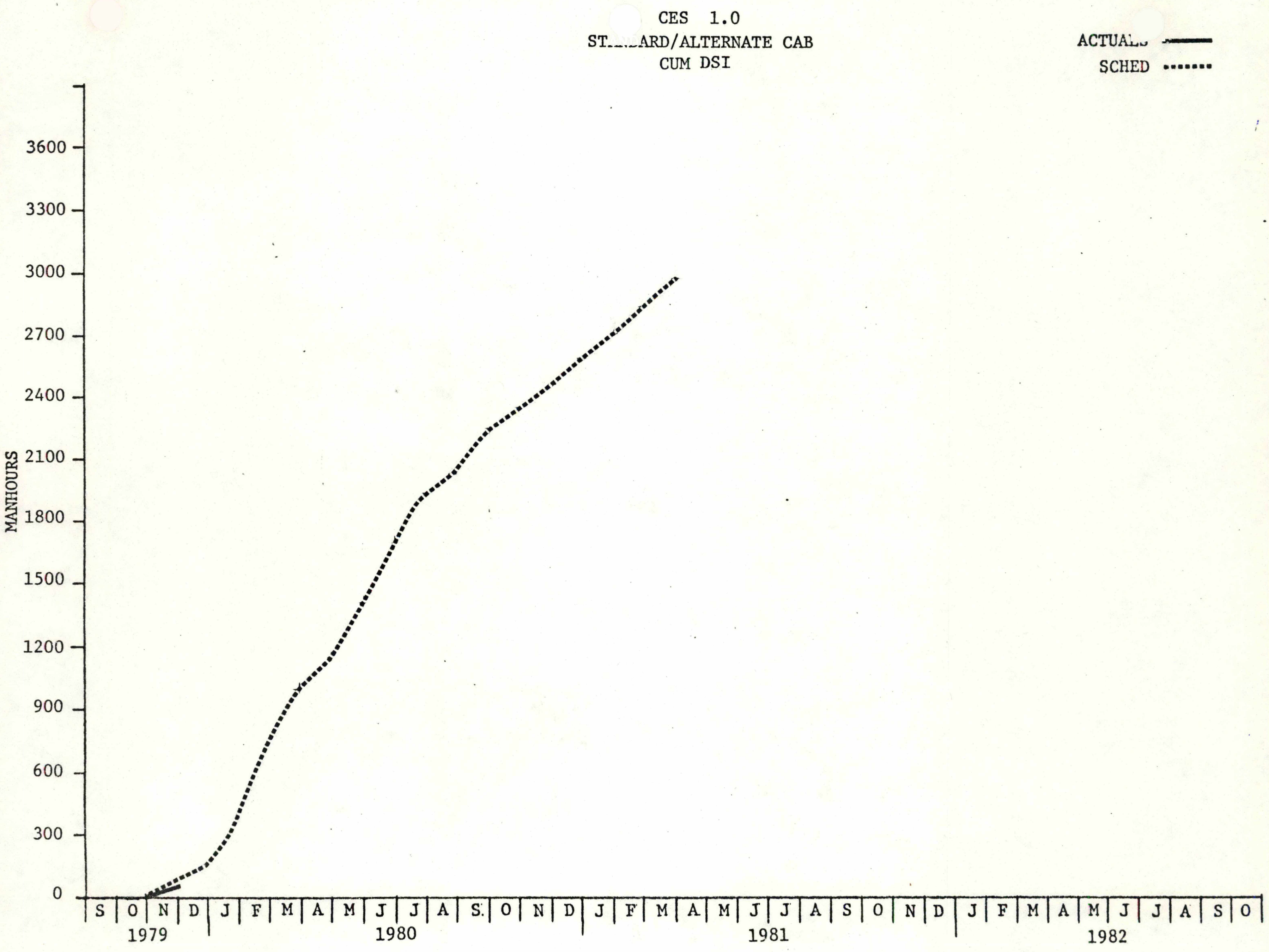
ACTUALS
SCHED
TOTAL EVALUATOR PROGRAM
CUM DSI
MANHOURS
78000
72000
66000
60000
54000
48000
42000
36000
30000
24000
18000
12000
6000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

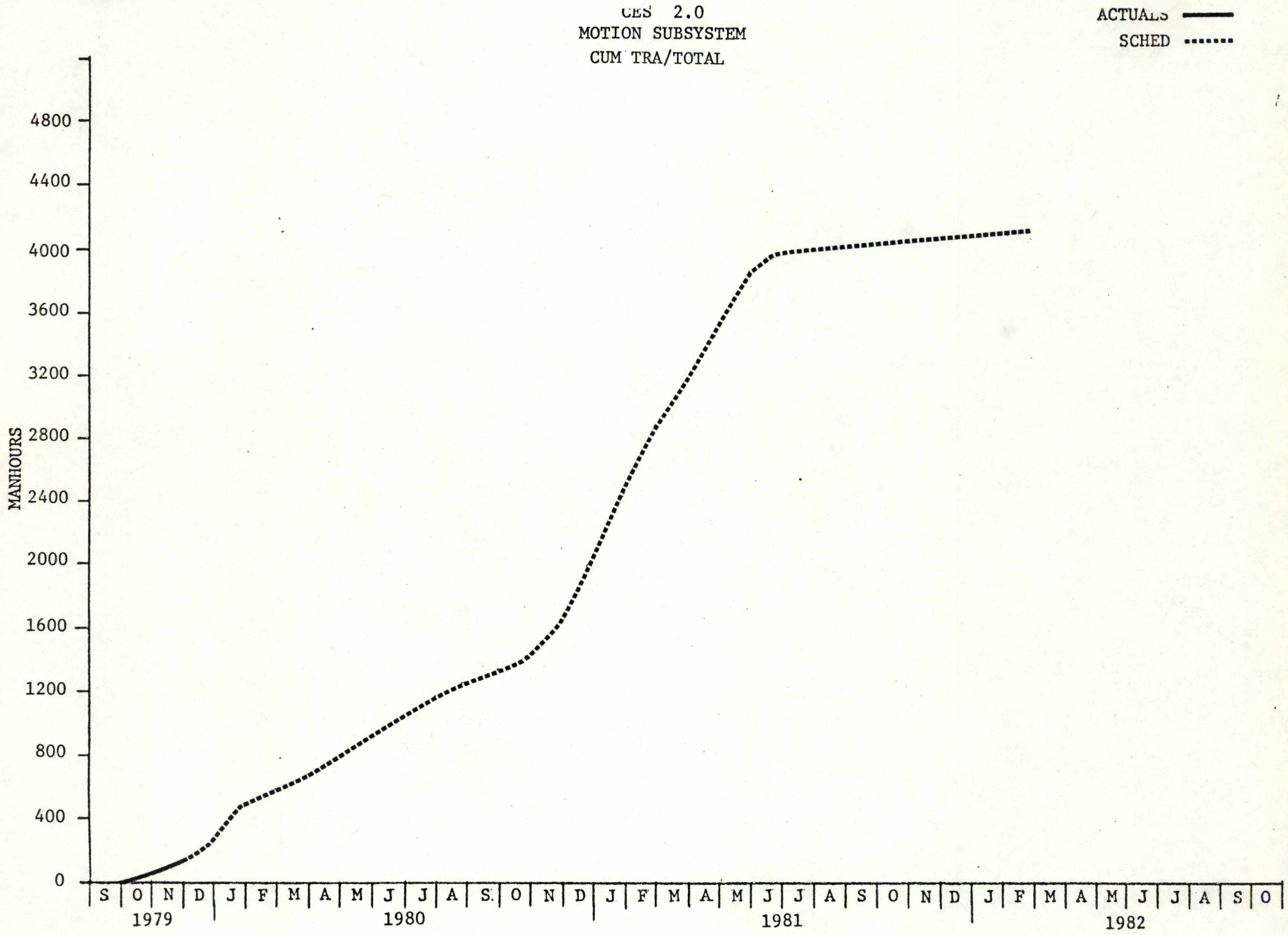

TOTAL EVALUATOR PROGRAM
CUM TRA
ACTUALS
SCHED
MANHOURS
78000
72000
66000
60000
54000
48000
42000
36000
30000
24000
18000
12000
6000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982


:S 1.0
STANDARD/ALTERNATE CAB
CUM TRA & DSI
ACTUA
SCHED
MANHOURS
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

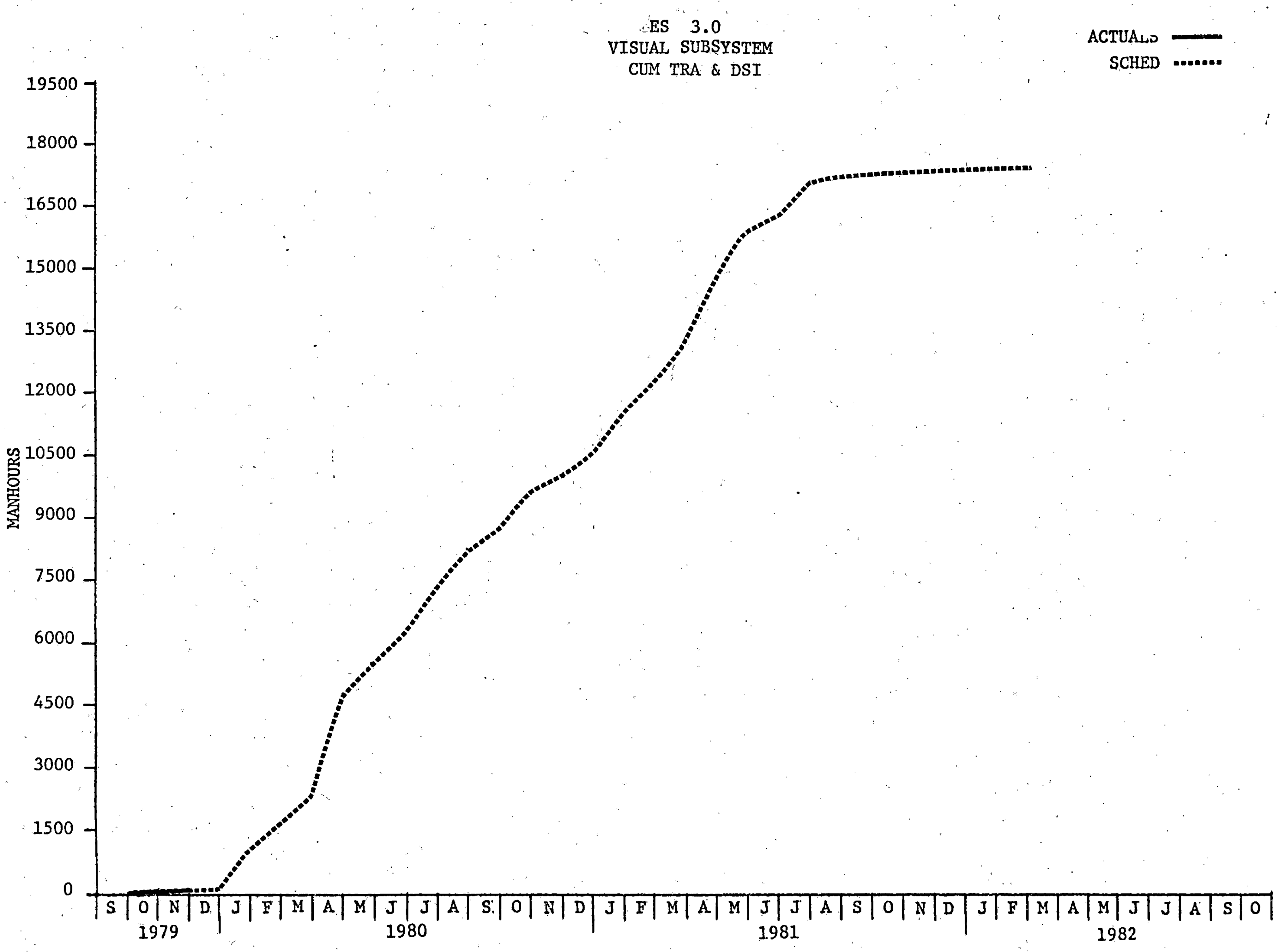


ES 1.0
STANDARD/ALTERNATE CAB
CUM TRA
ACTUAL
SCHED
MANHOURS
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982


CES 1.0
ST__DARD/ALTERNATE CAB
CUM DSI
ACTUAL_
SCHED
MANHOURS
3600
3300
3000
2700
2400
2100
1800
1500
1200
900
600
300
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982



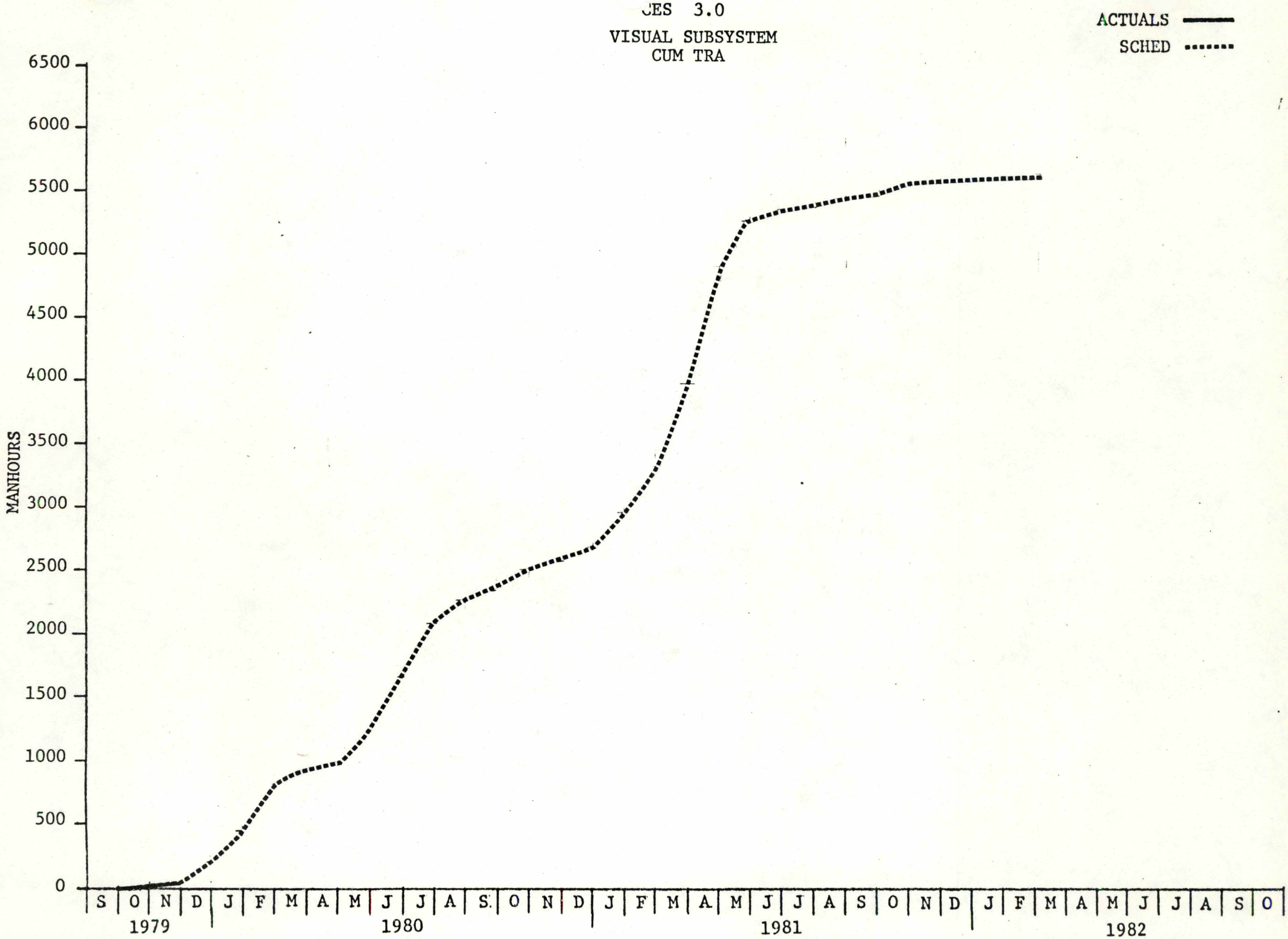
CES 2.0
MOTION SUBSYSTEM
CUM TRA/TOTAL
ACTUALS
SCHED
MANHOURS
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982



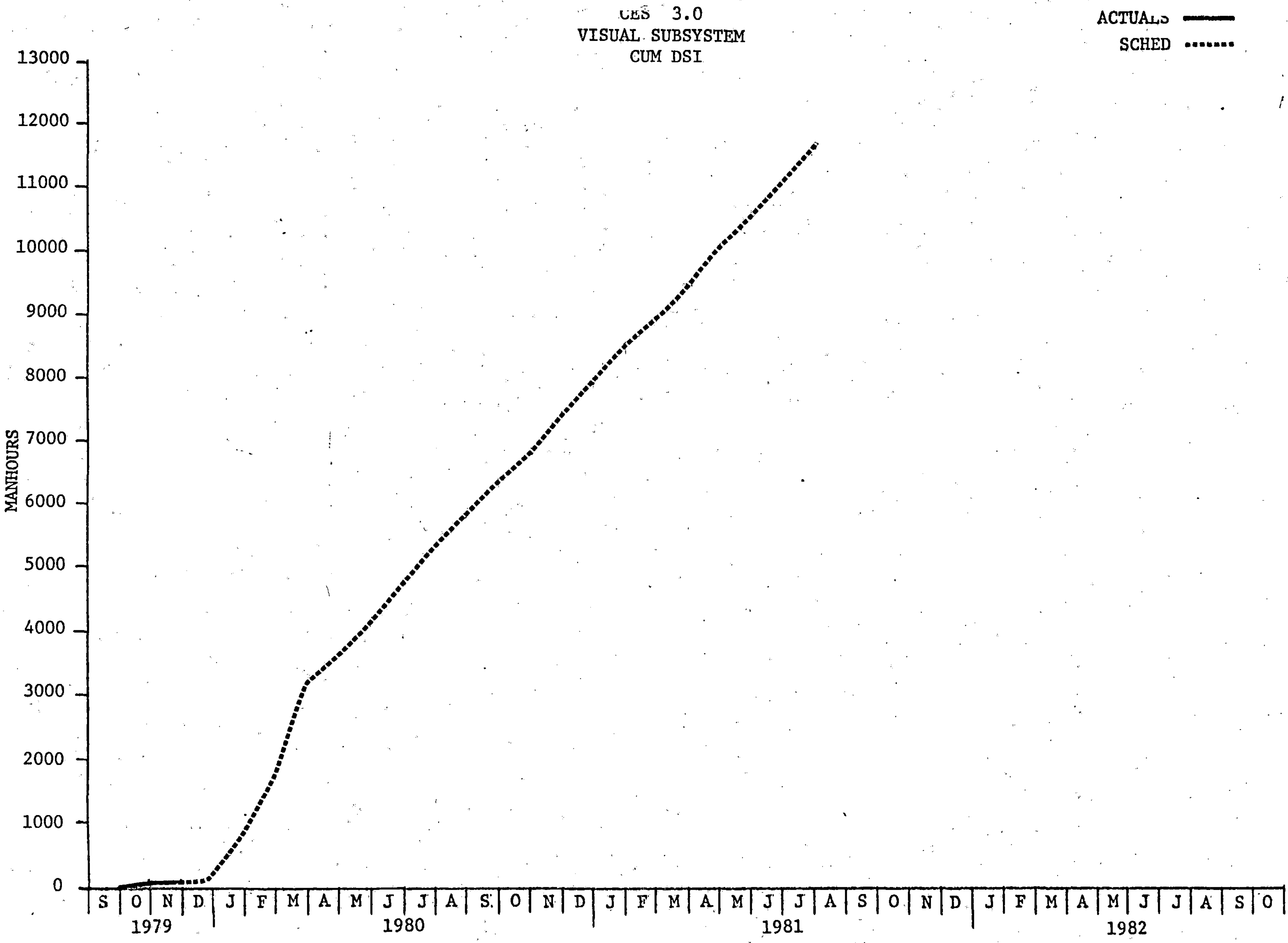
ES 3.0
VISUAL SUBSYSTEM
CUM TRA & DSI
ACTUALS
SCHED
MANHOURS
19500
18000
16500
15000
13500
12000
10500
9000
7500
6000
4500
3000
1500
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

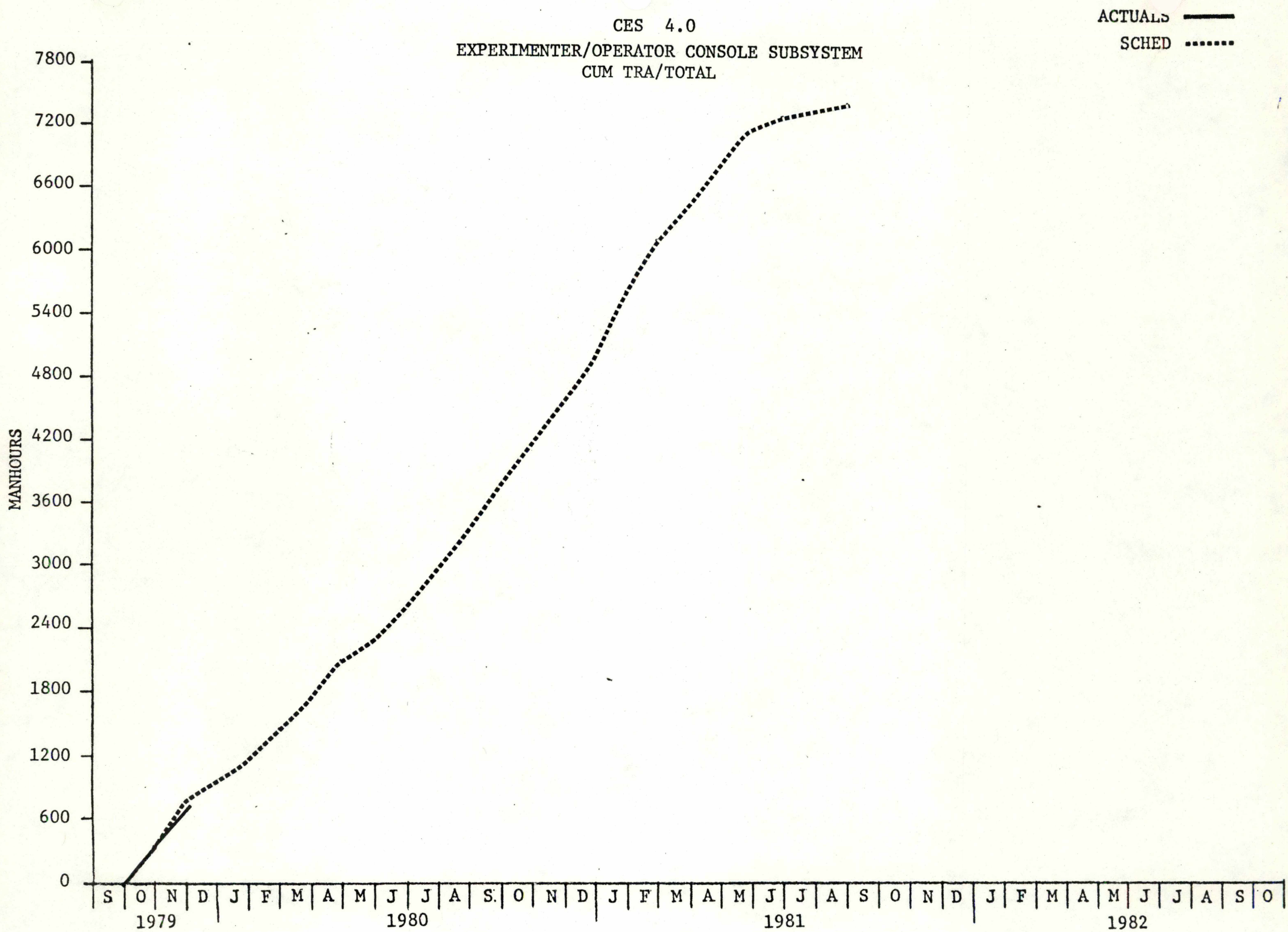
CES 3.0

VISUAL SUBSYSTEM
CUM TRA

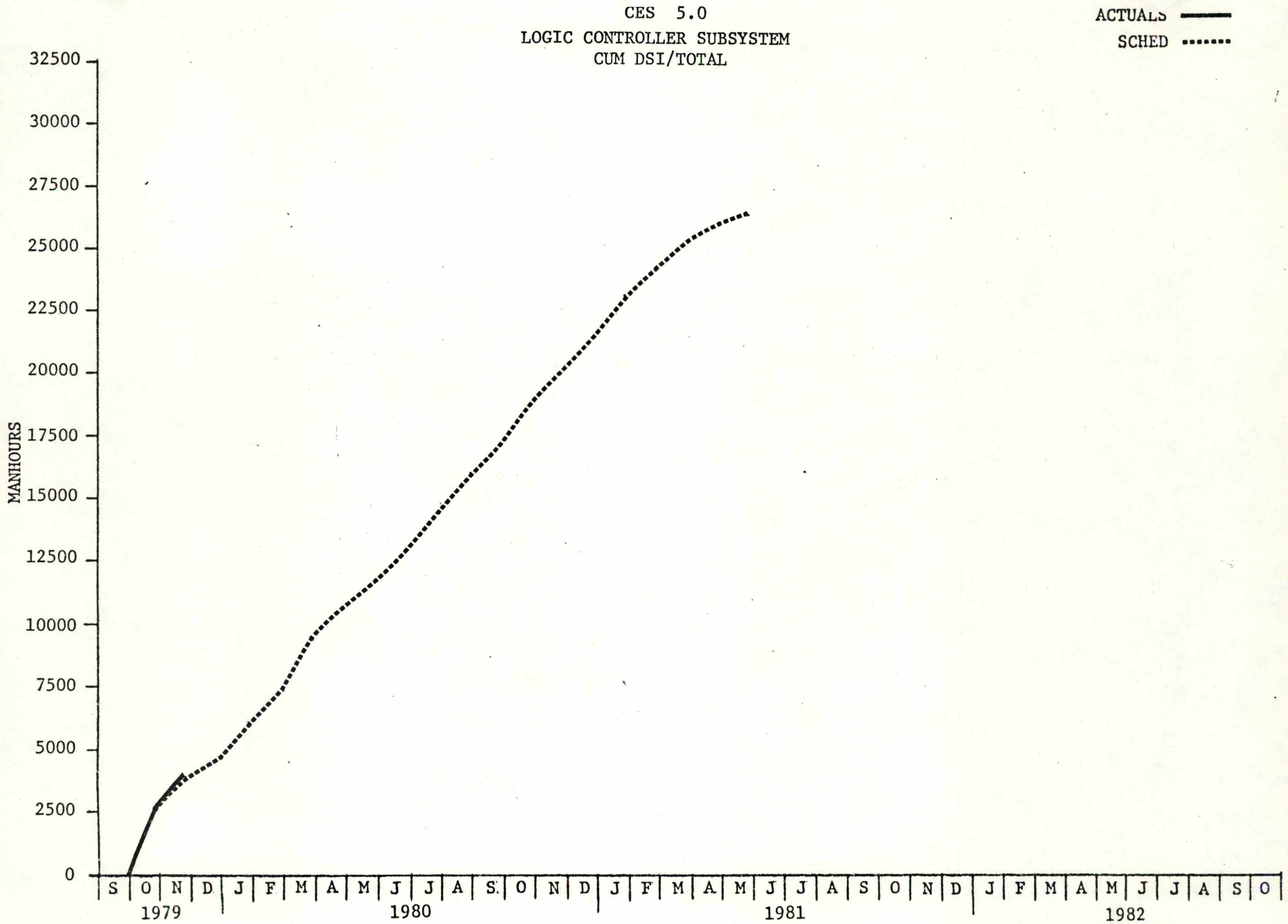


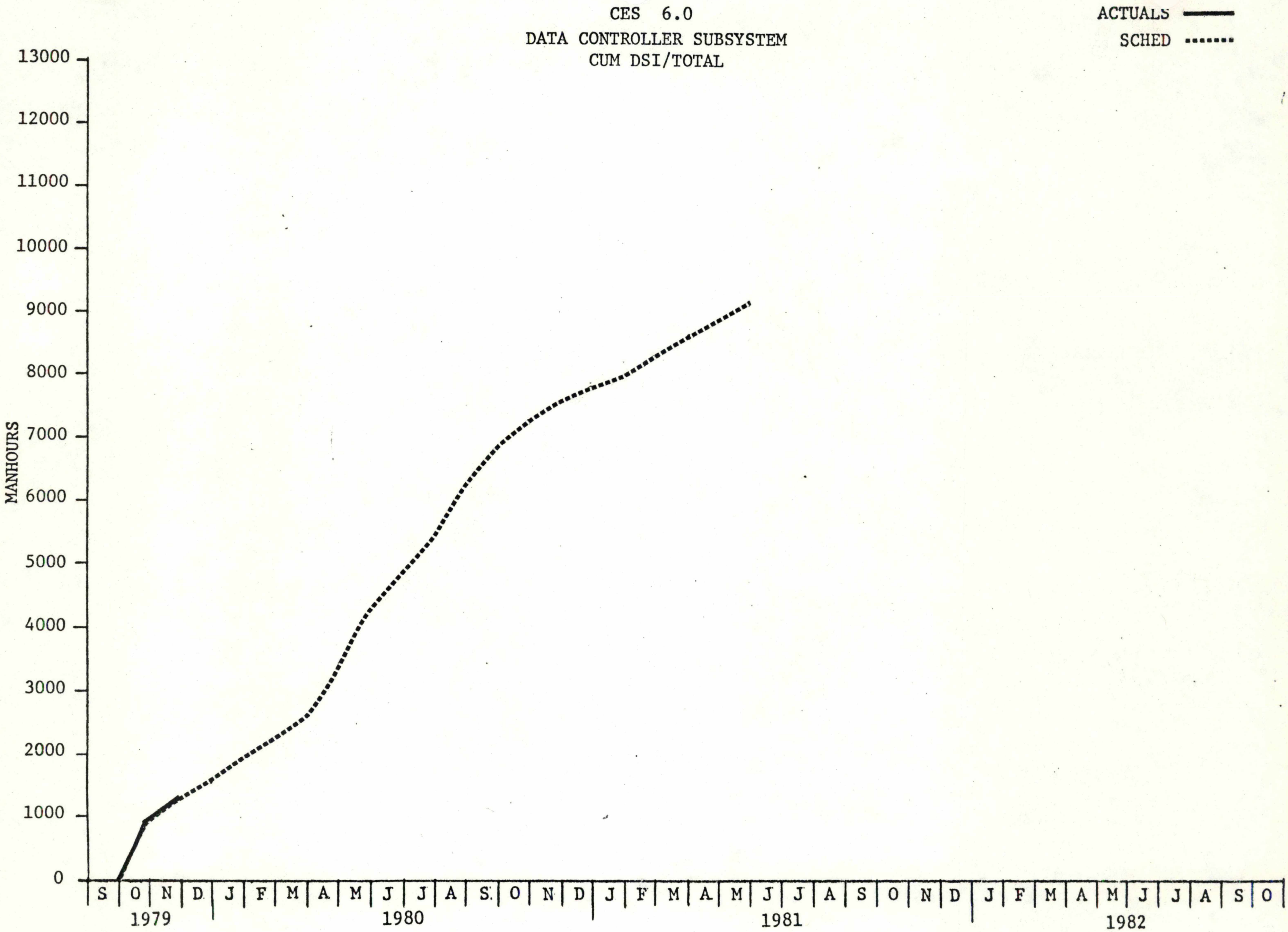
CES 3.0
VISUAL SUBSYSTEM
CUM DSI





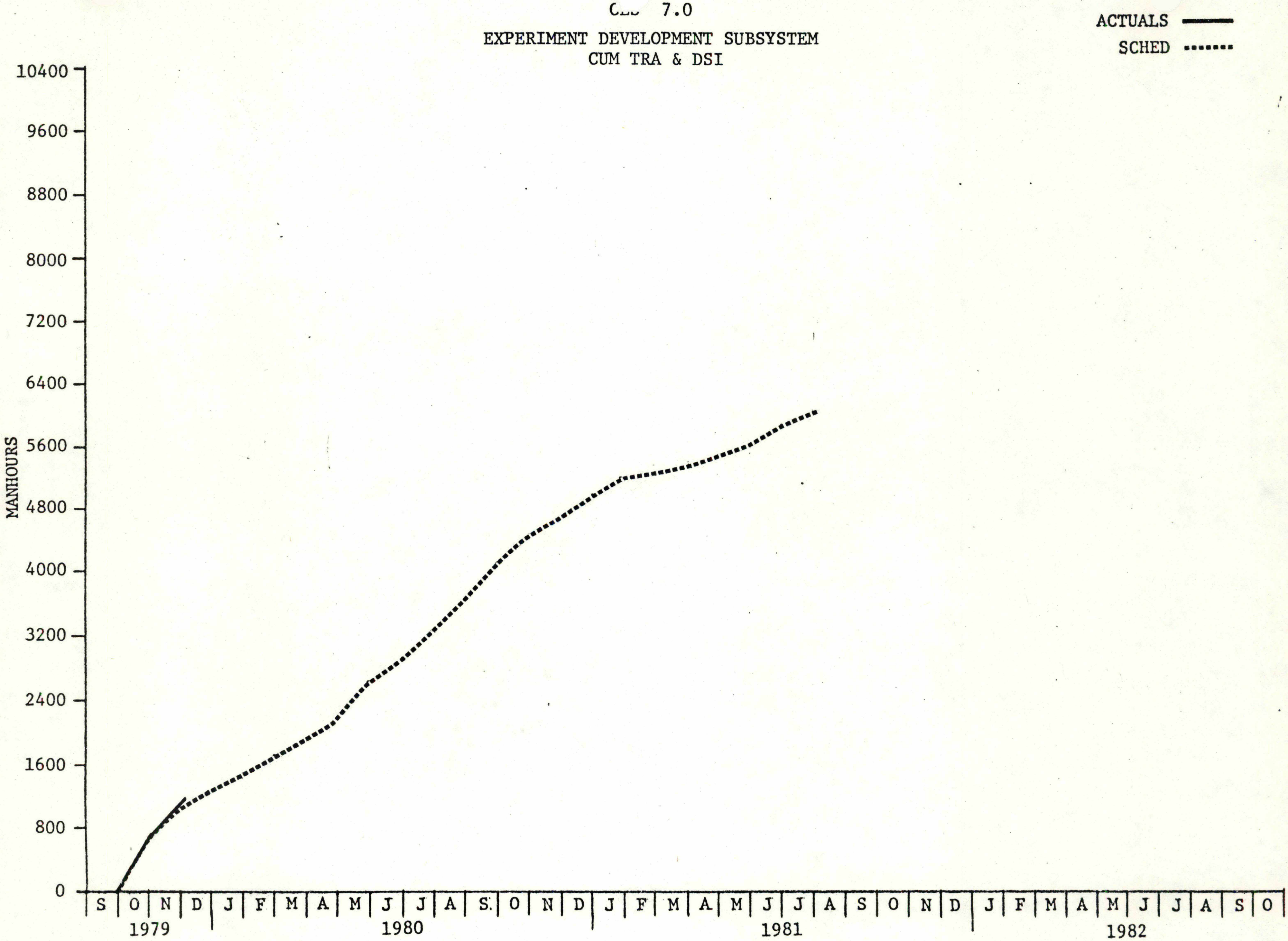
CES 4.0
EXPERIMENTER/OPERATOR CONSOLE SUBSYSTEM
CUM TRA/TOTAL
ACTUALS
SCHED
MANHOURS
7800
7200
6600
6000
5400
4800
4200
3600
3000
2400
1800
1200
600
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

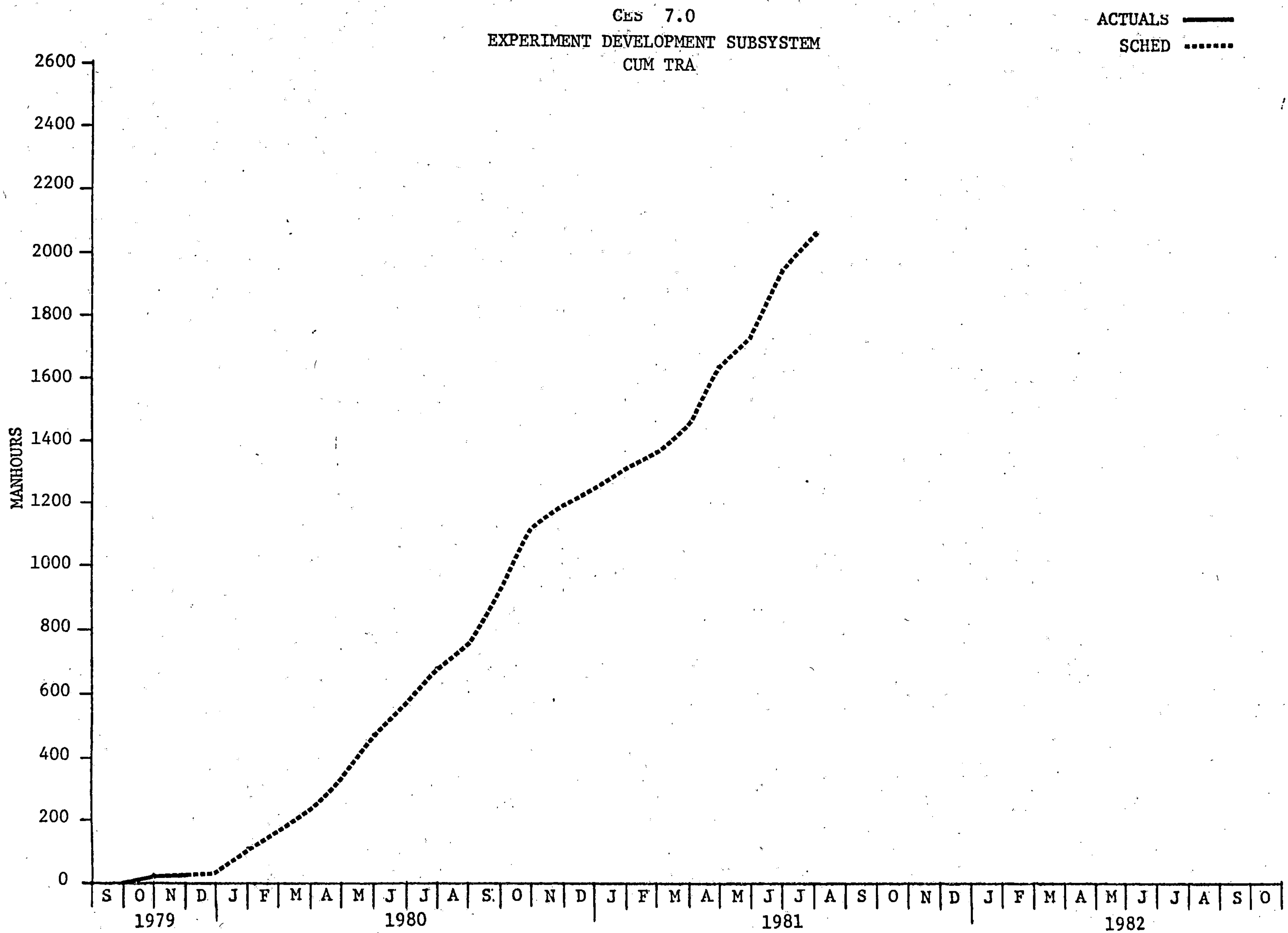

CES 5.0
LOGIC CONTROLLER SUBSYSTEM
CUM DSI/TOTAL
ACTUALS
SCHED
MANHOURS
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982


CES 6.0
DATA CONTROLLER SUBSYSTEM
CUM DSI/TOTAL
ACTUALS
SCHED
MANHOURS
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

CES 7.0

EXPERIMENT DEVELOPMENT SUBSYSTEM
CUM TRA & DSI





CES 7.0
EXPERIMENT DEVELOPMENT SUBSYSTEM
CUM TRA
ACTUALS
SCHED
MANHOURS
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
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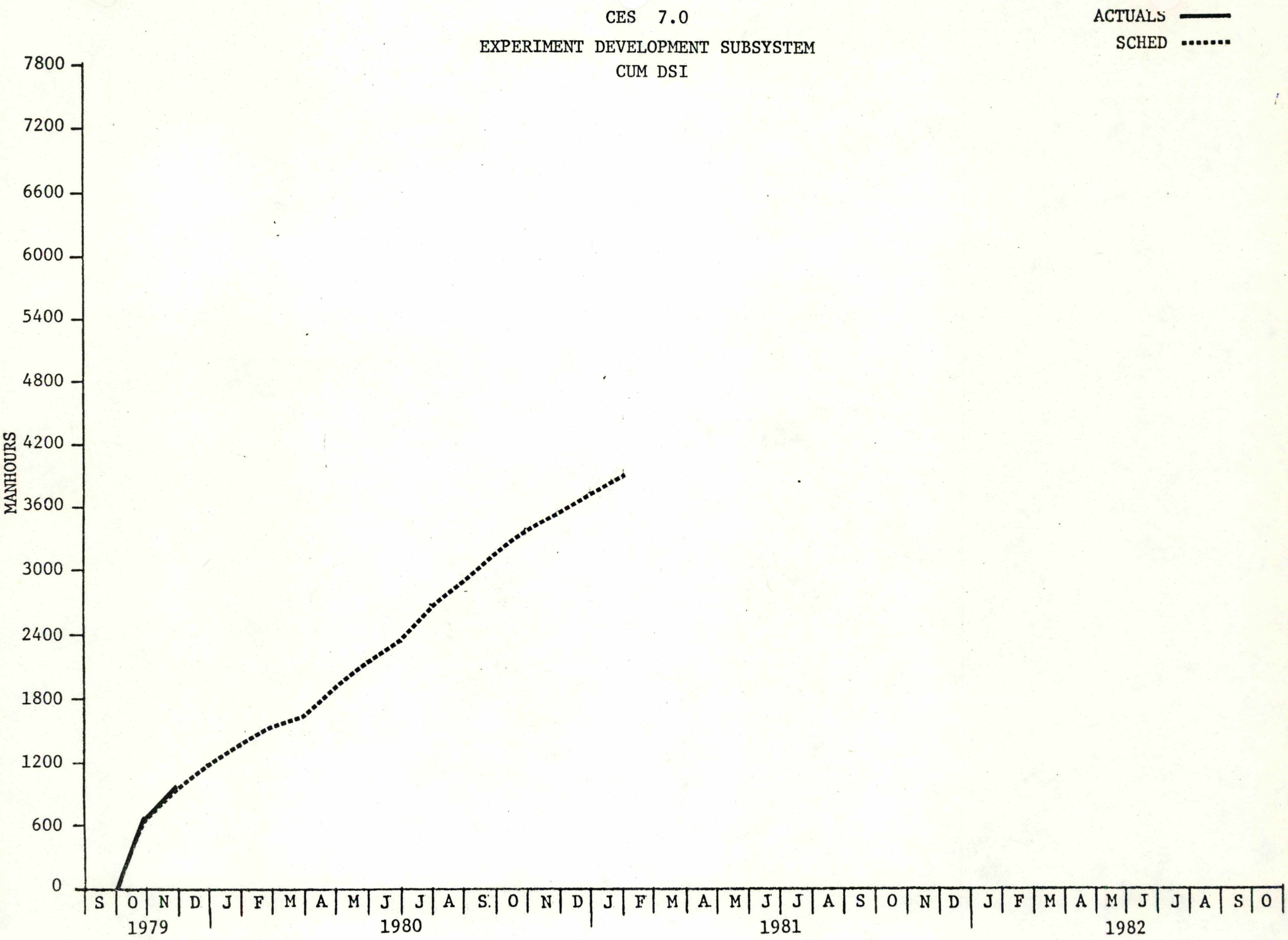
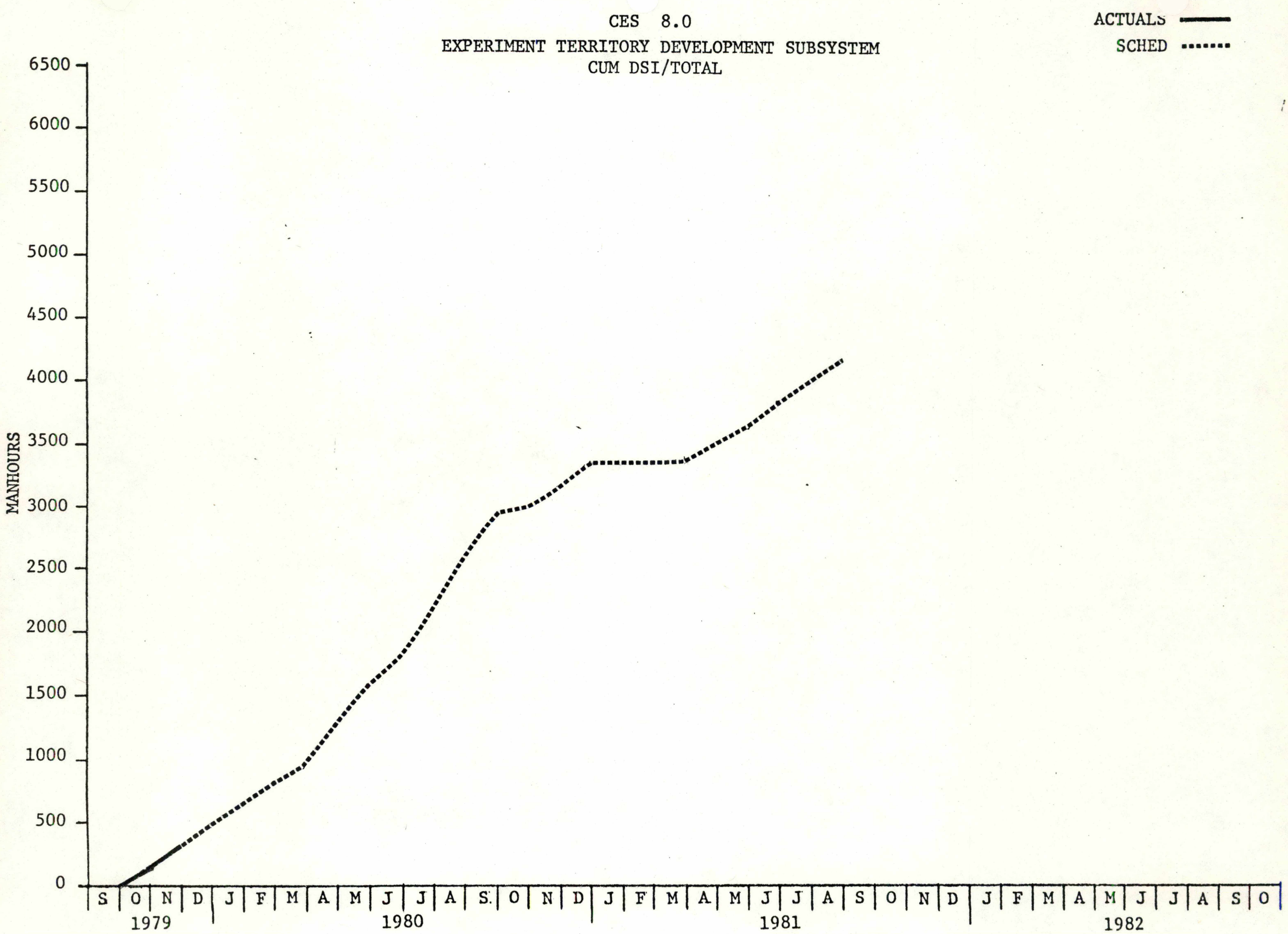
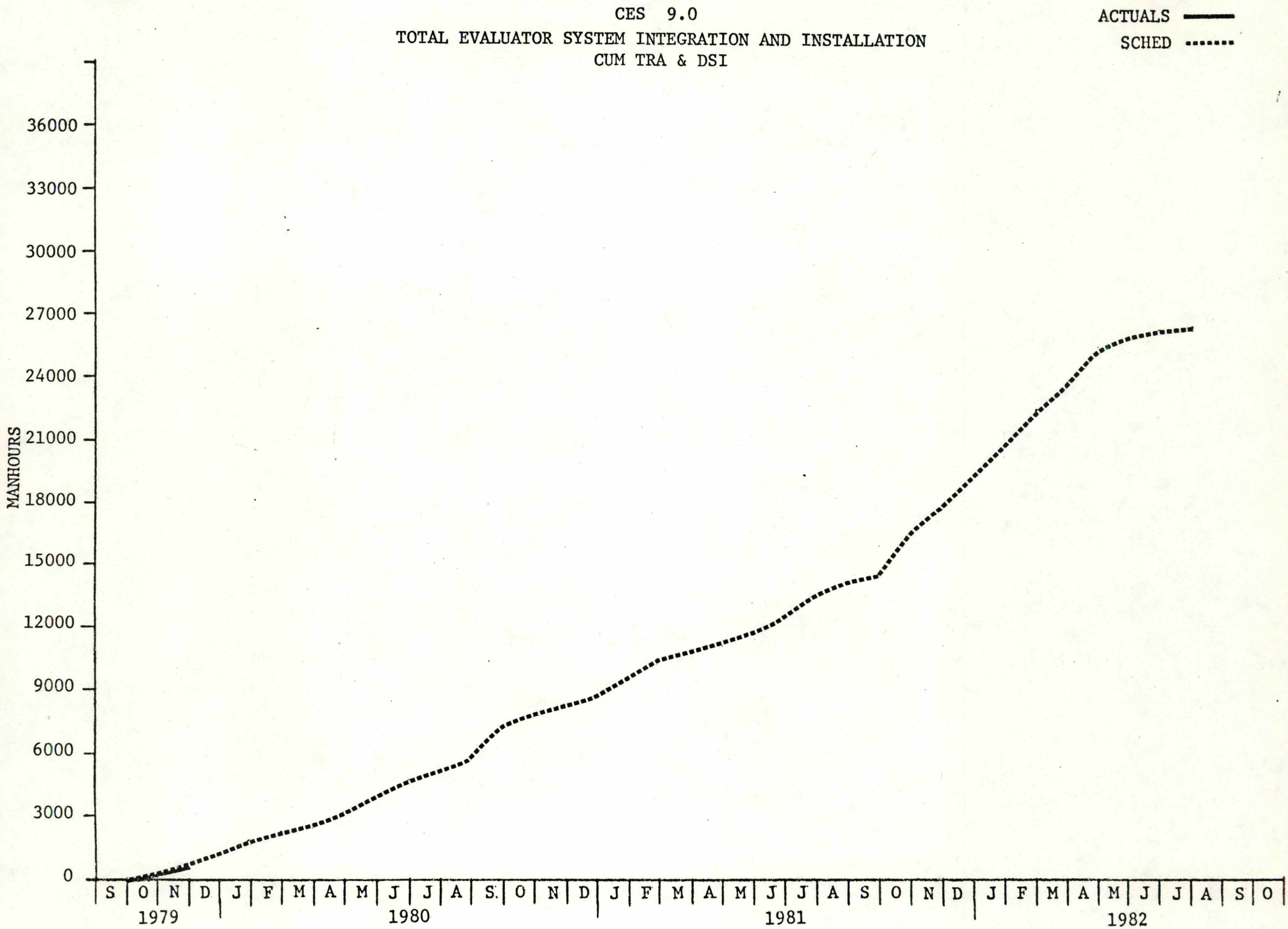
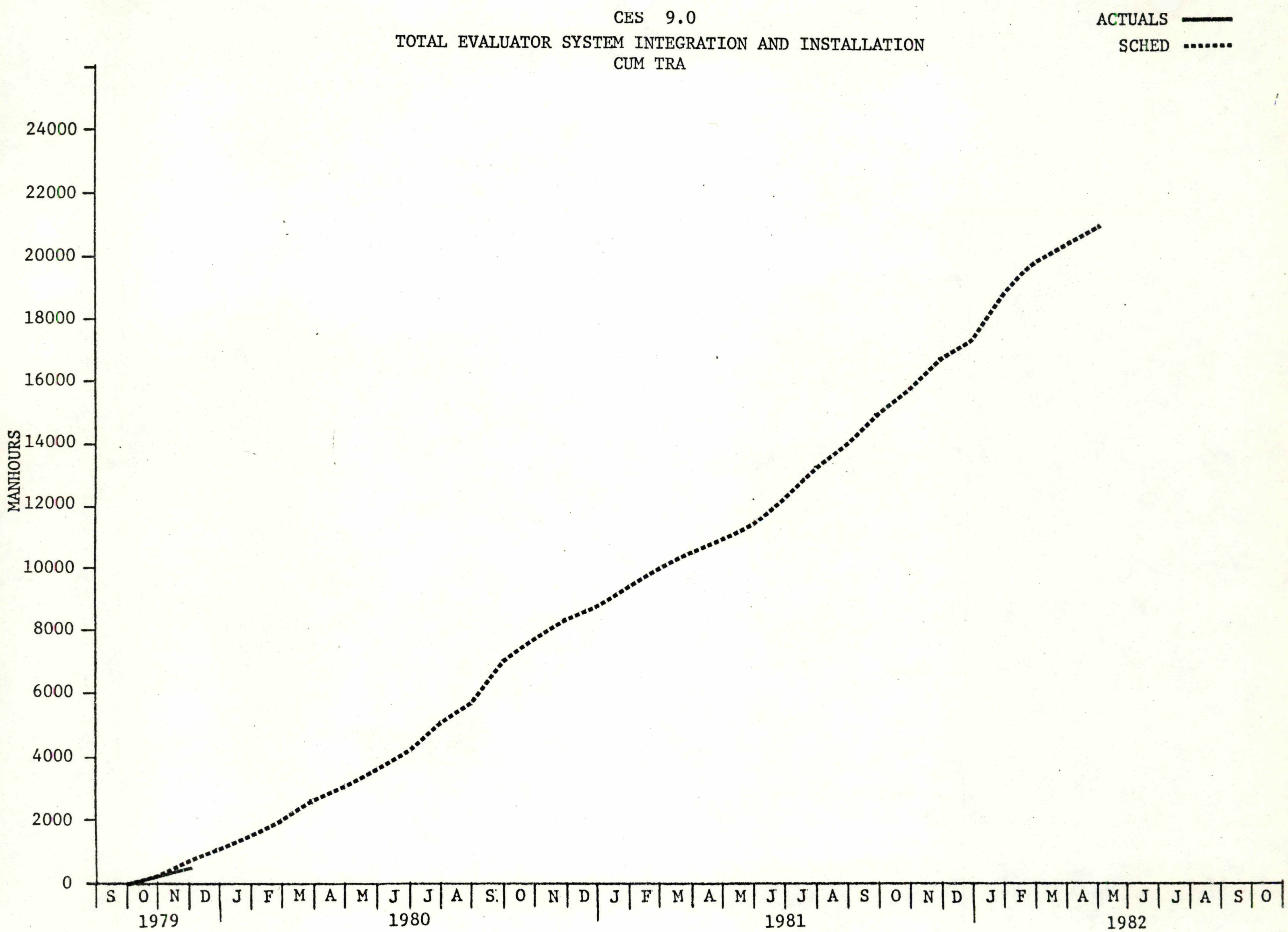
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982


CES 7.0
EXPERIMENT DEVELOPMENT SUBSYSTEM
CUM DSI
ACTUALS
SCHED
MANHOURS
7800
7200
6600
6000
5400
4800
4200
3600
3000
2400
1800
1200
600
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

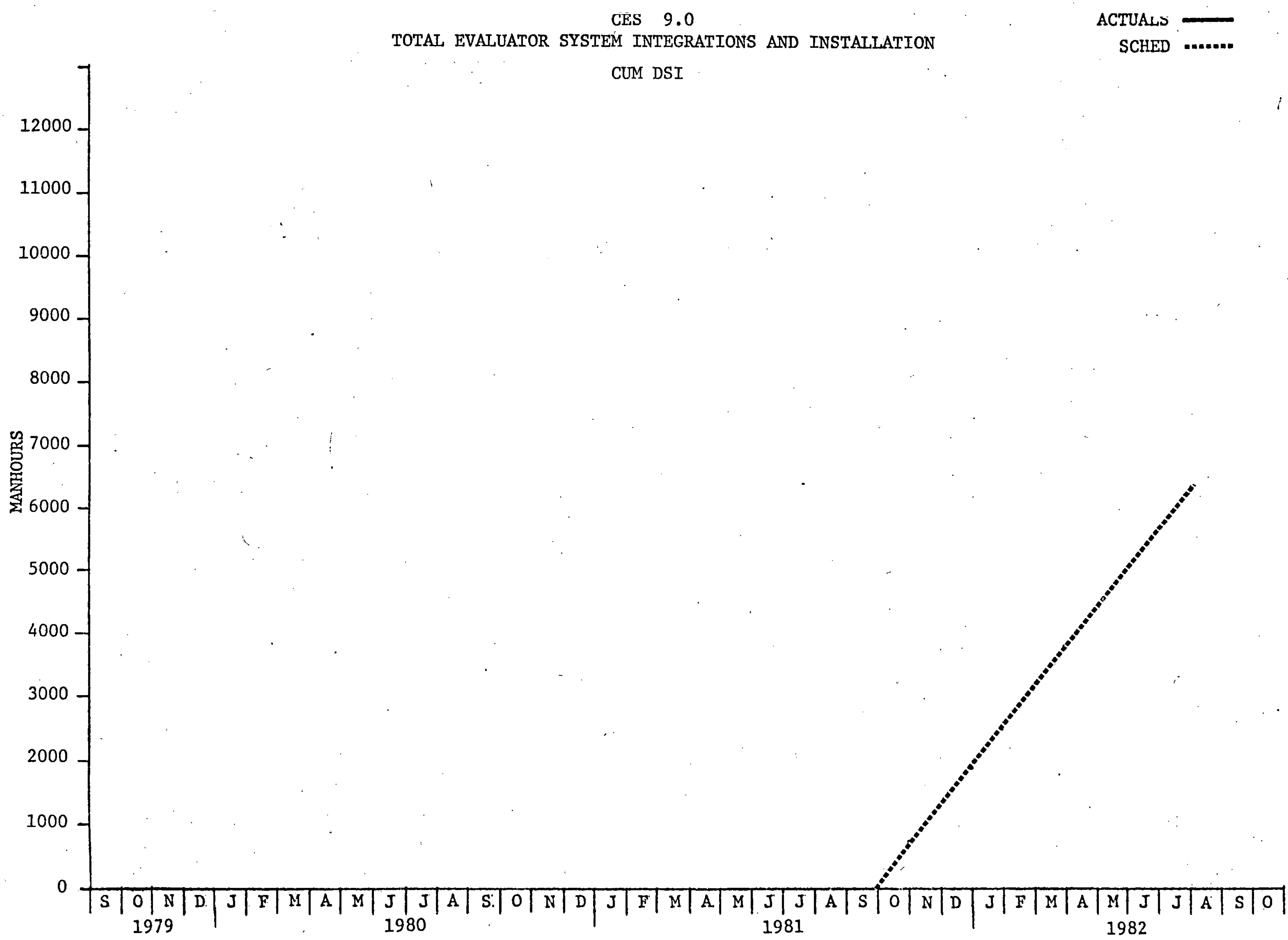

CES 8.0
EXPERIMENT TERRITORY DEVELOPMENT SUBSYSTEM
CUM DSI/TOTAL
ACTUALS
SCHED
MANHOURS
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982



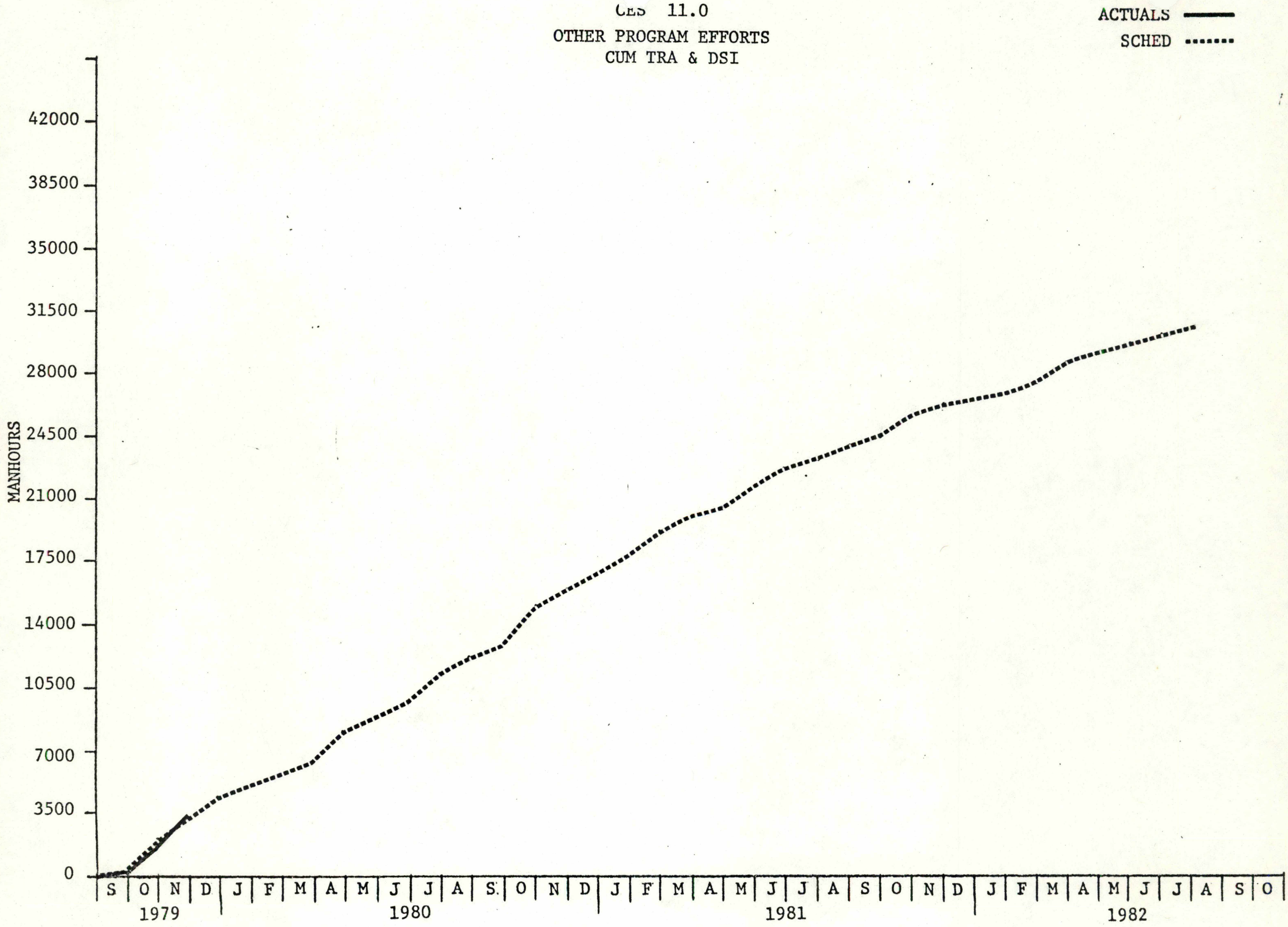
CES 9.0
TOTAL EVALUATOR SYSTEM INTEGRATION AND INSTALLATION
CUM TRA & DSI
ACTUALS
SCHED
MANHOURS
36000
33000
30000
27000
24000
21000
18000
15000
12000
9000
6000
3000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982



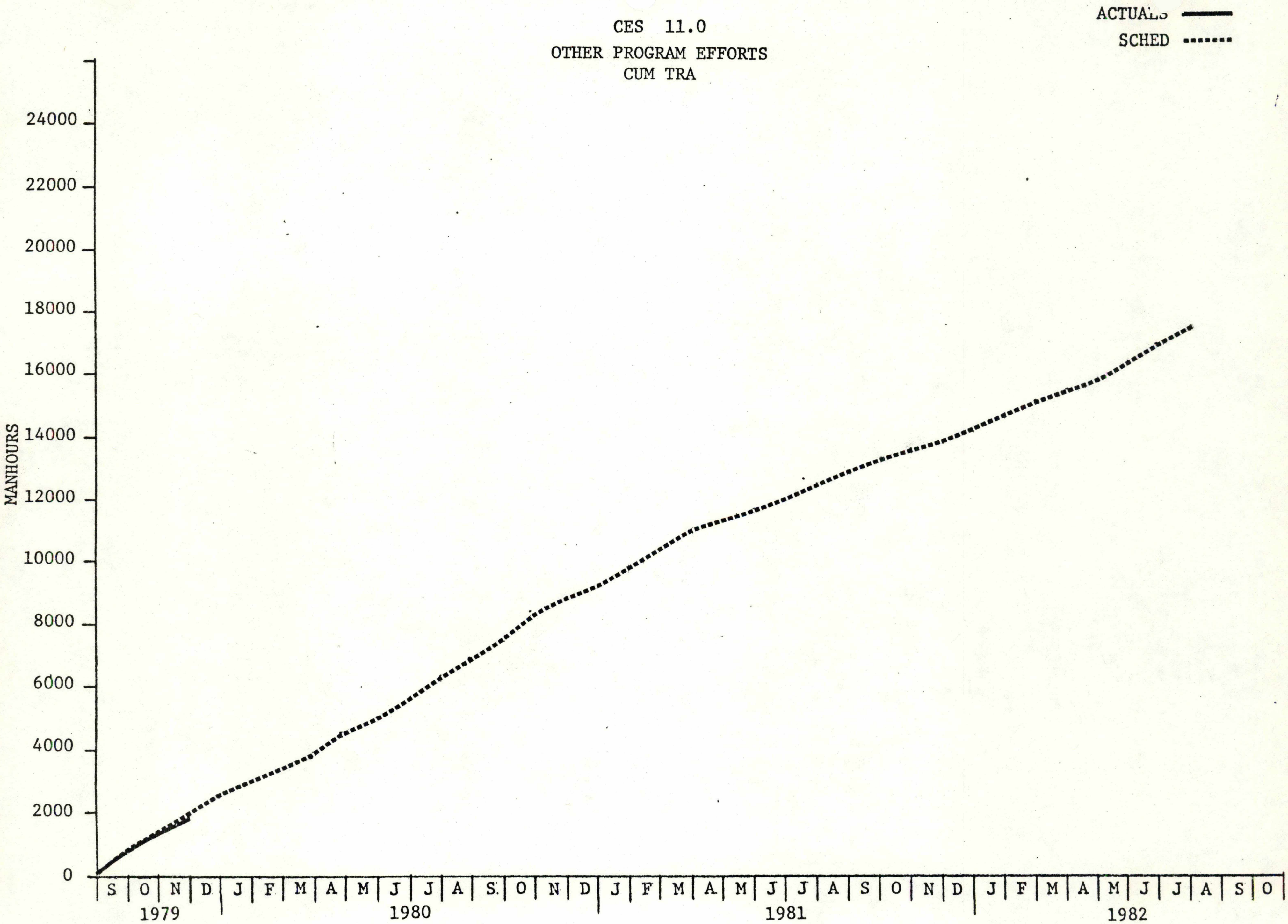
CES 9.0
TOTAL EVALUATOR SYSTEM INTEGRATION AND INSTALLATION
CUM TRA
ACTUALS
SCHED
MANHOURS
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982



CES 9.0
TOTAL EVALUATOR SYSTEM INTEGRATIONS AND INSTALLATION
CUM DSI
ACTUALS
SCHED
MANHOURS
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

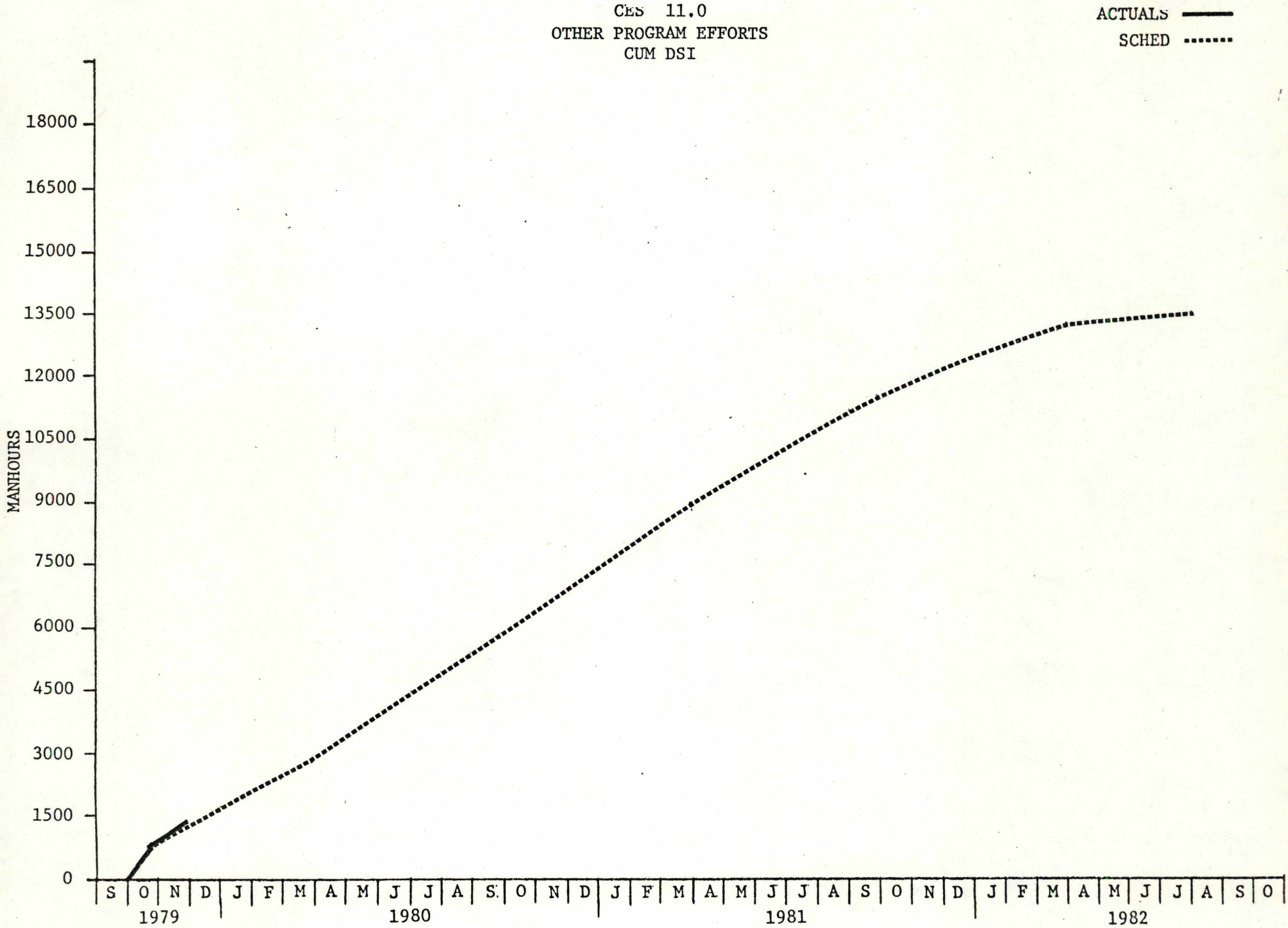


CES 11.0
OTHER PROGRAM EFFORTS
CUM TRA & DSI
ACTUALS
SCHED
MANHOURS
42000
38500
35000
31500
28000
24500
21000
17500
14000
10500
7000
3500
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982



CES 11.0
OTHER PROGRAM EFFORTS
CUM TRA
ACTUALS
SCHED
MANHOURS
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O
1979
1980
1981
1982

CES 11.0
OTHER PROGRAM EFFORTS
CUM DSI



	CES 1.0	CES 2.0	CES 3.0
Oct. 1979	20.6	1.6	1.2
Nov.	39.0	5.3	1.2
Dec.	57.1	10.5	1.2
Jan. 1980	81.2	86.4	9.3
Feb.	113.8	91.5	17.9
Mar.	156.6	96.1	27.5
Apr.	222.7	170.0	37.6
May	263.6	176.6	48.6
Jun.	310.0	182.7	62.1
Jul.	397.7	257.2	77.8
Aug.	454.9	261.8	86.9
Sep.	553.3	266.0	92.6
Oct.	639.3	299.1	122.8
Nov.	760.1	337.1	127.9
Dec.	799.8	365.8	129.5
Jan. 1981	854.7	387.4	145.2
Feb.	888.7	407.2	158.7
Mar.	914.1	419.6	187.5
Apr.	942.3	434.1	225.7
May	957.6	452.8	244.2
Jun.	969.1	454.9	246.4
Jul.	992.4	455.8	249.5
Aug.	1,010.6	457.2	251.7
Sep.	1,031.0	458.6	252.8
Oct.	1,048.9	459.3	254.8
Nov.	1,061.9	459.7	255.7
Dec.	1,065.7	460.2	256.6
Jan. 1982	1,068.4	462.2	258.4
Feb.	1,069.9	464.2	260.1
Mar.	1,069.9	464.2	260.1
Apr.	1,069.9	464.2	260.1
May	1,069.9	464.2	260.1
Jun.	1,069.9	464.2	260.1
Jul.	1,069.9	464.2	260.1

*Includes 20.3 of costs incurred for September 1979.

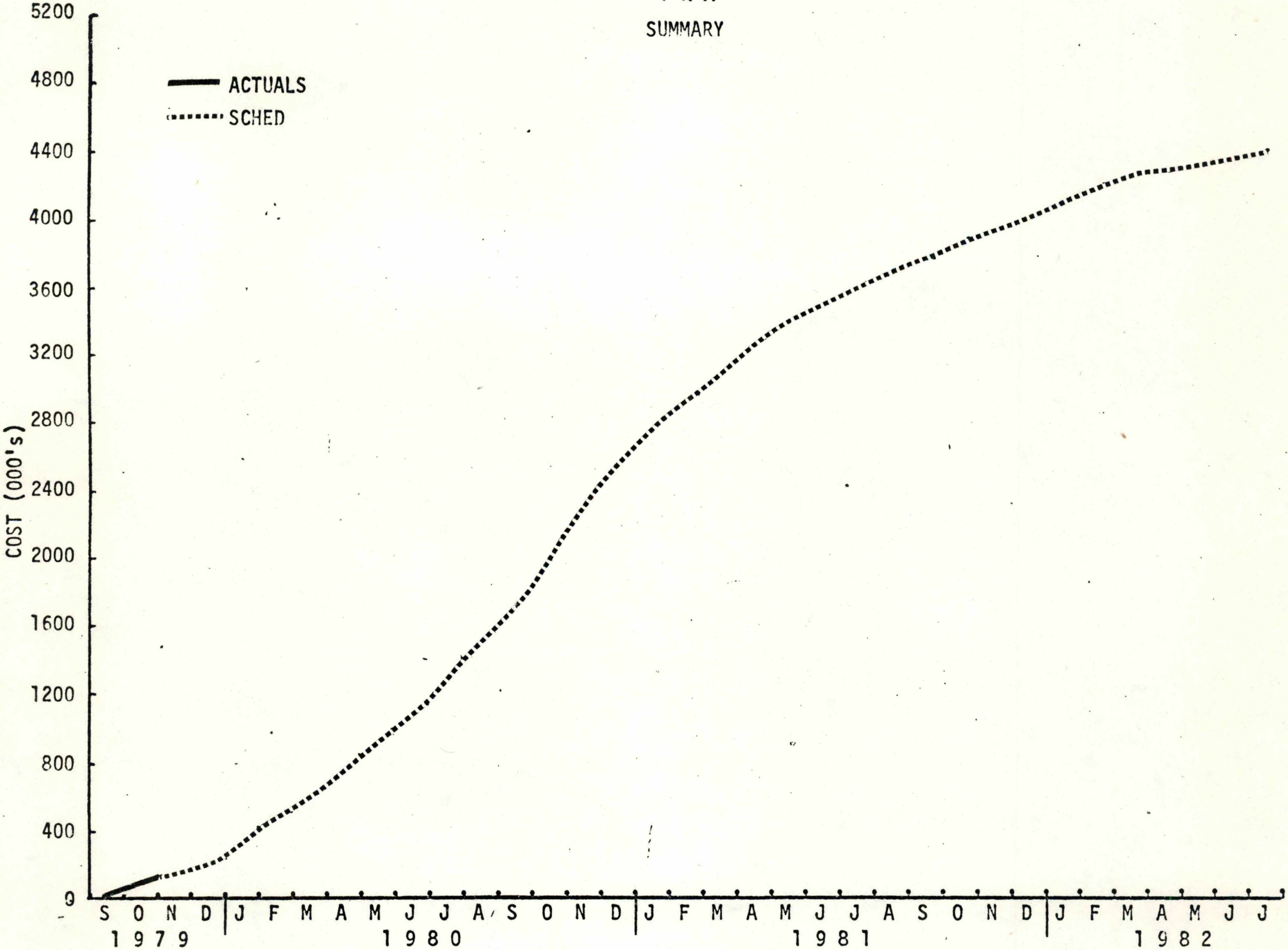
TRA ACCUM COST BY CES

(Dollars In Thousands)

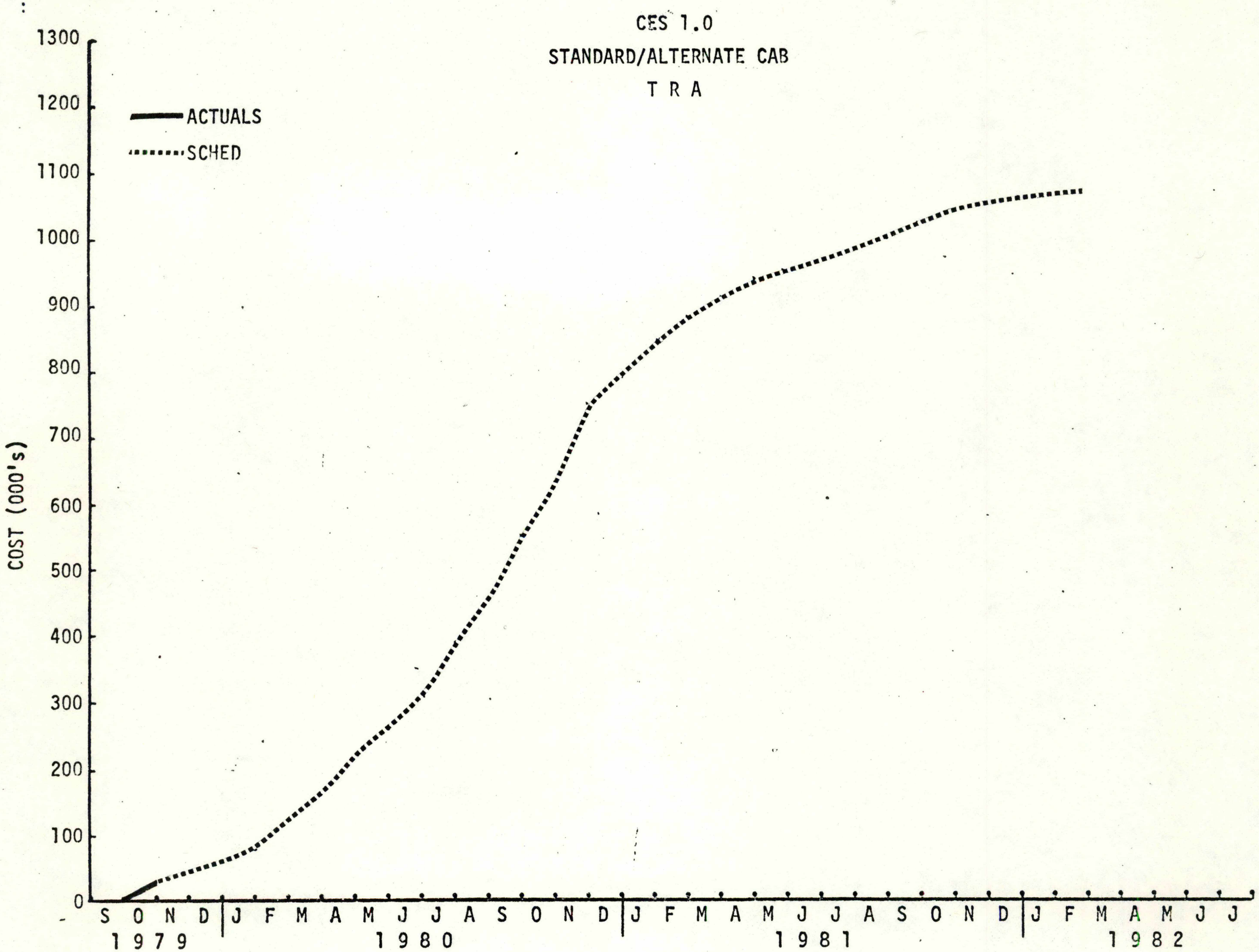
CES 4.0	CES 7.0	CES 9.0	CES 11.0		TOTAL	
12.9	1.5	8.0	56.2	*	102.0	*
26.1	1.5	24.3	84.5		181.9	
33.4	1.5	34.8	107.0		245.5	
46.5	3.8	57.8	133.4		418.4	
58.6	5.7	79.2	156.7		523.4	
68.7	8.8	96.5	180.0		634.2	
80.4	13.0	118.8	215.8		858.3	
87.9	18.4	140.7	246.0		981.8	
103.4	22.2	166.1	276.9		1,123.4	
115.9	43.8	202.9	311.4		1,406.7	
134.8	48.1	242.5	342.6		1,571.6	
175.6	54.1	288.9	374.2		1,804.7	
267.0	62.0	335.3	418.3		2,143.8	
345.2	64.9	373.0	452.3		2,460.5	
380.6	66.4	394.7	493.3		2,630.1	
413.8	72.8	432.4	527.6		2,833.9	
434.0	78.2	465.6	557.2		2,989.6	
454.3	83.1	488.0	587.6		3,134.2	
478.6	91.8	513.3	618.6		3,304.4	
493.7	96.3	533.7	644.5		3,422.8	
499.7	105.8	570.8	669.9		3,516.6	
502.5	111.2	617.6	695.1		3,624.1	
504.0	111.2	656.6	716.9		3,708.2	
504.0	111.2	694.4	738.0		3,790.0	
504.0	111.2	744.3	765.3		3,887.8	
504.0	111.2	779.7	788.4		3,960.6	
504.0	111.2	810.4	809.7		4,017.8	
504.0	111.2	887.0	829.9		4,121.1	
504.0	111.2	938.6	853.4		4,201.4	
504.0	111.2	974.5	876.7		4,260.6	
504.0	111.2	992.6	886.7		4,288.7	
504.0	111.2	992.6	927.7		4,329.7	
504.0	111.2	992.6	972.8		4,374.8	
504.0	111.2	992.6	1,001.0		4,403.0	

T R A

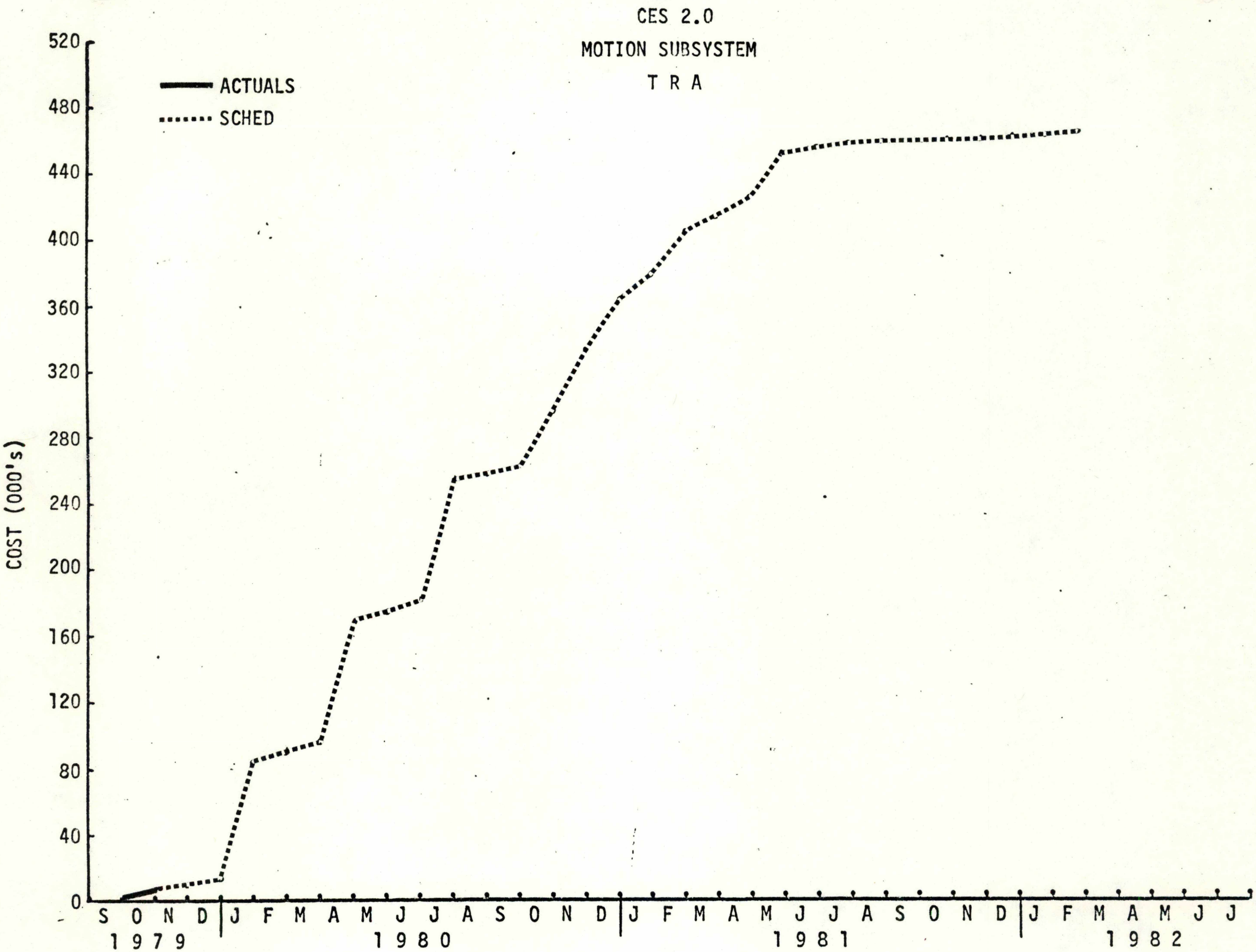
SUMMARY

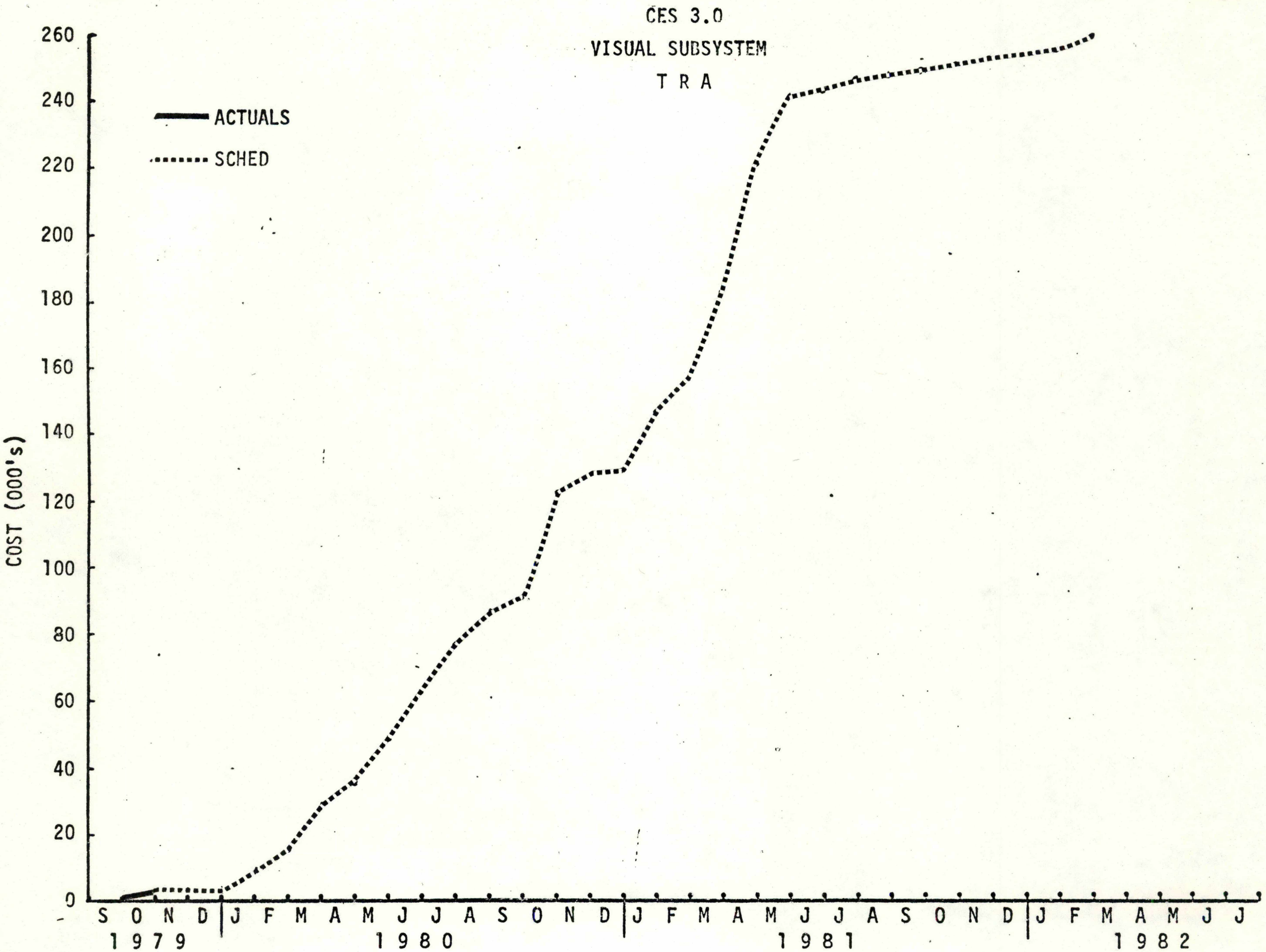


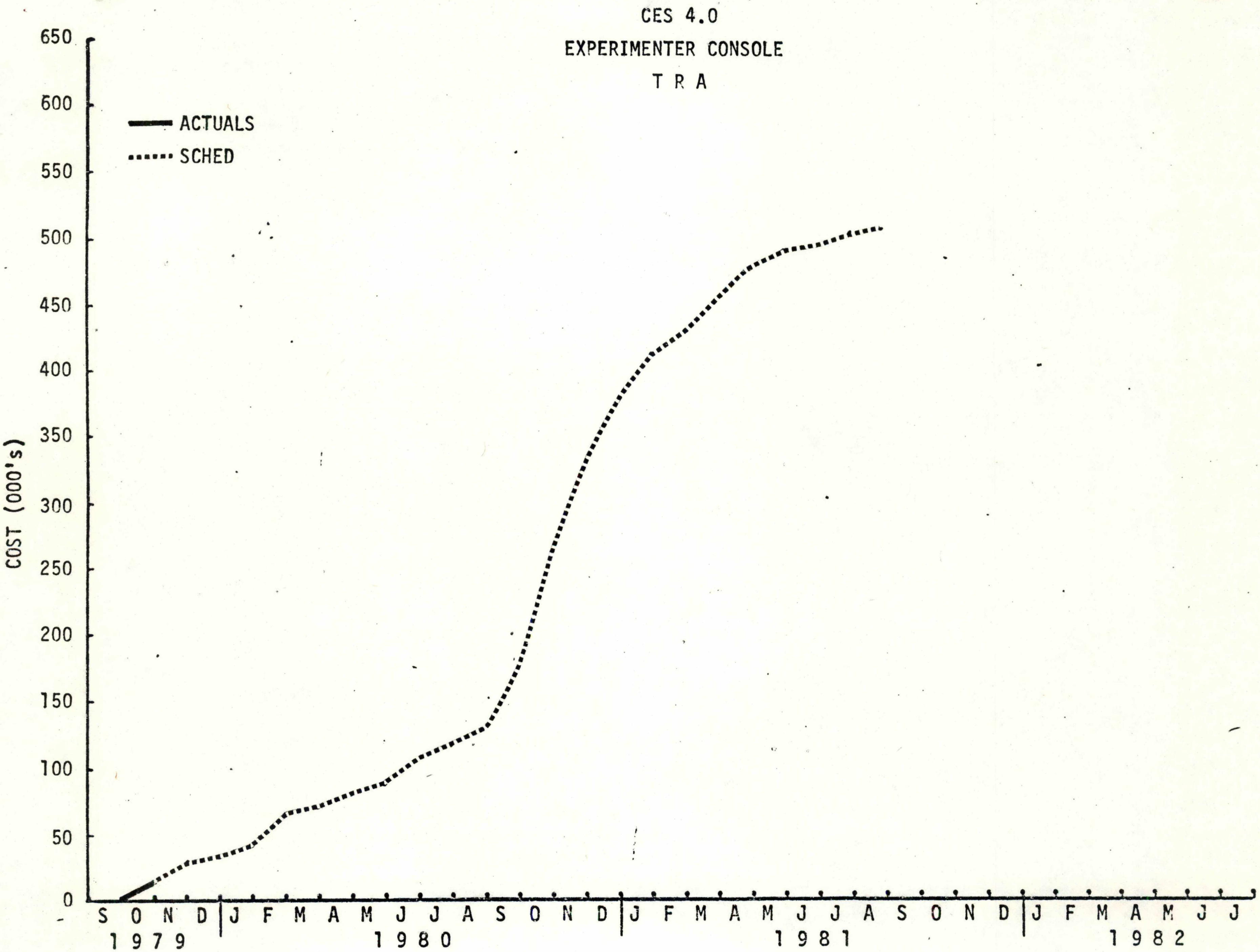
ACTUALS
SCHED
COST (000's)
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

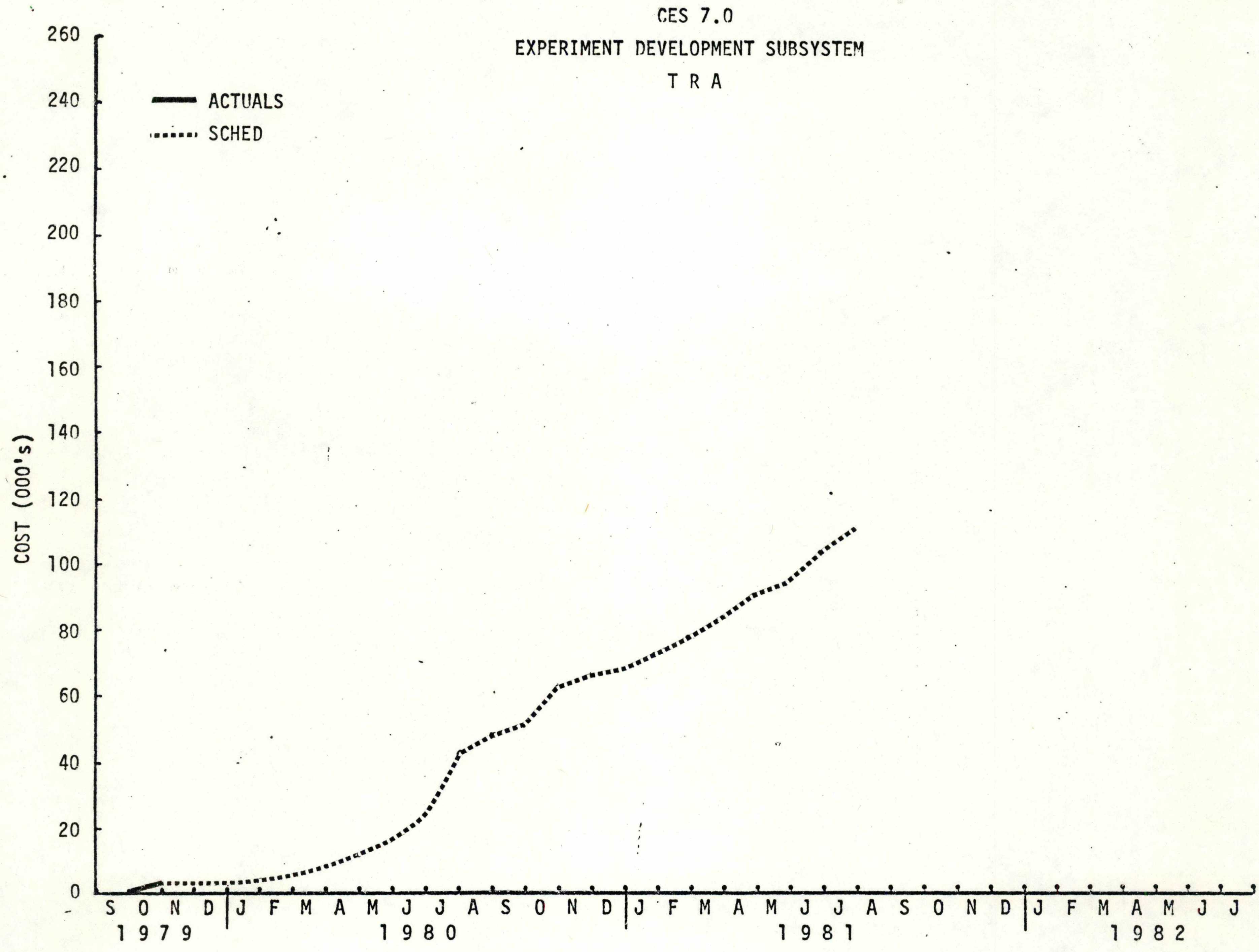


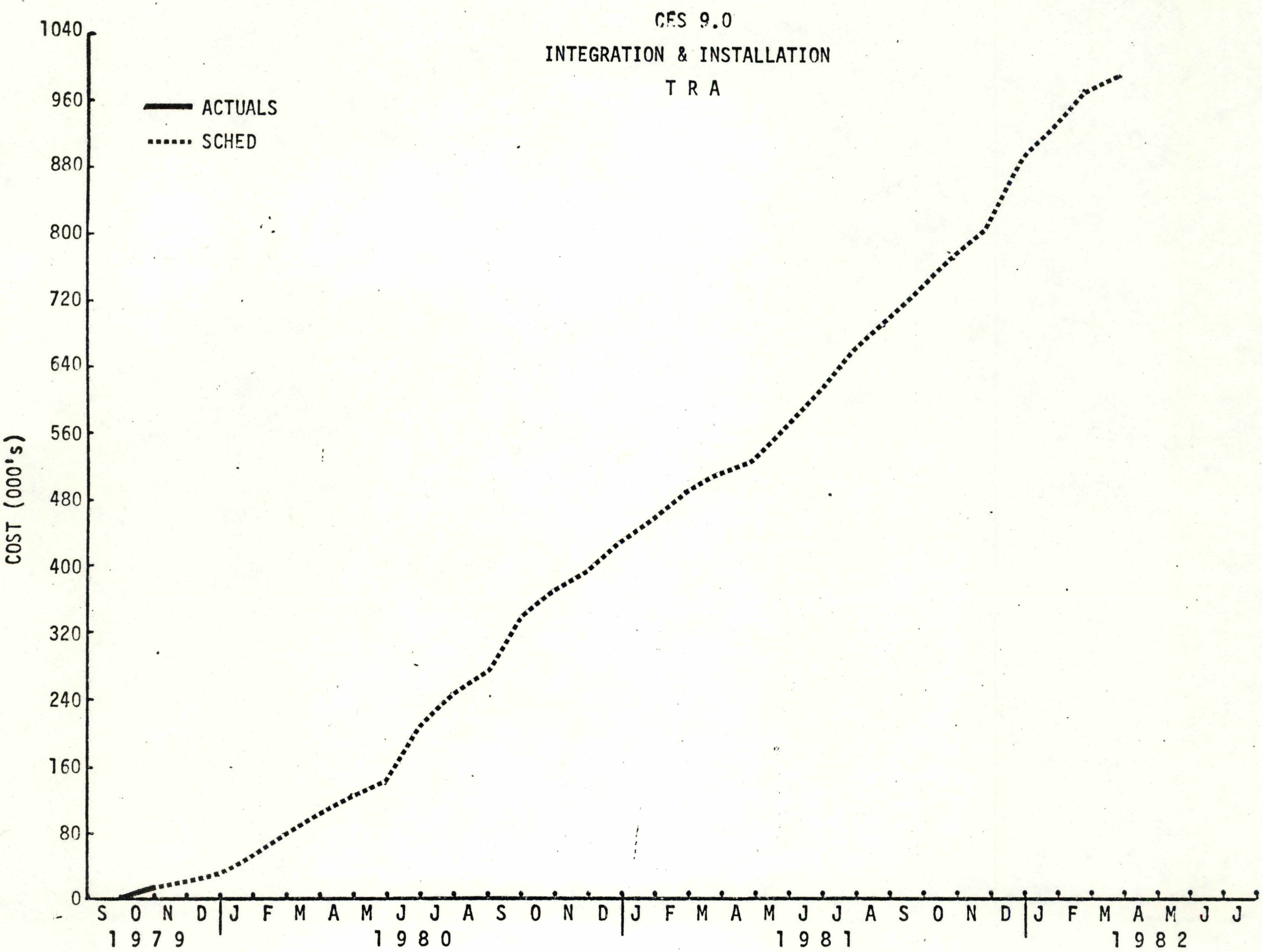
CES 1.0
STANDARD/ALTERNATE CAB
T R A
ACTUALS
SCHED
COST (000's)
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982


CES 2.0
MOTION SUBSYSTEM
T R A
ACTUALS
SCHED
COST (000's)
520
480
440
400
360
320
280
240
200
160
120
80
40
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982


CES 3.0
VISUAL SUBSYSTEM
T R A
ACTUALS
SCHED
COST (000's)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982


CES 4.0
EXPERIMENTER CONSOLE
T R A
ACTUALS
SCHED
COST (000's)
650
600
550
500
450
400
350
300
250
200
150
100
50
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

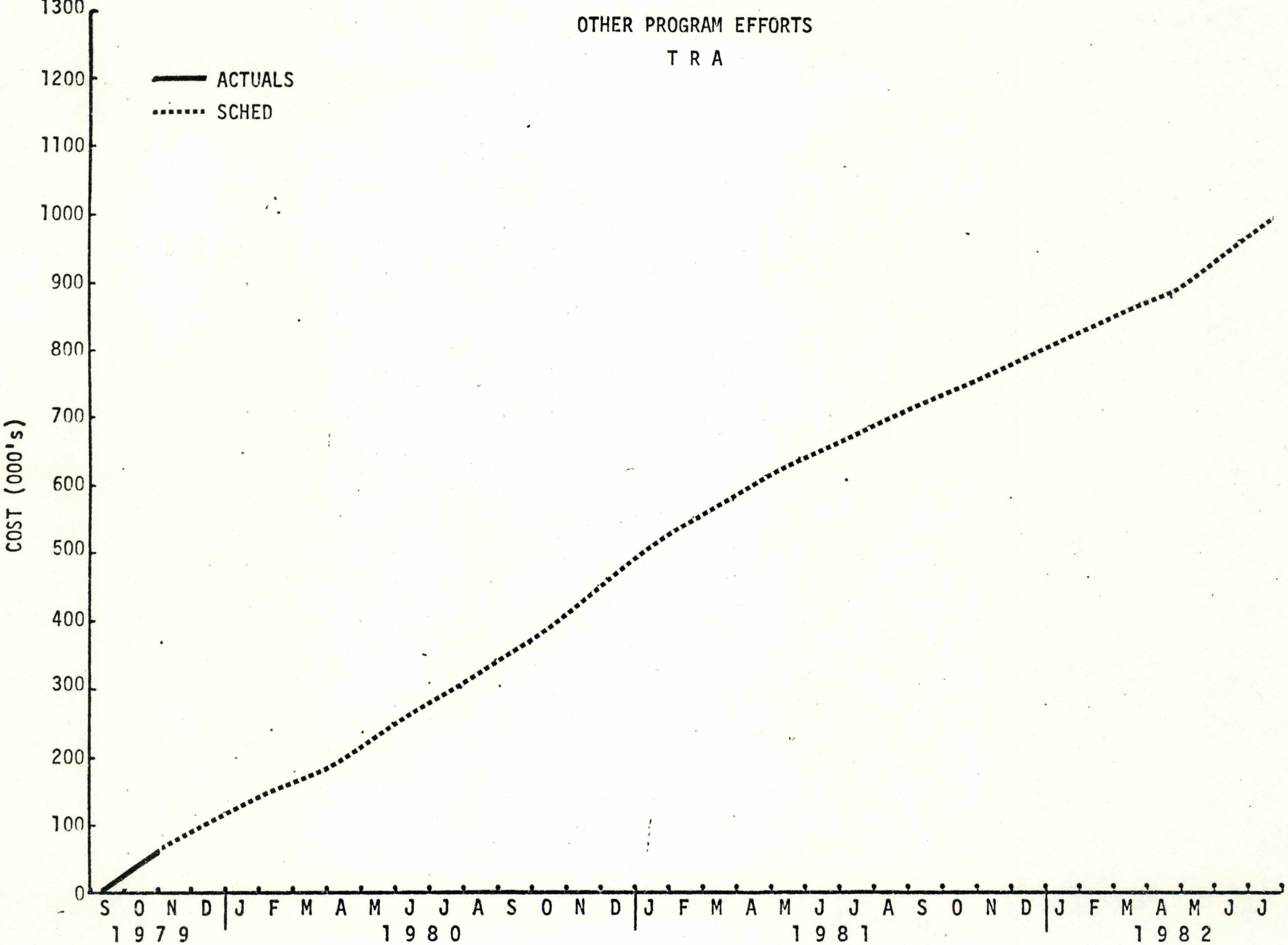

CES 7.0
EXPERIMENT DEVELOPMENT SUBSYSTEM
T R A
ACTUALS
SCHED
COST (000's)
260
240
220
200
180
160
140
120
100
80
60
40
20
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

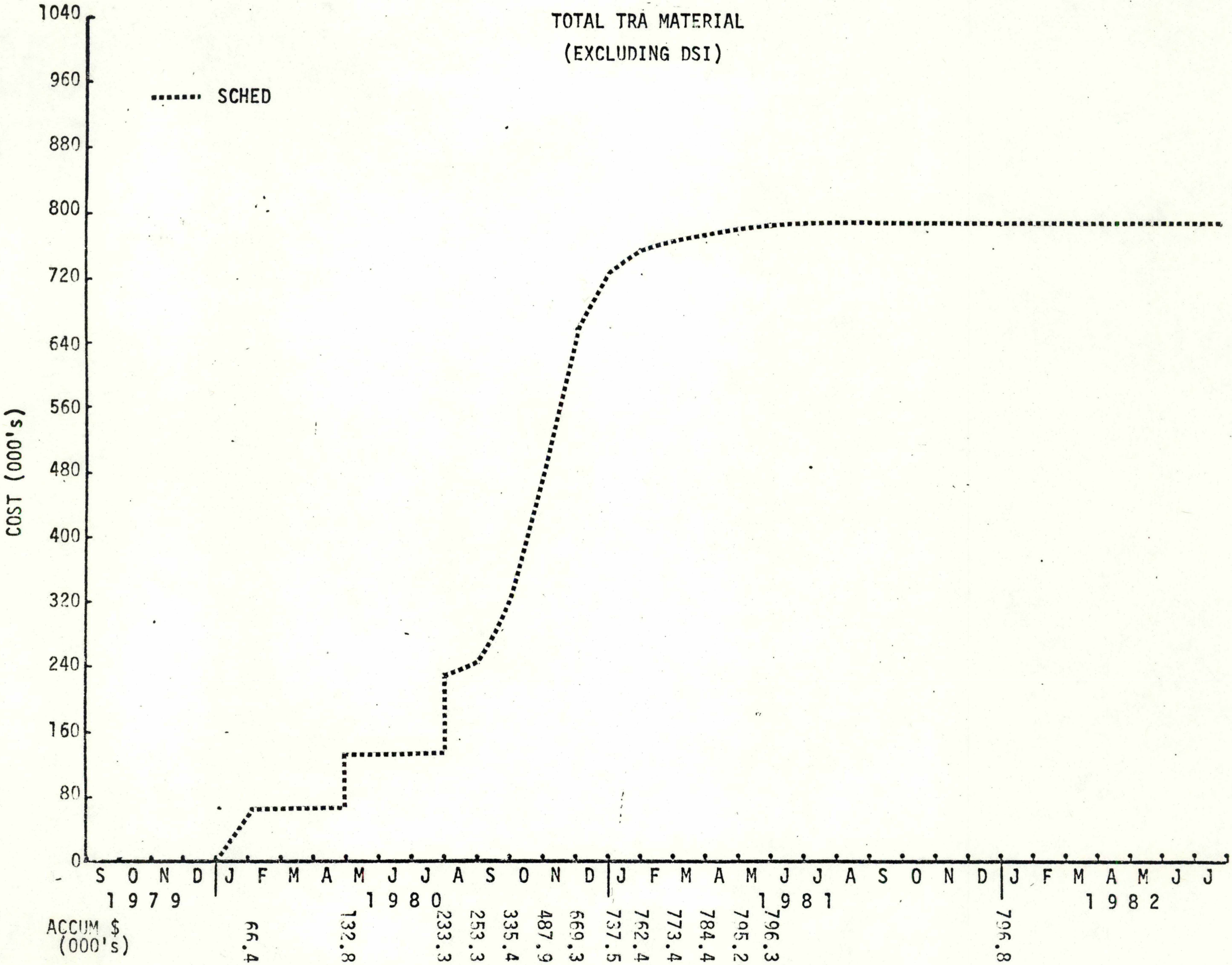

CES 9.0
INTEGRATION & INSTALLATION
T R A
ACTUALS
SCHED
COST (000's)
1040
960
880
800
720
640
560
480
400
320
240
160
80
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

CES 11.0

OTHER PROGRAM EFFORTS

T R A





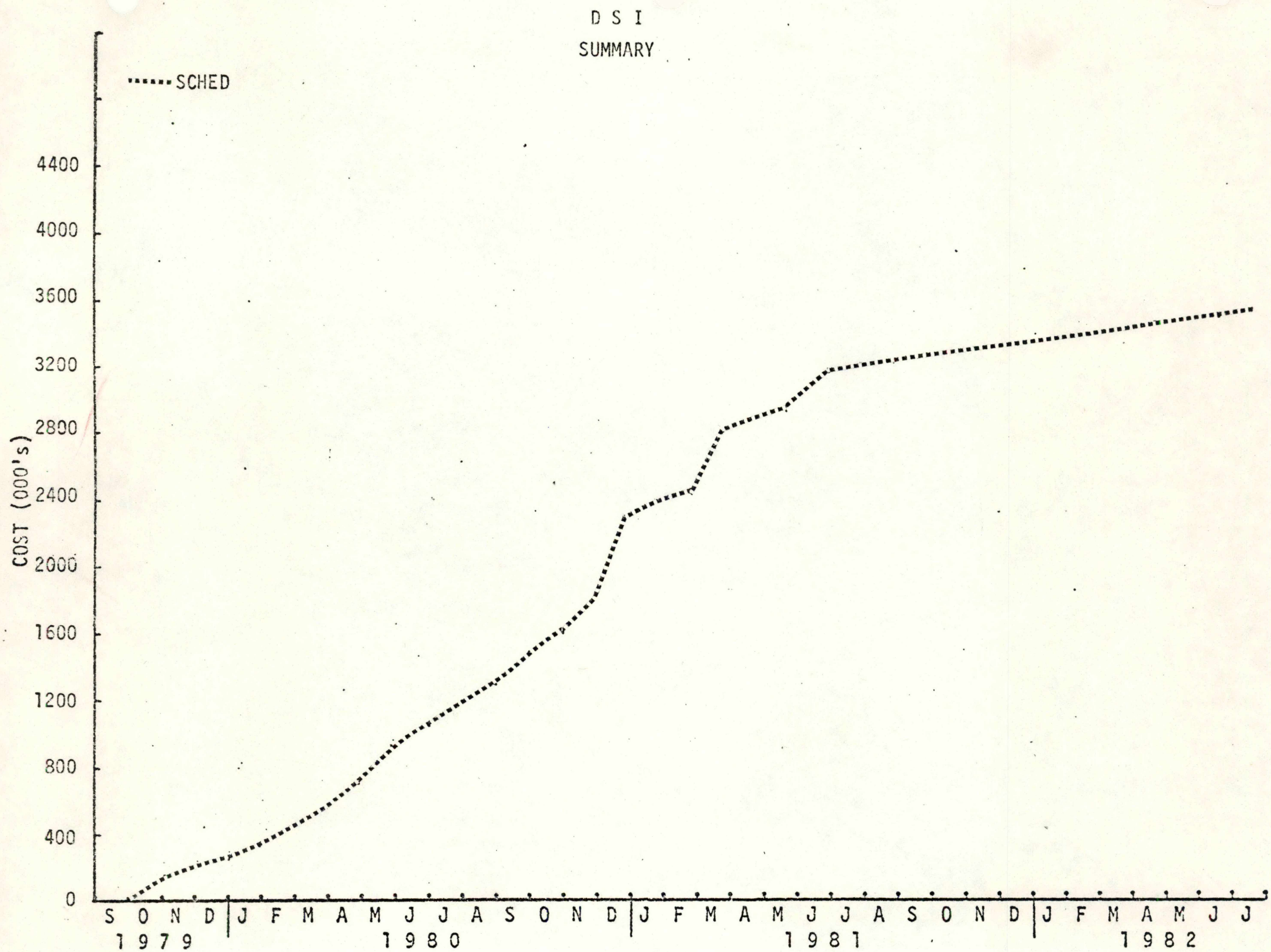
TOTAL TRA MATERIAL
(EXCLUDING DSI)
SCHED
COST (000's)
1040
960
880
800
720
640
560
480
400
320
240
160
80
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982
ACCUM $ (000's)
66.4
132.8
233.3
253.3
335.4
487.9
669.3
737.5
762.4
773.4
784.4
795.2
796.3
796.8

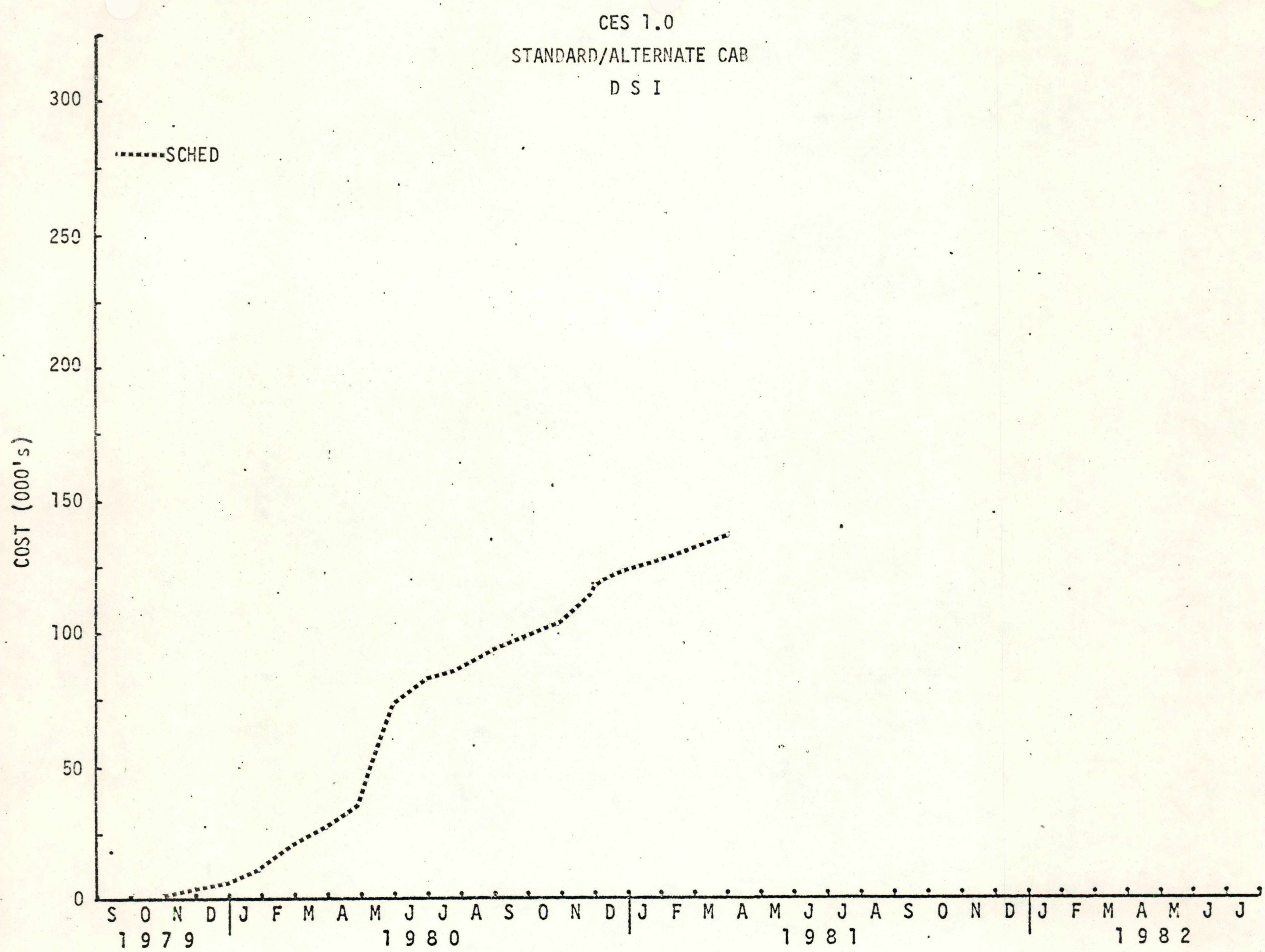
CES	DESCRIPTION
2.0	Motion Base (Prog. Paym't)
2.0	Motion Base (Prog. Paym't)
2.0	Motion Base (Prog. Paym't)
7.0	Experiment Development Console Components
1.0	Instrumentation Hardware
1.0	Instrumentation Hardware
1.0	Instrumentation Hardware
1.0	Environmental Control System
4.0	Video Components
1.0	EMD Cab Components
1.0	Electrical Supplier For Console And Interconnect
2.0	Motion Base (Prog. Paym't)
3.0	100° Panoramic Screen
4.0	Video Components
4.0	Panels
1.0	Biological TM System
1.0	Color TV Camera Head, Electronics Unit, Misc. Equipment
2.0	Motion Base (Prog. Paym't)
4.0	Panels
1.0	TV Cameras & Screen Splitter
2.0	Motion Base (Final Paym't)
4.0	6-Bay Console With Wings
1.0	Odor Injection System

MAJOR PURCHASED ITEMS

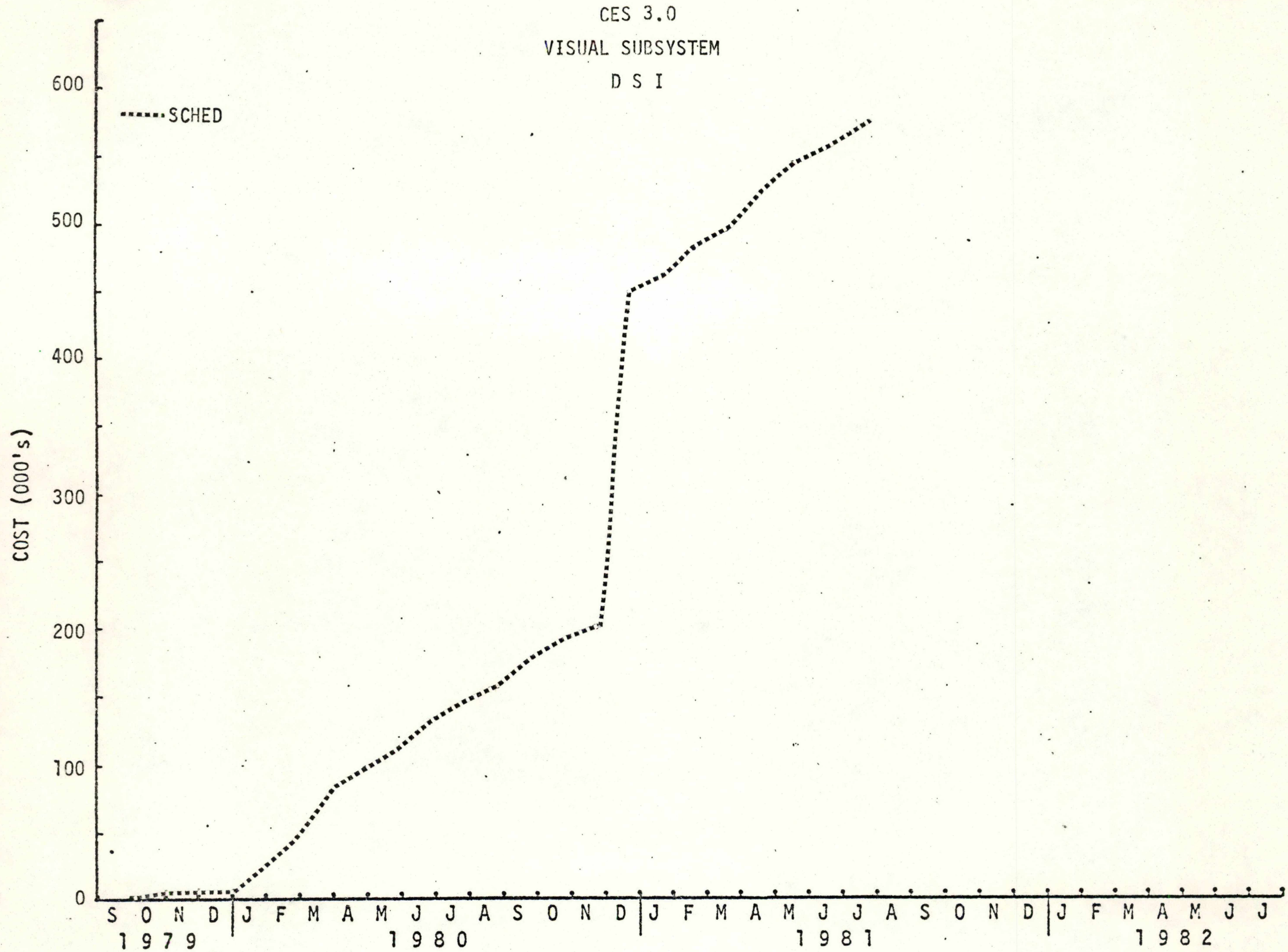
(Excluding DSI)

EVENT NOS. START	EVENT NOS. COMPLETE	ESTIMATED PLACEMENT DATE	ESTIMATED PAYMENT DATE	ESTIMATED PRICE (000's)
2-201	2-210	Dec. 79	Jan. 80	66.4
2-201	2-210	Dec. 79	Apr. 80	66.4
2-201	2-210	Dec. 79	Jul. 80	66.4
7-730	7-5	Mar. 80	Jul. 80	14.0
1-150	1-157	Dec. 79	Jul. 80	20.1
1-150	1-157	Dec. 79	Aug. 80	20.0
1-150	1-157	Dec. 79	Sep. 80	20.0
1-34	1-42	Mar. 80	Sep. 80	41.1
4-400	4-23	Mar. 80	Sep. 80	20.0
1-32	1-40	Feb. 80	Oct. 80	28.0
1-55	1-54	Feb. 80	Oct. 80	12.0
2-201	2-210	Dec. 79	Oct. 80	26.6
3-332	3-333	Mar. 80	Oct. 80	21.0
4-400	4-32	Mar. 80	Oct. 80	24.8
4-21	4-29	Jun. 80	Oct. 80	29.5
1-35	1-51	Mar. 80	Nov. 80	44.0
1-37	1-53	May 80	Nov. 80	44.3
2-201	2-210	Dec. 79	Nov. 80	26.6
4-21	4-29	Jun. 80	Nov. 80	46.7
1-37	1-53	May 80	Dec. 80	12.3
2-201	2-210	Dec. 79	Dec. 80	13.3
4-400	4-41	Mar. 80	Dec. 80	15.2
1-9	1-47	Dec. 79	Jan. 81	24.9

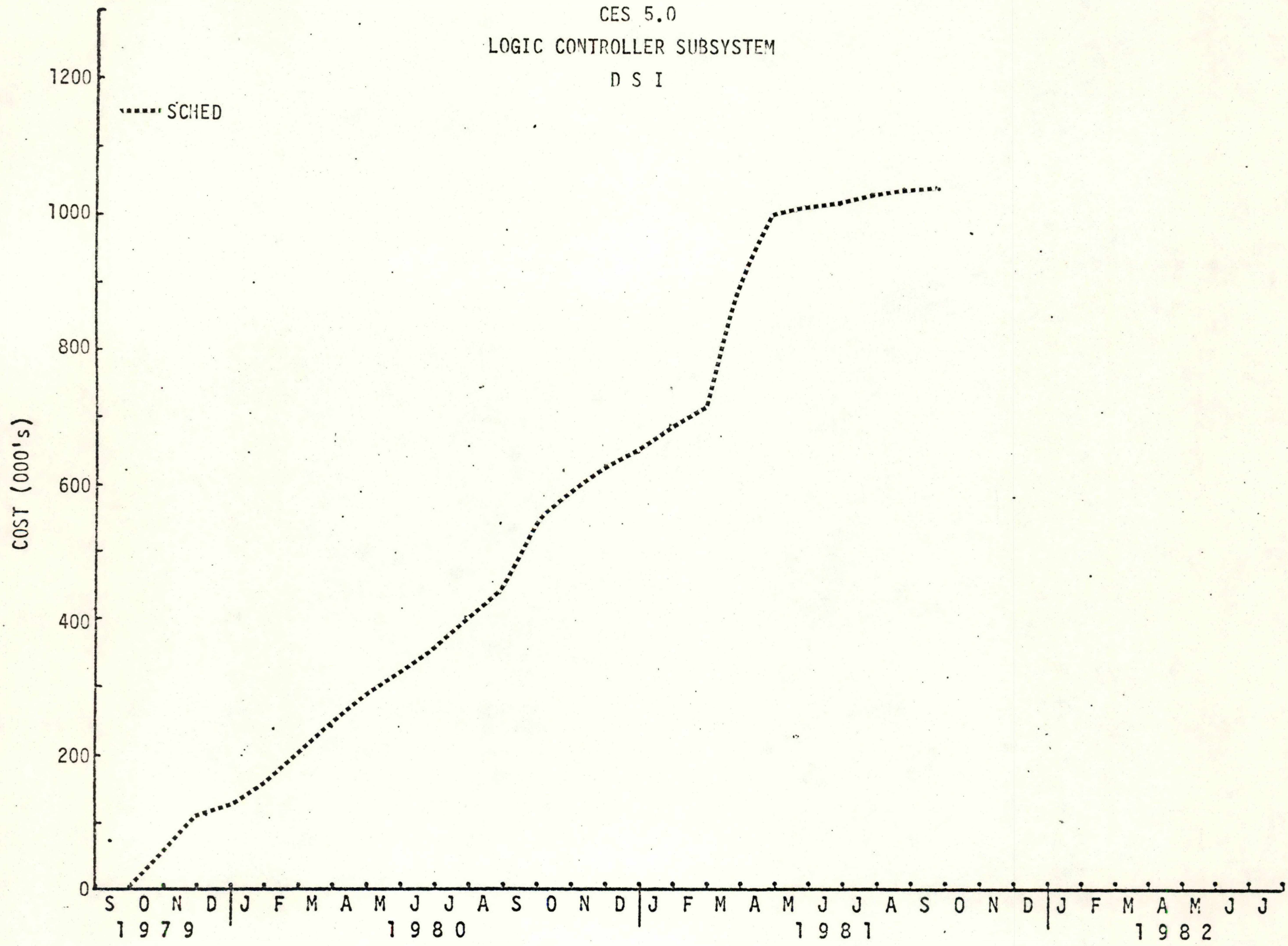

D S I
SUMMARY
SCHED
COST (000's)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

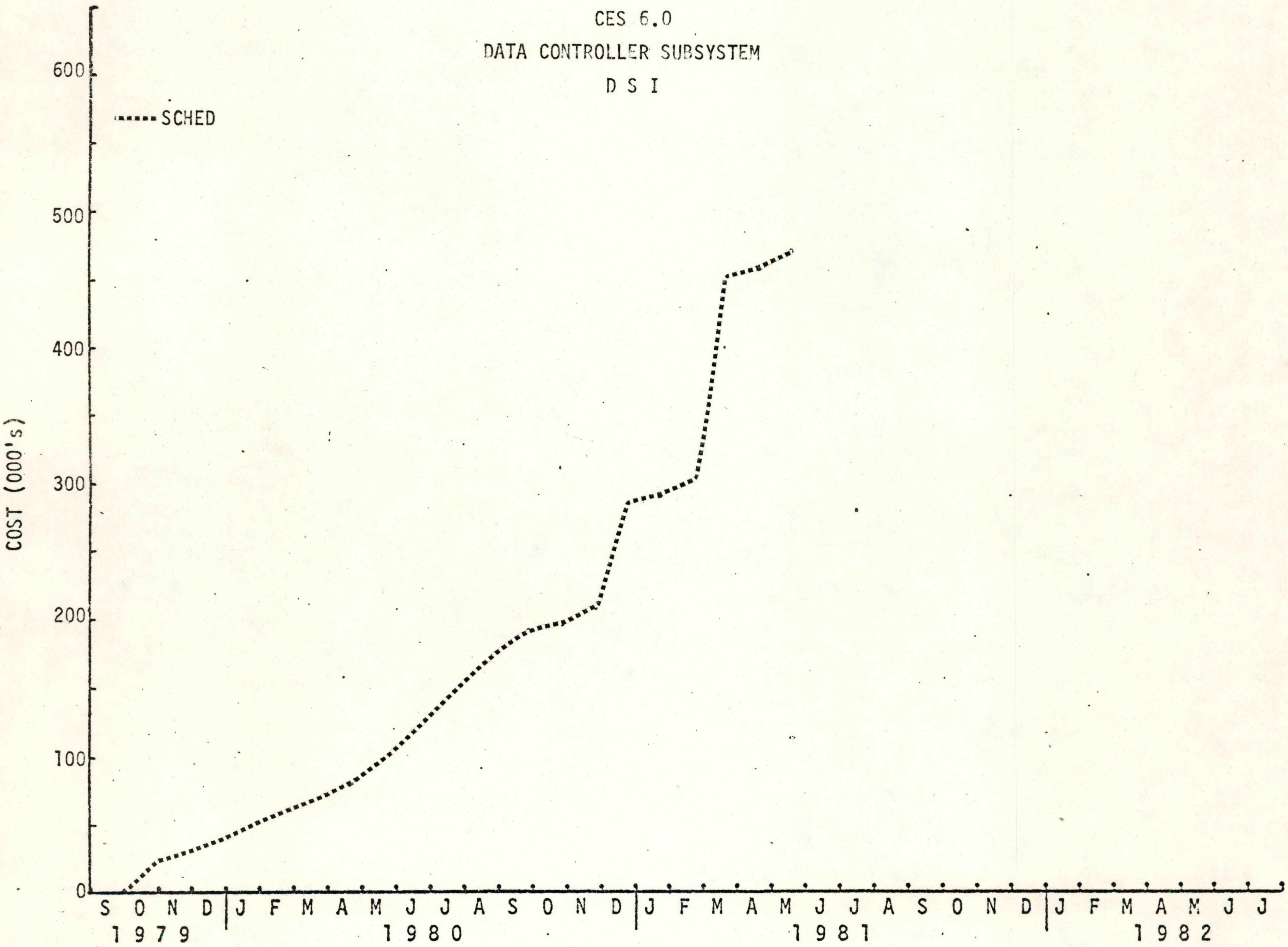


CES 1.0
STANDARD/ALTERNATE CAB
D S I
SCHED
COST (000's)
300
250
200
150
100
50
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982



CES 3.0
VISUAL SUBSYSTEM
D S I
SCHED
COST (000's)
600
500
400
300
200
100
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982


CES 5.0
LOGIC CONTROLLER SUBSYSTEM
D S I
SCHED
COST (000's)
1200
1000
800
600
400
200
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

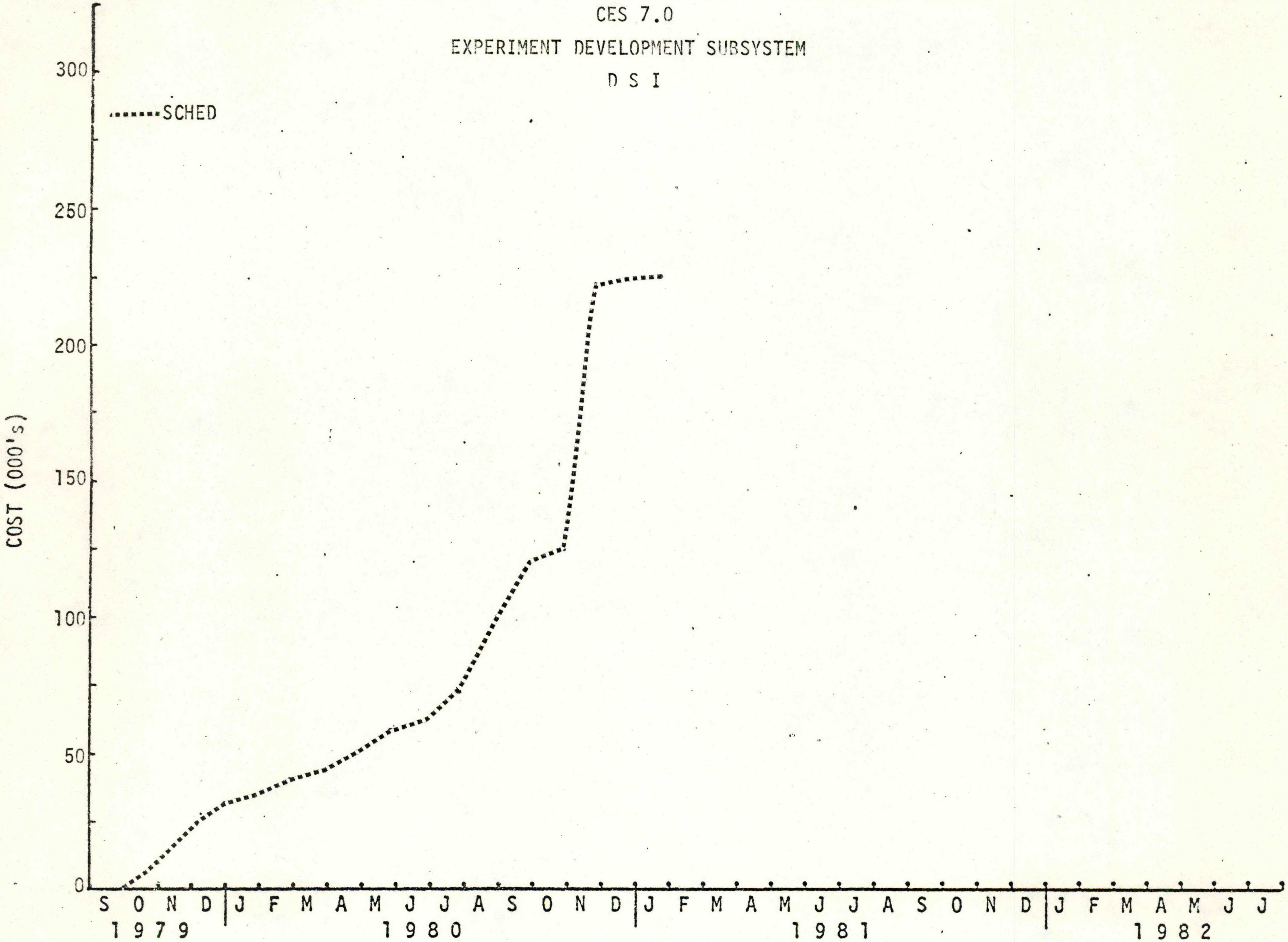


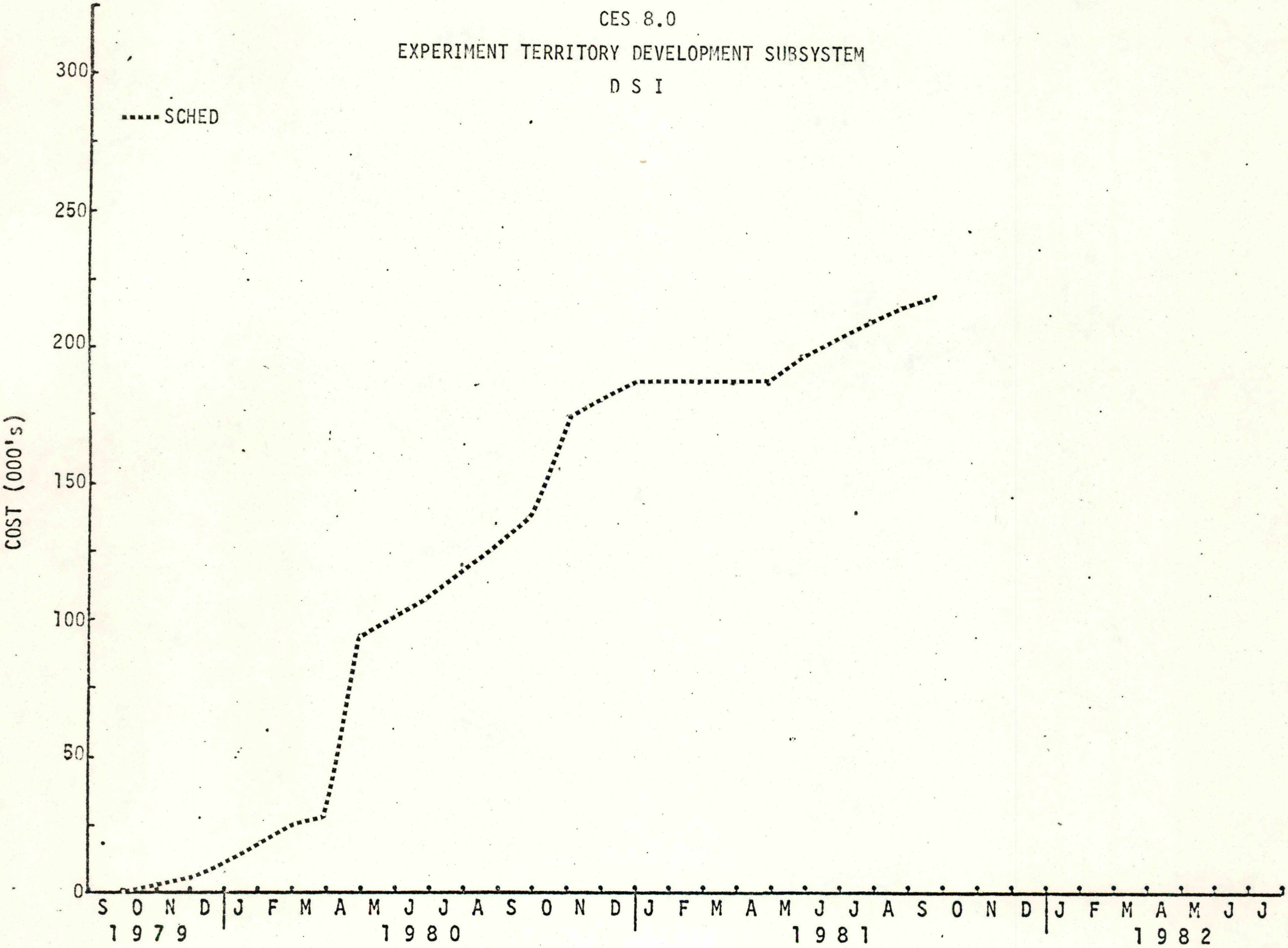
CES 6.0
DATA CONTROLLER SUBSYSTEM
D S I
SCHED
COST (000's)
600
500
400
300
200
100
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

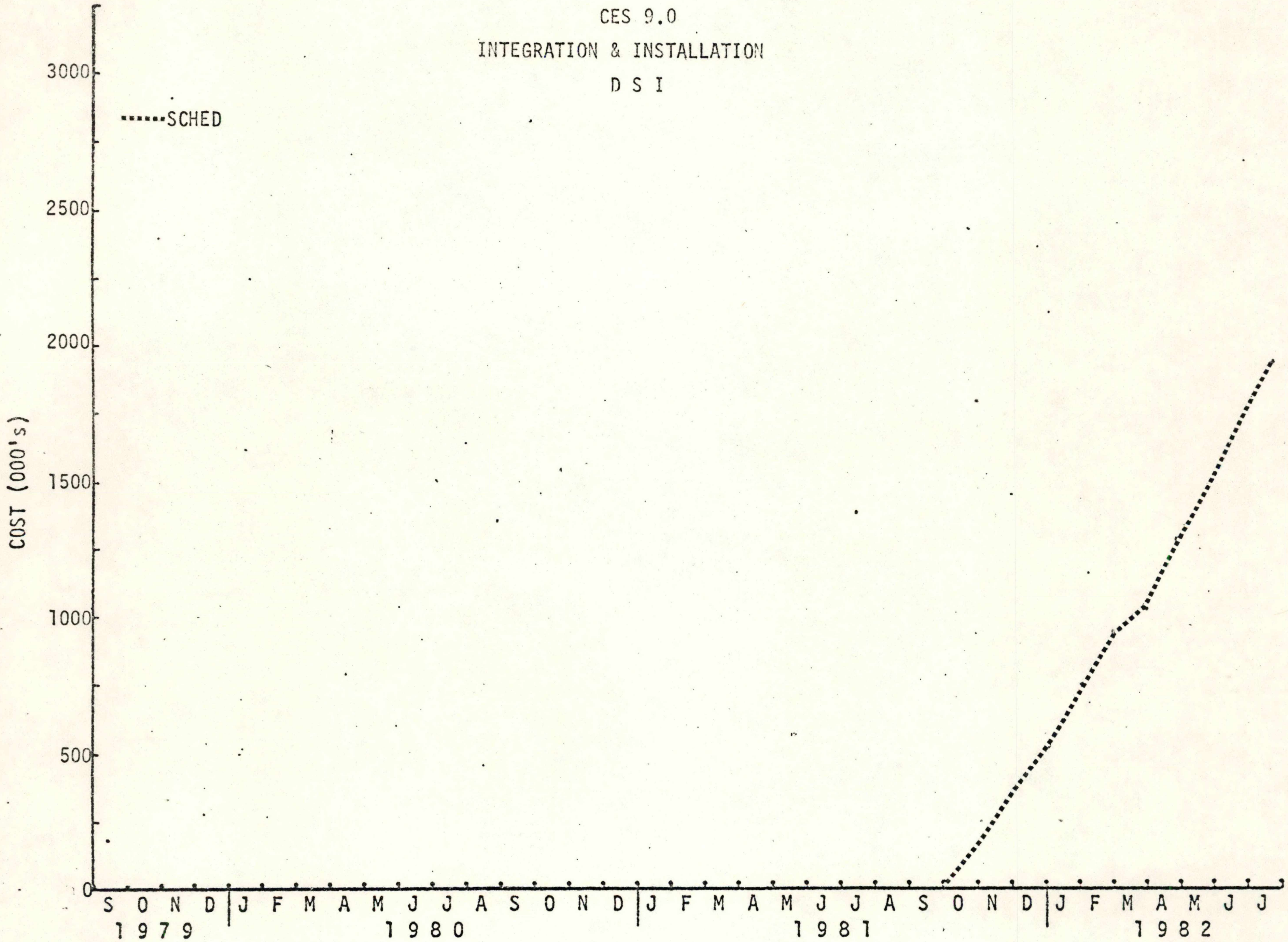
CES 7.0

EXPERIMENT DEVELOPMENT SUBSYSTEM

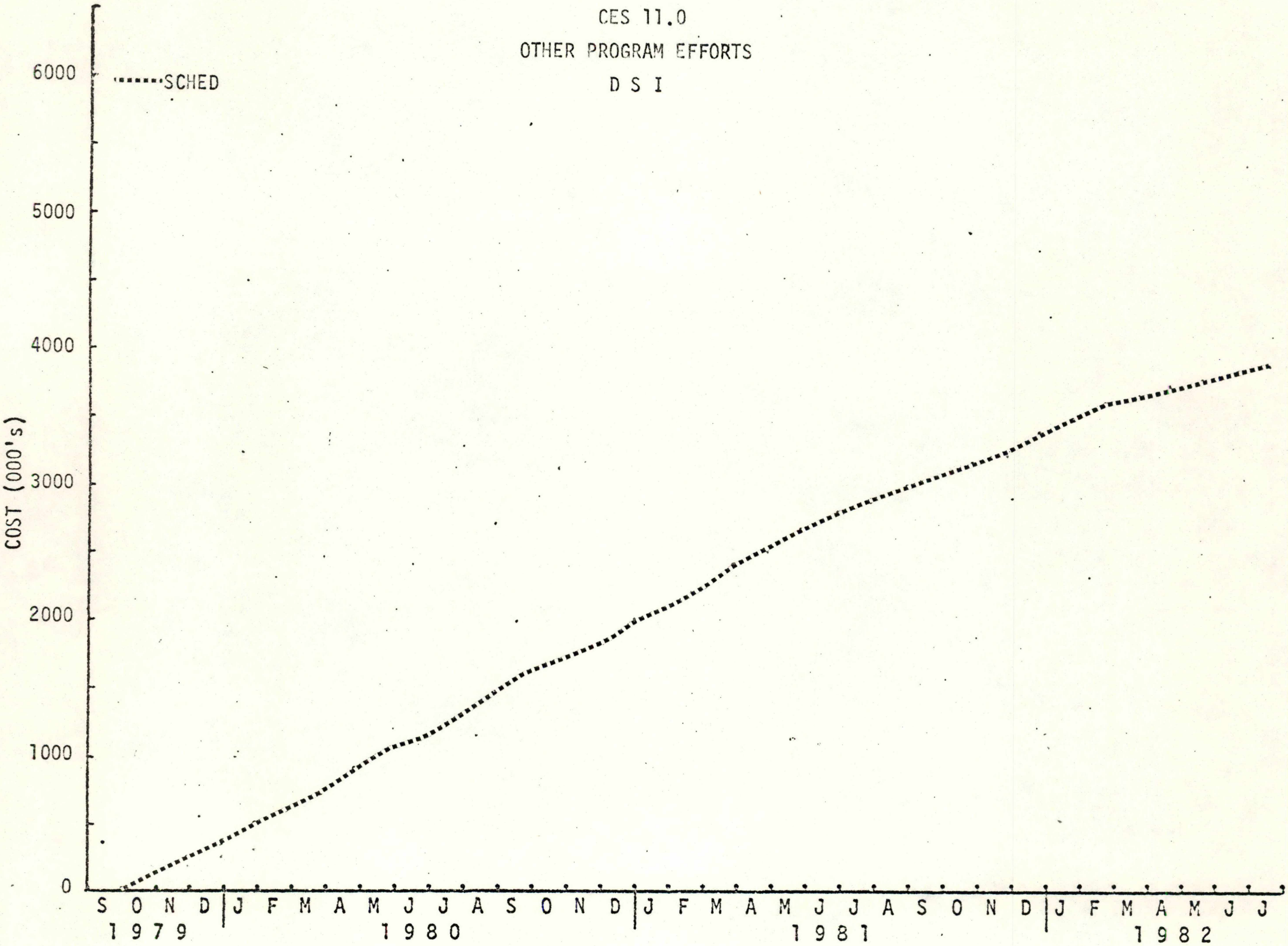
D S I




CES 8.0
EXPERIMENT TERRITORY DEVELOPMENT SUBSYSTEM
D S I
SCHED
COST (000's)
300
250
200
150
100
50
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

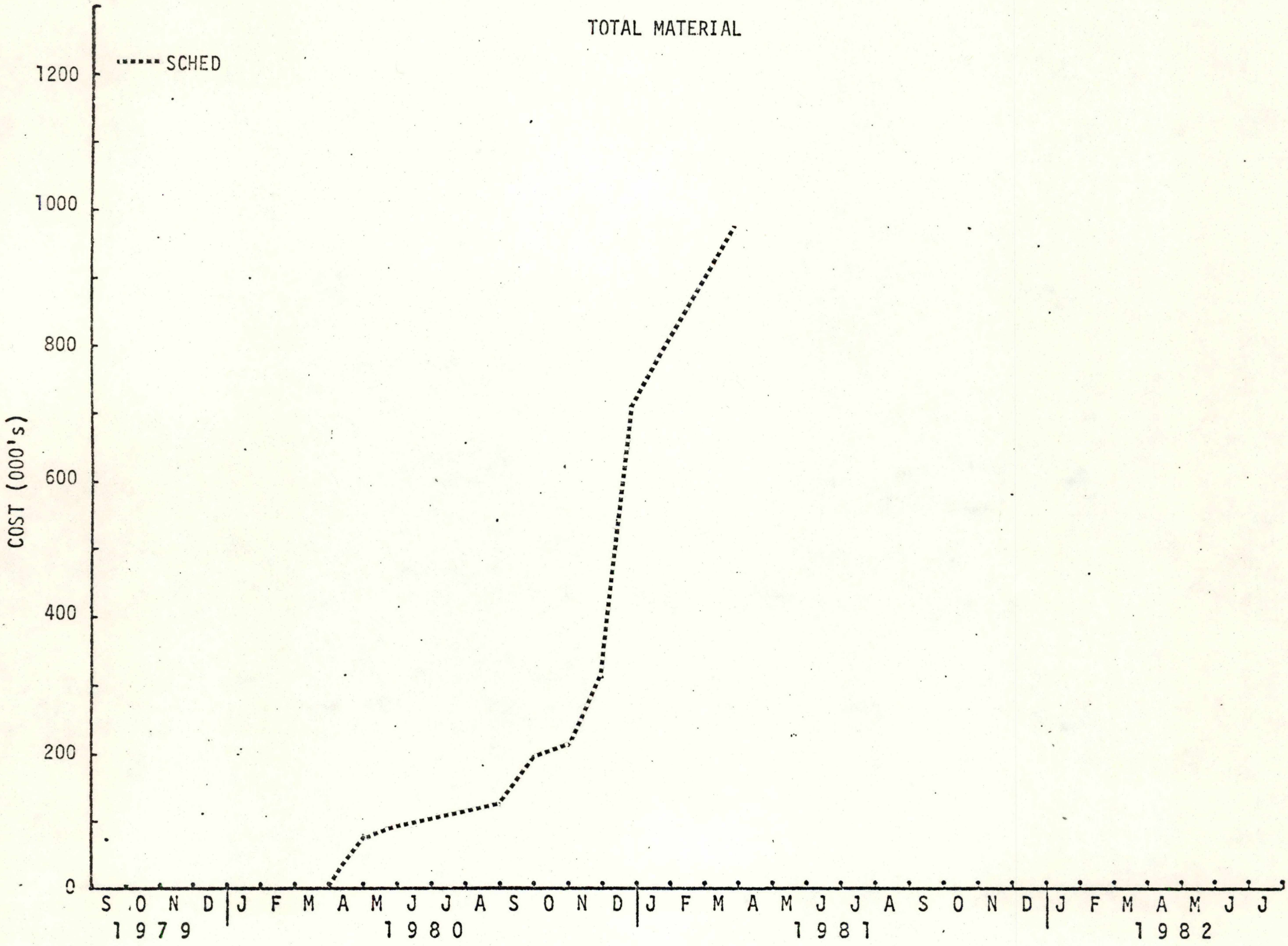


CES 9.0
INTEGRATION & INSTALLATION
D S I
SCHED
COST (000's)
3000
2500
2000
1500
1000
500
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982


CES 11.0
OTHER PROGRAM EFFORTS
D S I
SCHED
COST (000's)
6000
5000
4000
3000
2000
1000
0
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1979
1980
1981
1982

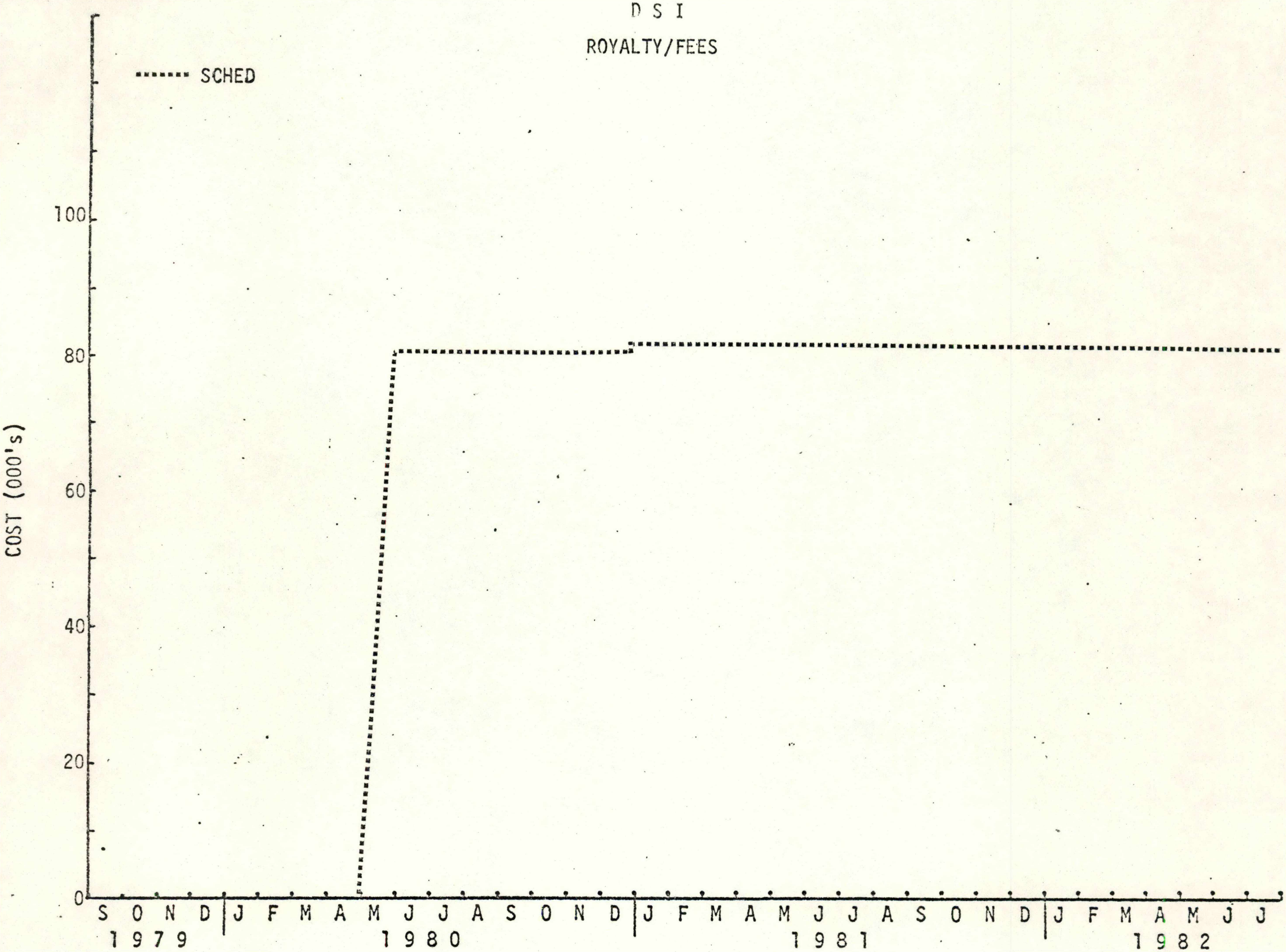
D S I

TOTAL MATERIAL



D S I

ROYALTY/FEES



DSI ACCUM

(Dollars I

	CES 1.0	CES 3.0	CES 5.0	CES 6.0	CES 7.0
Oct. 1979	-	2.1	69.0	26.4	17.5
Nov.	1.8	2.1	100.9	34.5	26.6
Dec.	3.1	2.1	126.5	41.1	33.8
Jan. 1980	10.3	25.6	160.8	51.2	39.0
Feb.	19.6	49.1	206.1	62.5	43.2
Mar.	27.9	84.7	256.9	74.9	46.3
Apr.	35.0	101.0	292.6	95.6	53.6
May	74.8	117.2	328.2	115.3	60.9
Jun.	81.9	133.4	364.3	134.3	68.2
Jul.	88.0	148.6	405.4	153.6	75.5
Aug.	92.9	164.7	444.6	171.9	114.1
Sep.	97.9	178.8	547.0	190.2	122.3
Oct.	101.8	193.5	591.6	199.8	127.3
Nov.	118.4	208.2	630.2	207.7	226.3
Dec.	122.4	451.8	752.2	289.7	231.4
Jan. 1981	126.5	466.6	790.2	296.7	236.5
Feb.	130.6	481.3	823.3	304.6	236.5
Mar.	135.8	496.0	992.9	458.2	236.5
Apr.	135.8	521.5	1,009.5	466.1	236.5
May	135.8	547.0	1,026.1	474.1	236.5
Jun.	135.8	561.7	1,033.8	474.1	236.5
Jul.	135.8	575.9	1,041.4	474.1	236.5
Aug.	135.8	575.9	1,049.0	474.1	236.5
Sep.	135.8	575.9	1,056.6	474.1	236.5
Oct.	135.8	575.9	1,056.6	474.1	236.5
Nov.	135.8	575.9	1,056.6	474.1	236.5
Dec.	135.8	575.9	1,056.6	474.1	236.5
Jan. 1982	135.8	575.9	1,056.6	474.1	236.5
Feb.	135.8	575.9	1,056.6	474.1	236.5
Mar.	135.8	575.9	1,056.6	474.1	236.5
Apr.	135.8	575.9	1,056.6	474.1	236.5
May	135.8	575.9	1,056.6	474.1	236.5
Jun.	135.8	575.9	1,056.6	474.1	236.5
Jul.	135.8	575.9	1,056.6	474.1	236.5

COST BY CES

n Thousands)

CES 8.0	CES 9.0	CES 11.0	ROYALTY/ FEES	TOTAL	WITH TRA LOADING
5.2	-	22.4	-	142.6	146.2
11.1	-	34.4	-	211.4	216.7
15.9	-	44.1	-	266.6	273.2
20.5	-	56.1	-	363.5	372.6
24.9	-	67.3	-	472.7	484.6
29.4	-	77.9	-	598.0	613.0
93.3	-	91.9	-	763.0	782.2
103.3	-	105.9	81.7	987.3	1,012.0
113.3	-	119.9	81.7	1,097.0	1,124.4
123.3	-	133.9	81.7	1,210.0	1,240.3
133.2	-	147.9	81.7	1,351.0	1,384.8
141.0	-	161.9	81.7	1,520.8	1,558.9
178.7	-	176.5	81.7	1,650.9	1,692.2
184.3	-	191.1	81.7	1,847.9	1,894.2
189.9	-	205.7	82.7	2,325.8	2,384.0
189.9	-	220.3	82.7	2,409.4	2,469.7
189.9	-	234.9	82.7	2,483.8	2,546.0
189.9	-	249.5	82.7	2,841.5	2,912.6
189.9	-	260.6	82.7	2,902.6	2,975.3
200.6	-	271.7	82.7	2,974.5	3,049.0
211.2	-	282.8	82.7	3,018.6	3,094.0
215.6	-	293.9	82.7	3,055.9	3,132.4
220.0	-	306.3	82.7	3,080.3	3,157.4
224.2	-	318.7	82.7	3,104.5	3,182.2
224.2	18.7	329.0	82.7	3,133.5	3,212.0
224.2	37.5	339.3	82.7	3,162.6	3,241.9
224.2	56.3	349.6	82.7	3,191.7	3,271.6
224.2	75.1	359.9	82.7	3,220.8	3,301.4
224.2	93.9	370.2	82.7	3,249.9	3,331.3
224.2	112.7	380.5	82.7	3,279.0	3,361.1
224.2	134.1	384.0	82.7	3,303.9	3,386.7
224.2	155.7	387.5	82.7	3,329.0	3,412.4
224.2	177.3	391.0	82.7	3,354.1	3,438.1
224.2	198.7	394.5	82.7	3,379.0	3,464.0

A copy of the November 15,1979 submittal covering the month of October 1979 is provided at the end of this section as an example of the reporting that will be provided.

5.5 Bi-Monthly Progress Reporting

Bi-Monthly Progress Reports are prepared in the form of briefing charts, such as those included in the monthly progress report, and are presented in bi-monthly program review meetings with TRA Executive Management. Problems highlighted are discussed, impacts highlighted, and alternative solutions are offered. In this manner, top level management is kept abreast of, and provide any necessary resources to resolve such problems.

Both TRA and DSI Program Managers are provided a bi-monthly Program Element Detail Description (PEDD) computer printout of labor hour expenditures against the planned level by CES/WBS element. This printout also accompanies TRA's invoices submitted every two weeks which is a substantiation of manhour expenditures included in the invoices. The same printout accompanies each Monthly Progress Report and is the basis for prepared charts included in that report.

5.6 Final Technical Report

TRA/DSI will submit a Final Technical Report which will include:

- Overview of technical problems and requirements
- Description of completed system
- Description of engineering innovations or newly designed methods/materials.

15 November 1979

TRA LATHE MONTHLY PROGRESS REPORT

1.0 INTRODUCTION - The following represents TRA's Progress Report for the period 28 September thru 2 November 1979 as required by Attachment 1 (Statement of Work) of Contract DOT-FR-9142.

2.0 CURRENT VERSUS PLANNED STATUS

2.1 PLANNED ACTIVITIES - Major planned activities included:

a. Preparing a detailed sub-contract Statement of Work for the major subcontractor (DSI).

b. Prepare the Project, Quality Assurance and Documentation Plans scheduled for submittal 30 November 1979.

c. Review requirements for long lead procured items and confirm price and delivery schedules thru Vendor Liaison.

d. Obtain statistical and configuration data to determine the optimum SD-45 cab configuration for presentation during the P.D.R.

e. Establish a detail program schedule based on contractual requirements, DSI schedule, and TRA's projectized organization.

f. Establish a comprehensive sub-contract technical monitoring function.

2.2 CURRENT STATUS - Status of planned activities depicted above (P2.1) is as follows:

a. Completed

b. Project, Quality and Documentation Plans

70% complete with draft copies ready for review 12 November.

c. Activity continuing

d. " "

e. " "

f. Preliminary technical monitoring methods have been negotiated with DSI and implementation is expected to start in Nov. 1979.

3.0 SIGNIFICANT ACCOMPLISHMENTS

a. Completed a detailed sub-contract Statement of Work (S.O.W.) for the major sub-contractor defining the tasks, interface and reporting requirements for progress/problem reporting. The S.O.W. is available for review by the FRA during the impending visit (Nov. 14 - 15, 1979).

b. Conducted trade-off studies on the following components/sub-systems to establish a firm baseline on which to base detail design:

1) Evaluation of Control versus Distributed Architecture - completed analysis to determine how to partition the computing tasks into specific machines.

2) Trade-off Study of Various Bus Configurations -- In order to understand the options open to us for distribution of processing hardware we have looked at what data buses are available, what their requirements and capabilities are. Applications here include both computer to computer communications as well as the computer to cab interface.

3) Experimentor/Operator Console - Reviewed requirement versus proposed hardware.

4) Motion Sub-System - Confirmed that the proposed motion base is acceptable.

c. Established contact with the Electro Motive Div. of G. M. technical personnel. Detail configuration information on the cab was obtained along with some drawings required to start detail design of the basic cab structure. This will be a continuing effort until cab/design fabrication is completed.

d. Implemented the established procedure to assure that all requests for quotations for material/parts/services are reviewed by TRA's "Small Disadvantaged Business Concerns" coordinator for appropriate action.

e. Fabricated preliminary mock-up of the Experimentor/Operator Console to assist in establishing the optimum configuration.

f. Physically reviewed various SD-45 locomotives at the Santa Fe R.R. yard in San Diego.

g. A meeting was conducted with TRA's proposed sub-contractor for the Noxis Odor Injection System to review requirements and establish preliminary interfaces. A technical and financial audit is currently underway in preparation for a future sub-contract.

h. System Manual Description - The system manual is identified as the major documentation device for both hardware, software and systems involving both hardware and software. The outline of this document is complete.

i. Defining Systems Manuals Software Inputs - Specifically identifying the contents of the Systems Manual that will make it an acceptable means of documenting software.

j. Digital Equipment Corporation -- Close contact with the DEC representative has been established to ascertain any computer related problems (delivery and maintenance for example) we may expect.

k. Program Size and Timing Estimates -- Preliminary estimates of memory and throughput requirements have been made and critiqued.

4.0 TECHNICAL, COST AND/OR SCHEDULE PROBLEMS/CORRECTIVE ACTION

4.1 Cost and Man Hour Schedule - Attachment I, Alternate Management Summary Report,and Attachment II, Program Element Detail Data (PEDD) printout reflect the total (TRA and DSI) planned expenditure rate as stipulated in the Cost and Contractual Proposal, Vol. III, dated 7 August 1979 (modified to incorporate the changes resulting from negotiations). As indicated, the actual man hour expenditures (also reflected in dollar value) exceed the planned value by 25 man hours (less than .5% overrun). Although the total (TRA/DSI) expenditure is effectively as planned, it is also evident that the individual expenditures of TRA and DSI vary considerably from the planned rate. The rationale for the anomally is as follows:

a. TRA - the planned man hour expenditure for October was 4,391 man hours and the actual expenditure was 1,933 man hours. This condition does not imply that a cost or schedule impact exists, but reflects an orderly build-up of personnel as more detailed program requirements are being formulated. This condition is expected to continue until the submittal of the January 1980 report when the revised detail cost and schedule based on TRA's projectized organization are completed.

b. DSI - The expenditure of 5,132 man hours against a 2,649 man hour planned budget resulted from the concerted effort required to perform the computer analysis to finalize the architecture and sizing. This urgency became evident when firm procurement lead times for the computers were obtained and the necessity of early finalization of the interface definition were assessed. DSI reported that although the October variance to plan condition exists, there will be no total cost or schedule impact or impact on the 1979 limited funding requirements. TRA is evaluating DSI's cost/schedule performance relative to the impact of the new computer delivery schedule.

5.0 PLANNING ACTIVITY - The activity planned for the period Nov. 1979 through January 1980 is as follows:

a. Complete the Project Plan and submit to the FRA per Contract Schedule - 30 Nov. 1979. The plan shall be prepared in accordance with the Contract SOW (Para. 2.2) and include:

1. Description of TRA/DSI approach in meeting FRA specification requirements.
2. Detail Program Schedule showing major milestones and/or decision points which TRA and DSI must meet.
3. A overall task oriented flow diagram depicting critical paths, hardware/software and/or interface definitions effecting successful completion of the program.

4. Description of the TRA/DSI approach for coordinating work, scheduling and interface requirements to assure smooth total system integration.

b. Complete analysis/layouts/design in sufficient detail to support PDR's for the following:

Standard Cab	January 1980 (PDR)
Motion Sub-system	January 1980 (PDR)

c. Complete the Quality and Documentation Plans for submittal with the Project Plan.

d. Define and justify ordering of critical and/or long lead items prior to PDR.

e. Establish a detail work and revised man hour expenditure schedule reflecting TRA's project organization and updated DSI input. This estimate/schedule will be reflected in a new Program Element Detail Data (PEDD) file which will be available in January 1980.

f. Language Investigations - Continue investigation into higher-order languages that might serve as an alternative to FORTRAN. The reason for this is that there are languages more suited to a structured programming approach and we would like to know if they might be applicable to this job.

g. Decomposing the software - Continue preparation of a Hiarachical diagram for the software. At this preliminary stage the level of detail is such that this serves as a functional decomposition of the software as well.

h. Define Software Development Procedures - The software development concepts are already established; however, we need to publish them in a form usable on a day-to-day basis by the individuals responsible for managing and producing software.

i. Investigate Projector Lens Systems - Continue studying lamphouse/lens combinations with the intent of optimizing this set for our application. We have also been talking to vendors to see what is currently available.

j. Visual Systems Concepts - Establish a procedure whereby intelligent decisions about the visual system can be studied as a system. In particular we are looking at trade-offs (and evaluating techniques) for choosing the recording and display media (film type & format) for the visual system.

k. Short Word Length Integration Schemes - Continued to investigate integration methods most applicable to handling the train action problem in a mini-computer or microprocessor.

l. Writing, Debugging, and Running Preliminary Train Models - Simplified train action models are being generated.

ALTERNATE MANAGEMENT SUMMARY REPORT

NAME AND LOCATION OF ACTIVITY	PROJECTS CONTRACT NO.	REPORT PERIOD	☐ DIRECT COST ☒ TOTAL COST	SYSTEM & LEVEL
Teledyne Ryan Aero., 2701 Harbor Drive, San Diego, Ca. 92138	DOT-FR-9142	11-2-79		LATHE

CES/DESCRIPTION	ACTUAL COST (MONTHS) (in thous.) (2)	WORK PERFORMED TO DATE (in thousands) PLANNED OR VALUE (3)	ACTUAL COST (4)	(OVER. RUN) UNDER. RUN (5)	☐ COST EXP COMMIT-MENTS (6)	TOTAL COMPLETION (in thousands) ORIG CONTR. ESTI-MATE (7)	PLANNED COST (8)	LATEST REVISED ESTI-MATE (9)	PROJ (OVER-RUN) UNDER-RUN (10)	SLACK (11)	SCHEDULE DATA START (12)	COMPLETION DATE SCHED-ULED (13)	ESTI-MATED (14)	ACTUAL (15)
1. Standard/Alter. Cab	20.6	52.2	20.6	31.6		1234.7					10/79	3/82		
2. Motion Subsystem	1.6	11.8	1.6	10.2		420.7					10/79	3/82		
3. Visual Subsystem	1.1	8.6	1.1	7.5		99.6					10/79	3/82		
4. Experimenter Console	12.9	24.9	12.9	12.0		570.5					10/79	3/82		
5. Logic Controller	0	.6	0	.6		11.6					10/79	3/82		
6. Data Controller	0	.6	0	.6		11.6					10/79	3/82		
7. Experiment Development	1.5	12.7	1.5	11.2		176.2					10/79	3/82		
8. Exper. Territory Dev.	0	0	0	0		14.3					10/79	3/82		
9. Integration & Install.	8.0	16.8	8.0	8.8		862.1					10/79	3/82		
11. Other Program Efforts	35.5	56.2	56.2	0		1002.1					9/79	7/82		
12. DSI (Subcontract)	151.9	77.3	151.9*	(74.6)	34.0	3463.6					10/79	7/82		
16. TOTAL PROGRAM COSTS	233.1	261.7	253.8	7.9	34.0	7867.0								

	NEXT MONTH	MO. 2	REM	MO. 4	MO. 5	MO. 6	MO. 7	MO. 8	MO. 9	MO. 10	MO. 11	MO. 12
17. TOTAL PROGRAM EXP. ($000)	292.0	267.8	7440.7									

18. CONTRACT WORK AUTHORIZED - PROJECTED (WITH FEE/PROFIT)	(1) OCT	(2) NOV	(3) DEC	(4) REM	(5)	(6)	(7)	(8)	(9)		AT COMPLETION
a. UNLIQUIDATED COMMITMENTS	34.0										
b. ACCRUED EXPENDITURES	266.5	558.5	826.3								8267.0
c. TOTAL (18a & 18b)	300.5	558.5	826.3								8267.0
19. FORCAST OF BILLINGS TO THE GOVERNMENT	185.7	372.8	267.8	7440.7							8267.0

20. ANALYSIS REPORT OF SIGNIFICANT PROJECT END ITEM AND COMPONENT VARIANCES AND PROBLEMS
(Use reverse side if more space is necessary)

*Represents DSI invoices for period Oct. 6, 1979 thru Nov. 2, 1979 plus TRA loading.

Note: $48.9K of DSI invoices received after TRA month closing but has been included to compare to plan.

21. Signature and Title W. W. Campbell
W. W. Campbell, Accounting Manager

TP-228

LATHE STATUS SUMMARY

PAGE ___ OF ______
REVIEW DATE ______
DATE OF DATA 11-2-79

FUNCTIONS REPORTED

TOTAL TRA PROGRAM

BUDGET STATUS-MANHOURS

BUDGET 82,363 EAC ______

	MANPOWER (WKLY. EQUIV.)	MANHOURS (CUM. TO DATE)	% TO BUD./EAC
PLANNED	18.1	4064	4.9
ACTUAL	10.8	2577	3.1
VARIANCE	7.3	1487	1.8

TASK STATUS

	EST'D. % COMPLETE
PLANNED	
ACTUAL	
VARIANCE	

MAJOR ACCOMPLISHMENTS

- PROGRAM GROWTH LIST COMPLETED.
- WORK CONTINUES ON PROGRAM PLAN, SYSTEMS MANUALS, CAB SELECTION & AMIR GENERATION

NEAR TERMED SCHEDULED EVENTS

- DSI CONTRACT NEGOTIATIONS (6 NOV.)
- FRA COTR VISIT (12 NOV.)
- DRAFT OF PROJECT PLAN (12 NOV.)

ITEMS OF CONCERN

- DSI IS OVER-BUDGET FOR THE FIRST THREE WEEKS OF THE REPORT PERIOD, BASED UPON THE ORIGINAL COST PROPOSAL. THEY HAVE BEEN REQUESTED TO REVIEW THEIR STATUS AND PROVIDE A NEW PROJECTION.

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	CONTRACT TYPE	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

FUNDING: $2,495,000

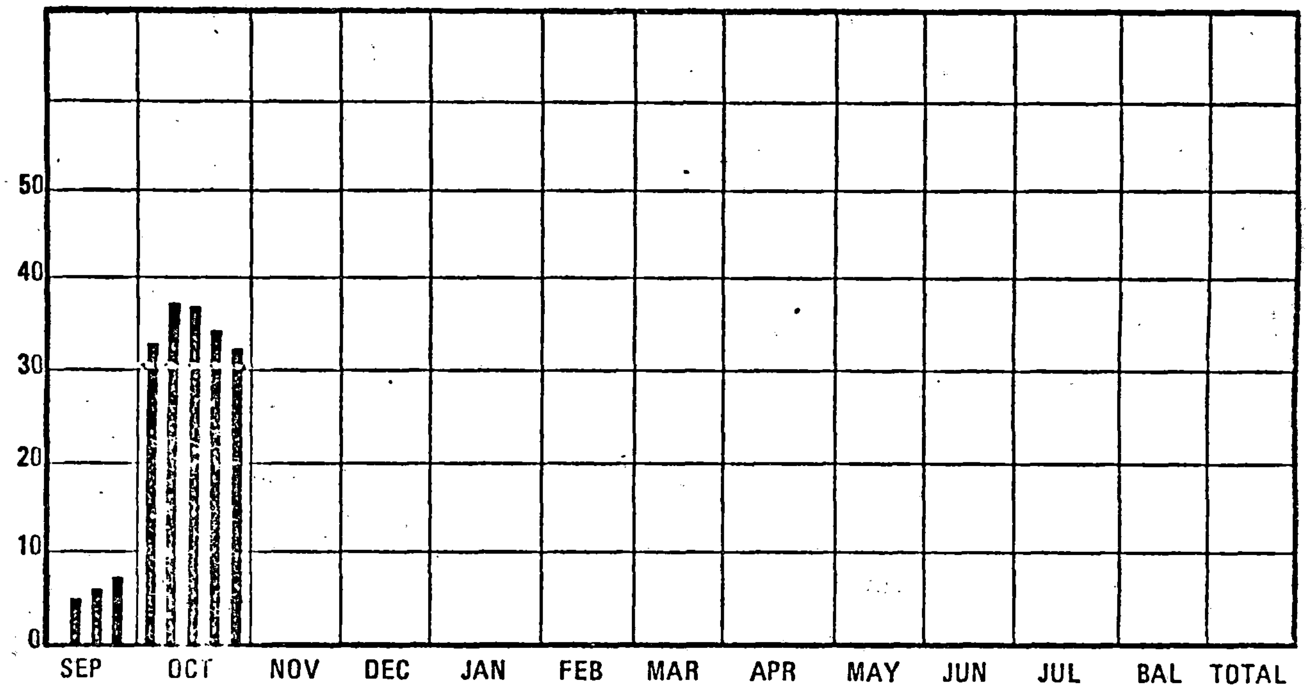
TOTAL PROGRAM
(TRA & DSI)

EQUIVALENT MEN

TARGET WEEK 30.3

ACTUAL WEEK 32.2

ACTUAL MONTH 35.3



* VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS	645	6068	5392	5688									
CUM SCHEDULED MANHOURS	645	6713	12105	17793									
ACTUAL MANHOURS	645	7064											
CUM ACTUALS	645	7709											
CUM VARIANCE (OVER)/UNDER	-0-	(996)											

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER DOT-FR-9142	CONTRACT TYPE CPIF	CONTRACT AMOUNT $8,267,000	OPER. AUTH.	CONTRACT PERIOD 9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

FUNDING: $2,495,000

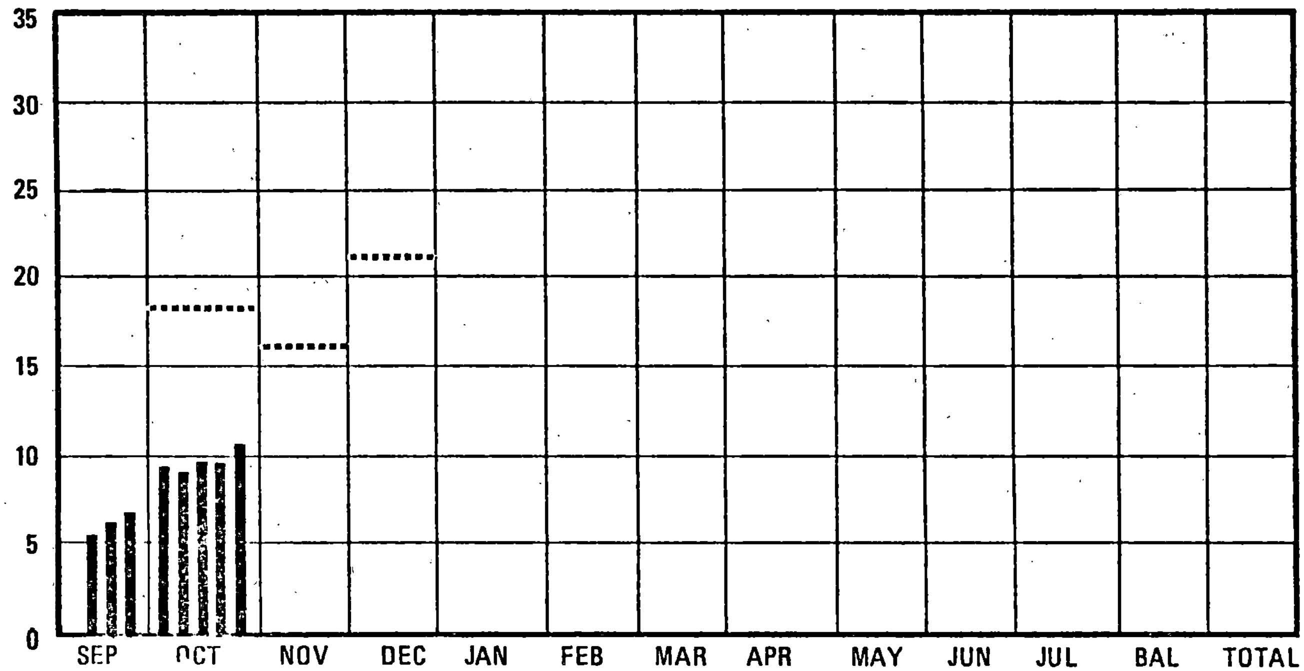
TOTAL PROGRAM
(TRA)

EQUIVALENT MEN

TARGET WEEK 18.1

ACTUAL WEEK 10.8

ACTUAL MONTH 9.7



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS	645	3419	2330	2538									
CUM SCHEDULED MANHOURS	645	4064	6394	8932									
ACTUAL MANHOURS	645	1932											
CUM ACTUALS	645	2577											
CUM VARIANCE (OVER)/UNDER	-0-	1487											

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	11 NOV 1979	
CONTRACT NUMBER DOT-FR-9142	CONTRACT TYPE CPIF	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD 9-6-79 THRU 7-27-82	

SALES ORDER: TA-15651

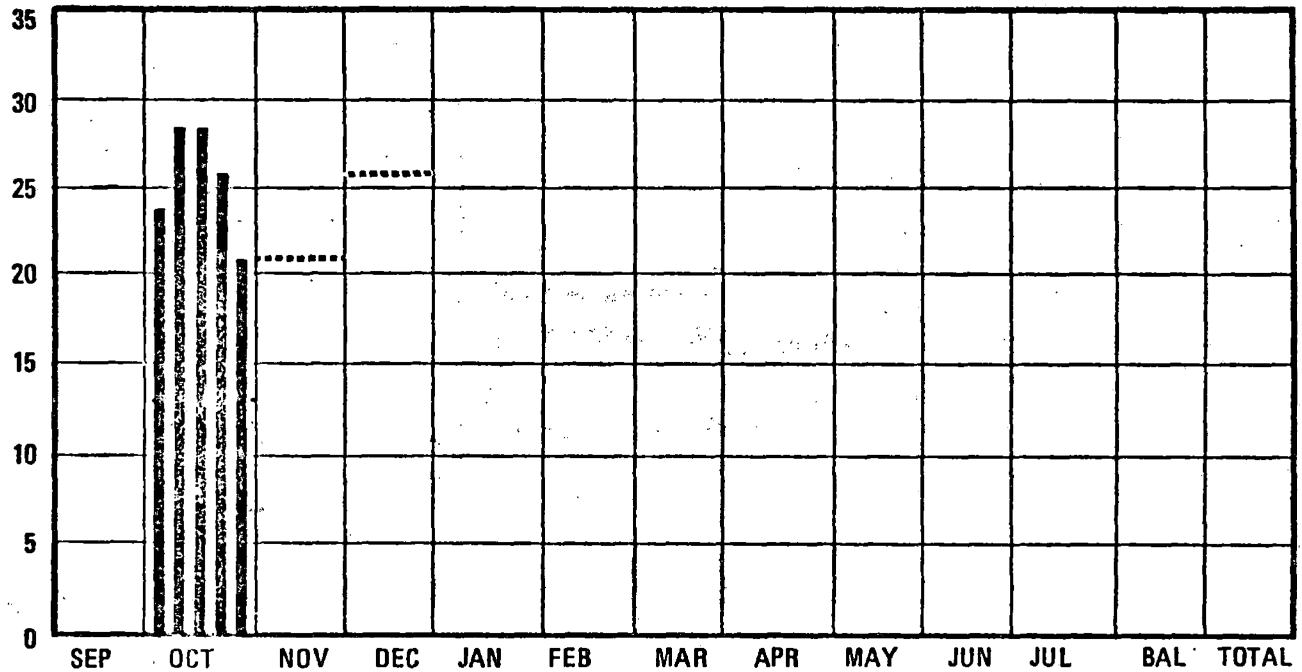
DYNAMIC SCIENCES INCORPORATED
(DSI)

EQUIVALENT MEN

TARGET WEEK 13.2

ACTUAL WEEK 21.4

ACTUAL MONTH 25.7



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		2649	3062	3150									
CUM SCHEDULED MANHOURS	-0-	2649	5711	8861									
ACTUAL MANHOURS		5132											
CUM ACTUALS	-0-	5132											
CUM VARIANCE (OVER)/UNDER		(2483)											

TELEDYNE RYAN AERONAUTICAL

R-4936D-1

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	CONTRACT TYPE	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

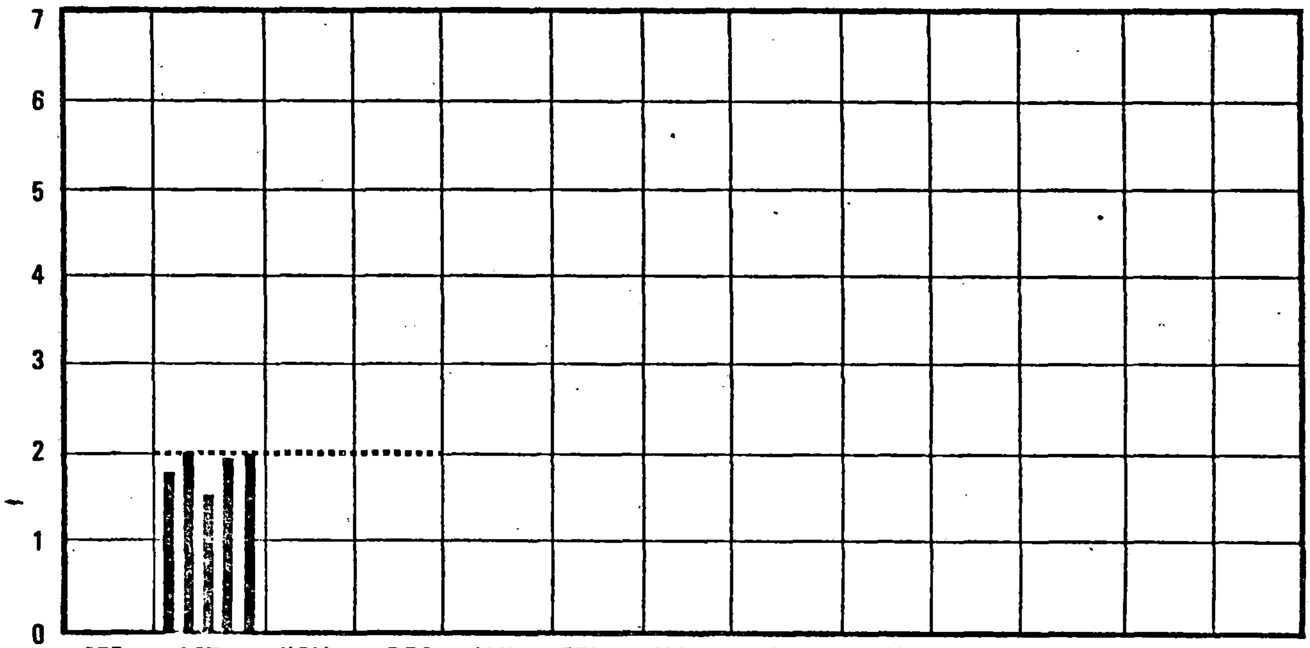
PROGRAM OFFICE (01) & (03)

EQUIVALENT MEN

TARGET WEEK 2.0

ACTUAL WEEK 2.0

ACTUAL MONTH 1.9



***VARIANCE**

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		400	288	240									
CUM SCHEDULED MANHOURS	-0-	400	688	928									
ACTUAL MANHOURS		378											
CUM ACTUALS	-0-	378											
CUM VARIANCE (OVER)/UNDER		22											

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

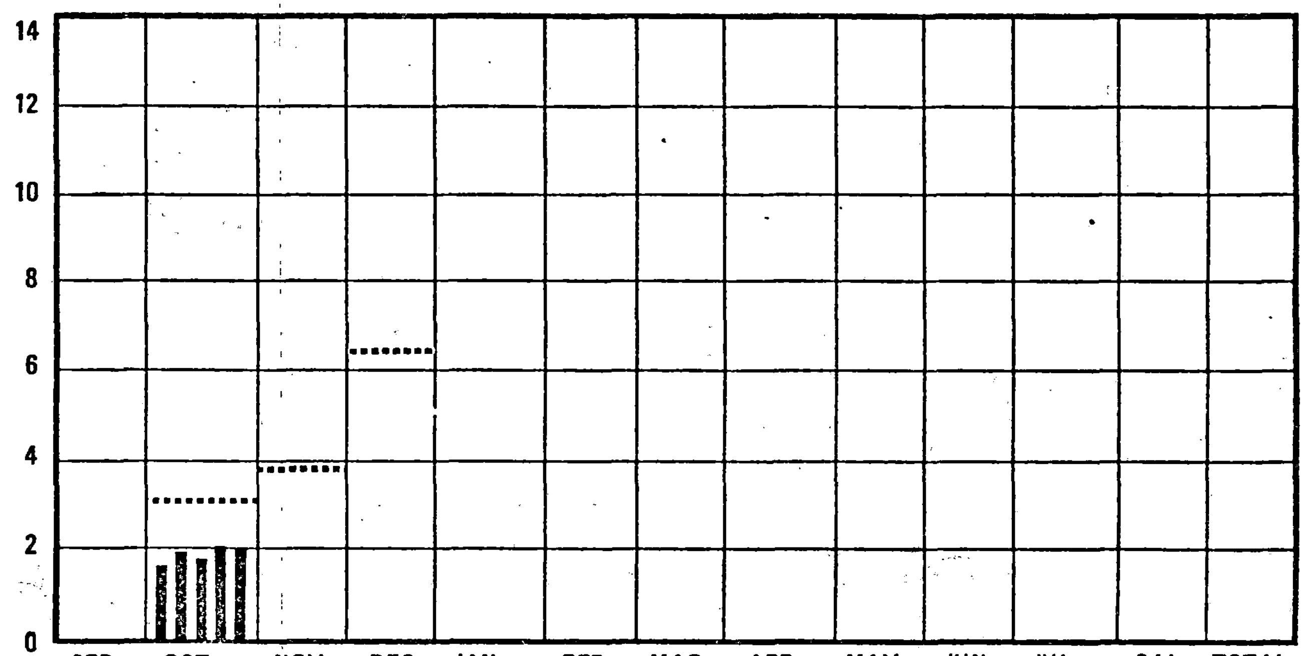
CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	CONTRACT TYPE	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

MECHANICAL SYSTEMS ENGINEERING (86)

EQUIVALENT MEN

TARGET WEEK	3.0
ACTUAL WEEK	2.0
ACTUAL MONTH	1.9



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		599	542	768									
CUM SCHEDULED MANHOURS	-0-	599	1141	1909									
ACTUAL MANHOURS		374											
CUM ACTUALS	-0-	374											
CUM VARIANCE (OVER)/UNDER		225											

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

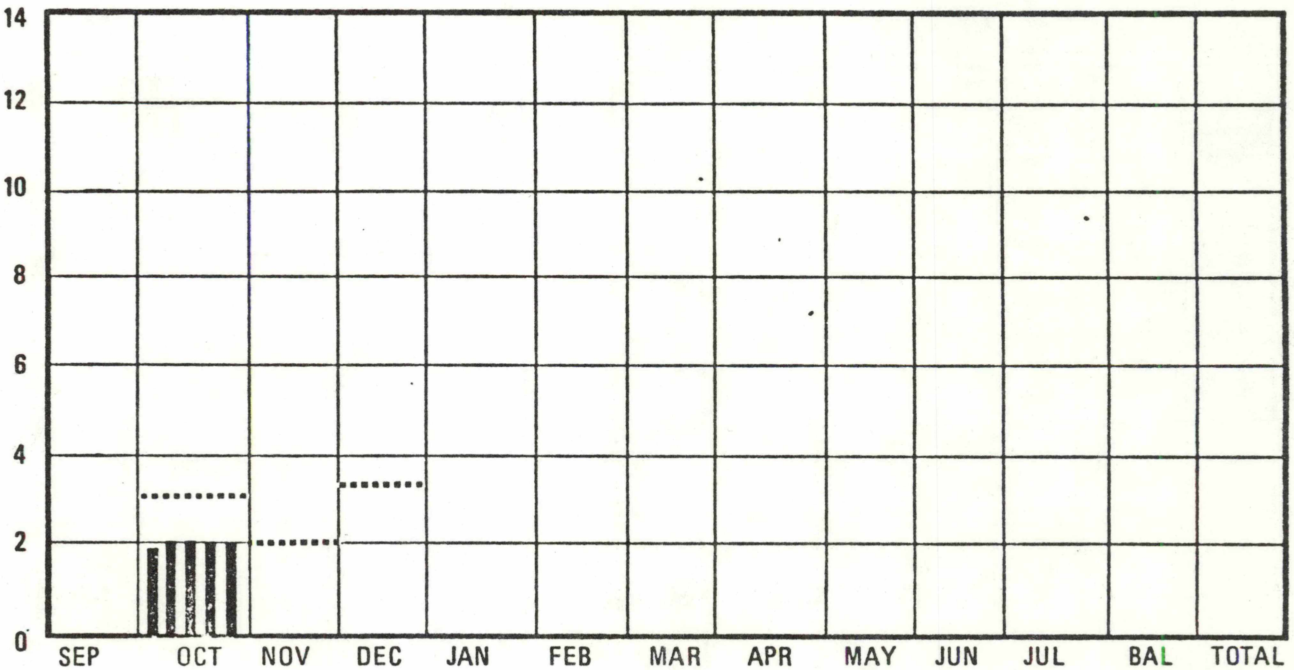
CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	CONTRACT TYPE	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

ELECTRICAL SYSTEMS ENGINEERING (87)

EQUIVALENT MEN

TARGET WEEK	3.0
ACTUAL WEEK	2.0
ACTUAL MONTH	2.0



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		600	288	400									
CUM SCHEDULED MANHOURS	-0-	600	888	1288									
ACTUAL MANHOURS		396											
CUM ACTUALS	-0-	396											
CUM VARIANCE (OVER)/UNDER		204											

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	CONTRACT TYPE	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

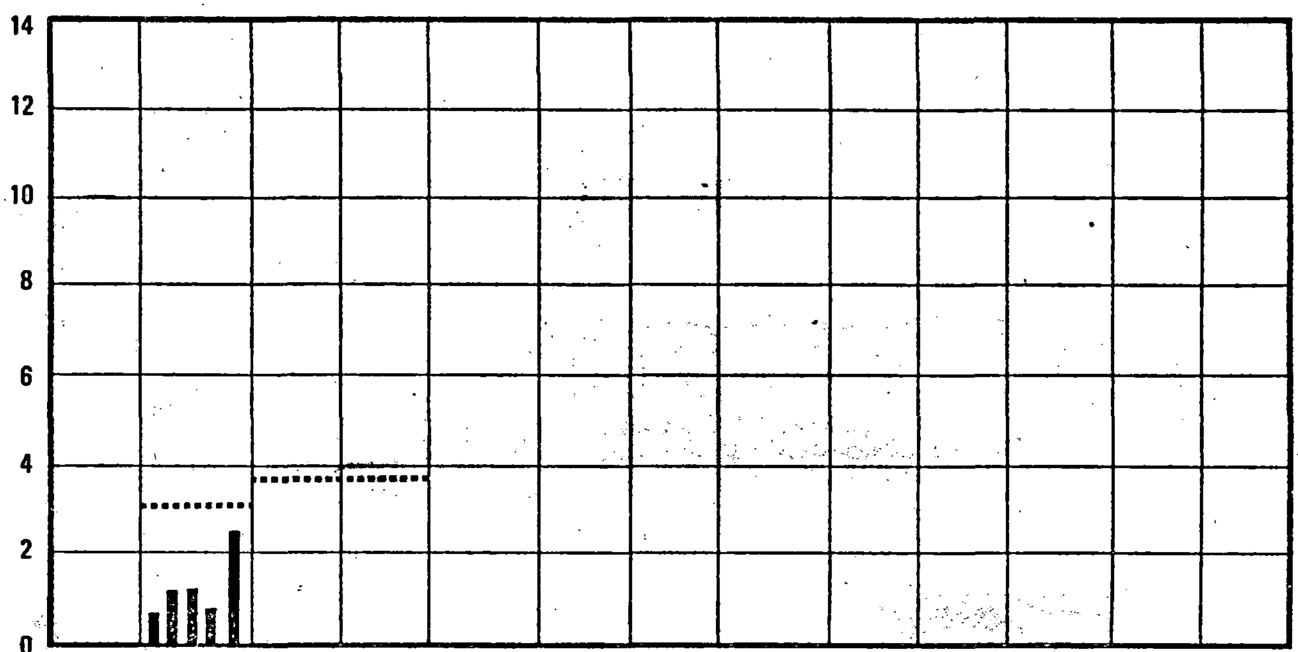
ELECTRONIC SYSTEMS ENGINEERING (88)

EQUIVALENT MENT

TARGET WEEK 3.0

ACTUAL WEEK 2.6

ACTUAL MONTH 1.2



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		600	528	460									
CUM SCHEDULED MANHOURS	-0-	600	1128	1588									
ACTUAL MANHOURS		230											
CUM ACTUALS	-0-	230											
CUM VARIANCE (OVER)/UNDER		370											

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	**CONTRACT TYPE**	**CONTRACT AMOUNT**	**OPER. AUTH.**	**CONTRACT PERIOD**	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

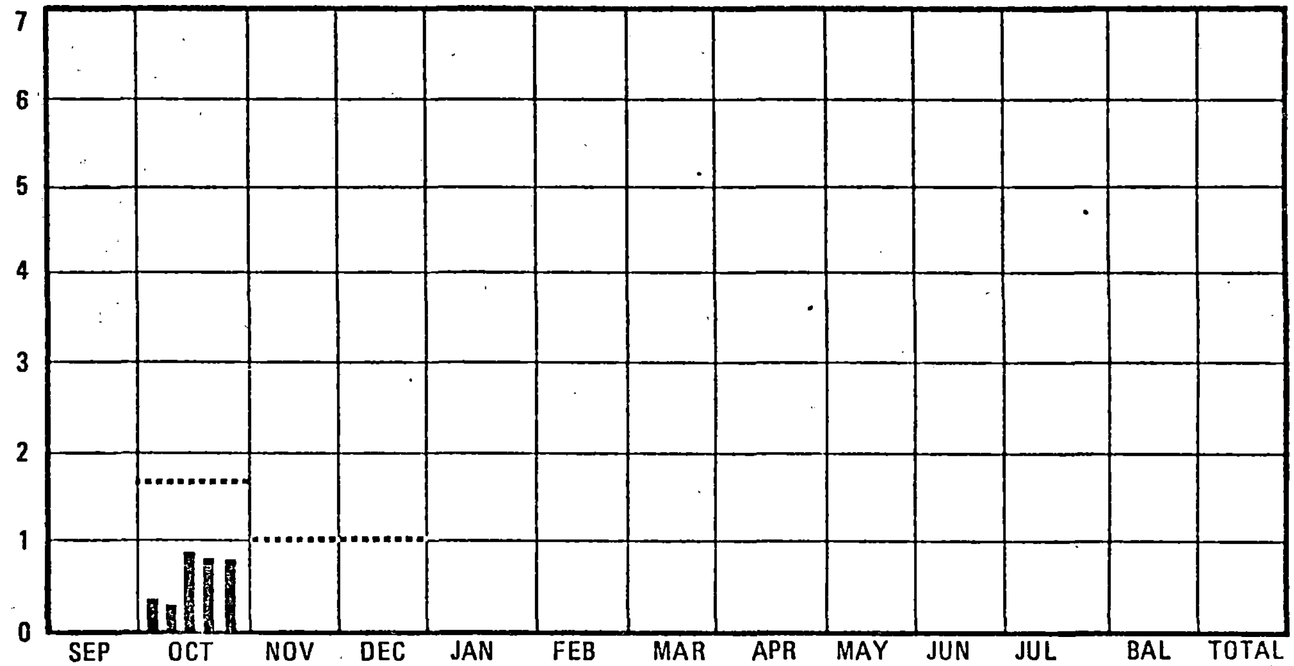
COMPUTER SYSTEMS ENGINEERING (89)

EQUIVALENT MEN

TARGET WEEK 1.7

ACTUAL WEEK .7

ACTUAL MONTH .7



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		340	144	120									
CUM SCHEDULED MANHOURS	-0-	340	484	604									
ACTUAL MANHOURS		135											
CUM ACTUALS	-0-	135											
CUM VARIANCE (OVER)/UNDER		205											

MANHOUR REPORT

TELEDYNE RYAN PRIVATE DATA

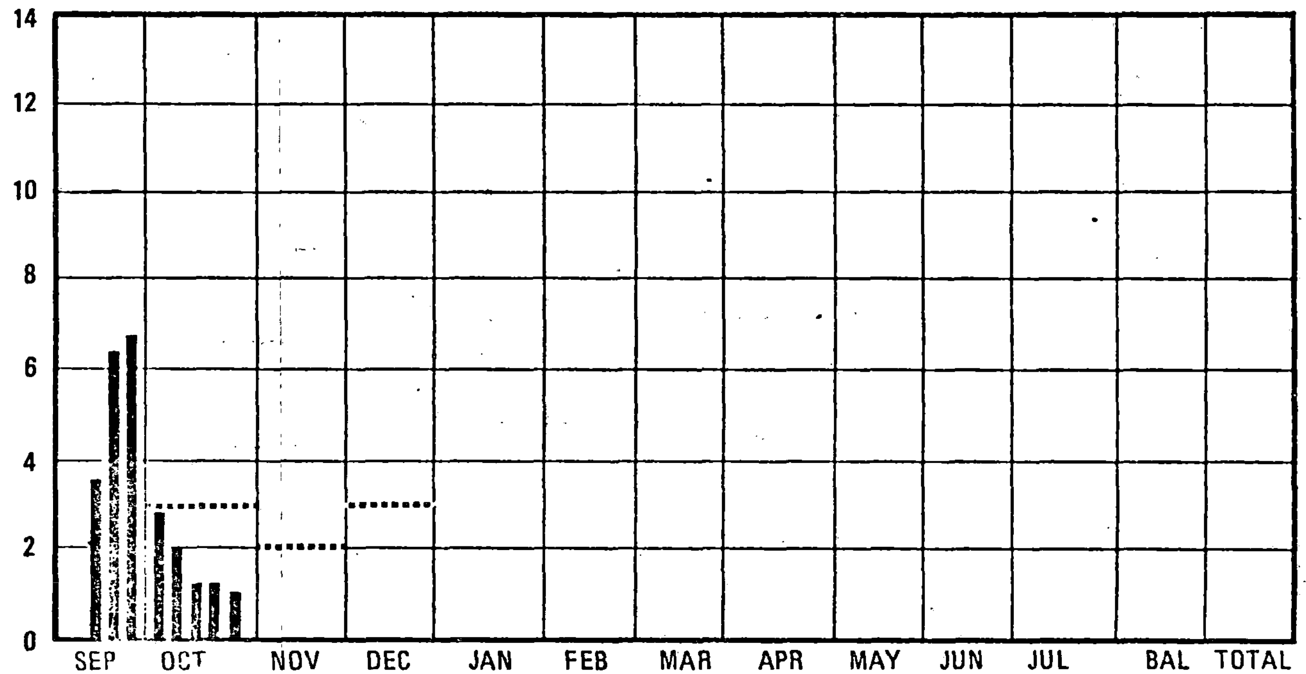
CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	**CONTRACT TYPE**	**CONTRACT AMOUNT**	**OPER. AUTH.**	**CONTRACT PERIOD**	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU	7-27-82

SALES ORDER: TA-15651

PROJECT ENGINEERING (90)

EQUIVALENT MEN

TARGET WEEK	2.8
ACTUAL WEEK	1.1
ACTUAL MONTH	1.6



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS	645	360	284	330									
CUM SCHEDULED MANHOURS	645	1005	1289	1619									
ACTUAL MANHOURS	645	332											
CUM ACTUALS	645	977											
CUM VARIANCE (OVER)/UNDER	-0-	28											

TELEDYNE RYAN PRIVATE DATA

MANHOUR REPORT

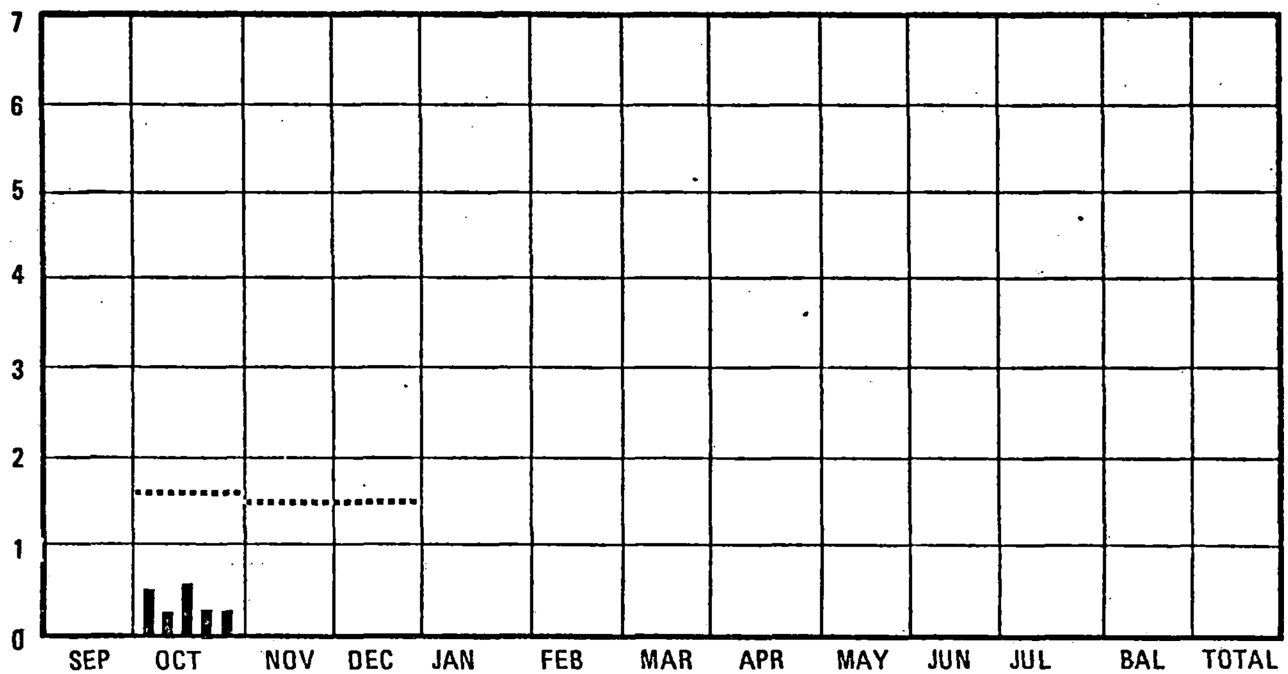
CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT-FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	CONTRACT TYPE	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

SUPPORT – FABRICATION – INSTALLATION – TEST (91)

EQUIVALENT MEN

TARGET WEEK	1.6
ACTUAL WEEK	.2
ACTUAL MONTH	.3



*VARIANCE

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		320	216	180									
CUM SCHEDULED MANHOURS	-0-	320	536	716									
ACTUAL MANHOURS		59											
CUM ACTUALS	-0-	59											
CUM VARIANCE (OVER)/UNDER		261											

MANHOUR REPORT

TELEDYNE RYAN PRIVATE DATA

CONTRACT TITLE	CUSTOMER		PROGRAM MANAGER	REPORTING DATE	CHART NO.
TRAIN EVALUATOR	DOT - FRA		M. E. JUBERG	2 NOV 1979	
CONTRACT NUMBER	CONTRACT TYPE	CONTRACT AMOUNT	OPER. AUTH.	CONTRACT PERIOD	
DOT-FR-9142	CPIF	$8,267,000		9-7-79 THRU 7-27-82	

SALES ORDER: TA-15651

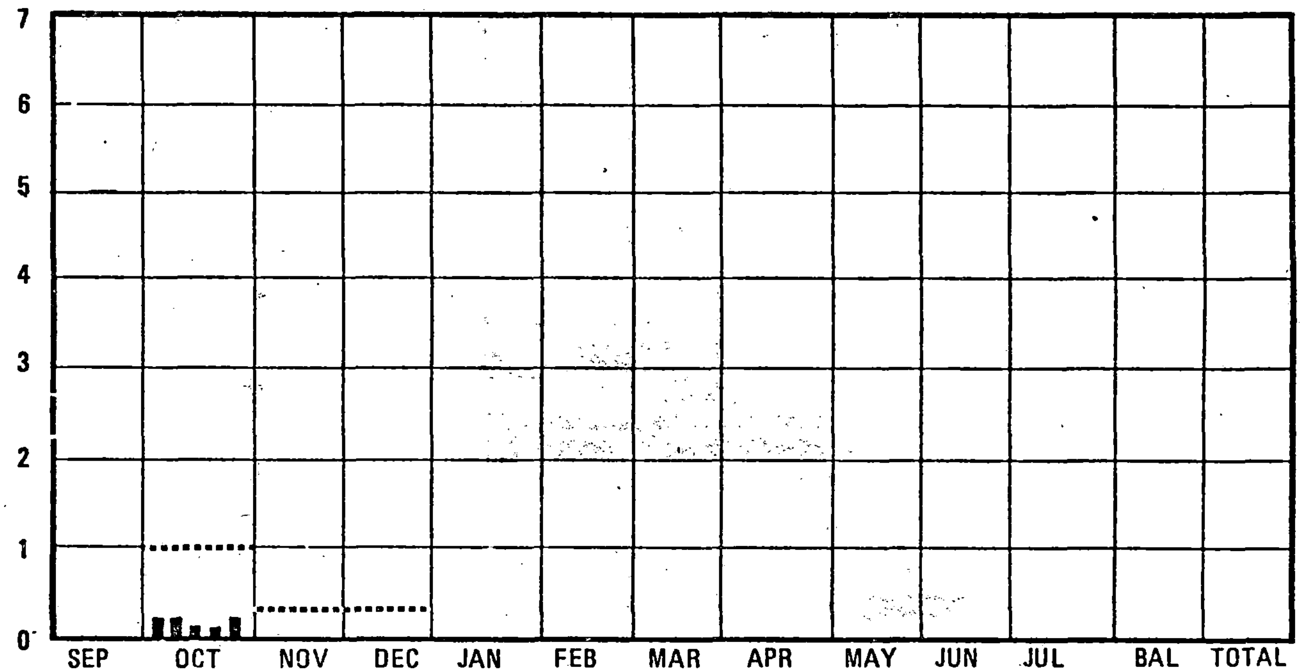
QUALITY ENGINEERING AND CONTROL (92)

EQUIVALENT MEN

TARGET WEEK 1.0

ACTUAL WEEK .2

ACTUAL MONTH .1



*VARIANCE 07

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	BAL	TOTAL
SCHEDULED MANHOURS		200	40	40									
CUM SCHEDULED MANHOURS	-0-	200	240	280									
ACTUAL MANHOURS		28											
CUM ACTUALS	-0-	28											
CUM VARIANCE (OVER)/UNDER		172											

ATTACHMENT II

PEDD printout for the period 10 September thru 2 November 1979 is presented in an interim format as stipulated in the TRA LATHER Monthly Progress Report. The following is provided to assist in understanding the data as presented on the printout:

(1) WBS/TSO # relates to the WBS or CES item and TSO # is a PEDD file number/computer program address.

(2) Package Description is the WBS/CES item title.

(3) Package Number is a sequential number which will vary dependant on the number of specific tasks within a WBS element by performing organization.

(4) Performing Organization Code - is a number representing a particular organization (i.e. 86 = mechanical design, 87 = electrical design, etc.). For the interim PEDD, TRA is represented by Performing Organization 90 and DSI by 95.

(5) Department Code is either TRA or DSI.

(6) Responsibility Code (RESP) is utilized to identify Planned and Actual Manhours as follows

01 = TRA Planned Manhours
03 = TRA Expended Actual Manhours
04 = DSI Planned Manhours
06 = DSI Expended Actual Manhours

The printout permits comparing Planned vs. Actual Manhour Expenditures by:

a) WBS TRA

b) WBS DSI

c) Total TRA

d) Total DSI

e) Total Program

ATTACHMENT II

Year 1979

Page 1

Note: Resp 01=TRA Planned; 03=Actuals

Program Element Detail Data

Locomotive Evaluator

Run 11/09/79 (11:12)

Year 1979

Note: Resp 04=DSI Planned; 06=Actuals

Page 1

WBS TSO #	Pkg No.	Perf Org	Dept	Resp	Package Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
(1) 1.0 0001	001 (3)	90 (4)	TRA (5)	01 (6)	Cab/Alt Cab Structure S/S (2) Labor										1,446	1,746	2,072	5,264	5,264
1.0 0002	001	90	TRA	03	Cab/Alt Cab Structure S/S Labor										554			554	554
1.0 0003	001	95	DSI	04	Sound System Labor										200	200	200	600	600
1.0 0004	001	95	DSI	06	Sound System Labor														
2.0 0005	001	90	TRA	01	Motion Subsystem Labor										328	364	396	1,088	1,088
2.0 0006	001	90	TRA	03	Motion Subsystem Labor										46			46	46
3.0 0007	001	90	TRA	01	Visual Subsystem Labor										243	203	290	736	736
3.0 0008	001	90	TRA	03	Visual Subsystem Labor										30			30	30
3.0 0009	001	95	DSI	04	Visual Subsystem Labor										373	373	454	1,200	1,200
3.0 0010	001	95	DSI	06	Visual Subsystem Labor										77			77	77
4.0 0011	001	90	TRA	01	Experimental/Operator Console Labor										690	826	915	2,431	2,431
4.0 0012	001	90	TRA	03	Experimental/Operator Console Labor										333			333	333

Note: Resp 01=TRA Planned; 03=Actuals

Locomotive Evaluator Program Note: Resp 04=DSI Planned; 06=Actuals

Run 11/09/79 (11:12)

WBS	TSO #	Package Description	Pkg No.	Perf Org	Dept	Resp		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
5.0	0013	Logic Controller S/S	001	90	TRA	01	Labor										16	16	8	40	40
5.0	0014	Logic Controller S/S	001	90	TRA	03	Labor														
5.0	0015	Logic Controller S/S	001	95	DSI	04	Labor										1,071	1,231	1,238	3,540	3,540
5.0	0016	Logic Controller S/S	001	95	DSI	06	Labor										2,511			2,511	2,511
6.0	0017	Data Controller S/S	001	90	TRA	01	Labor										16	16	8	40	40
6.0	0018	Data Controller S/S	001	90	TRA	03	Labor														
6.0	0019	Data Controller S/S	001	95	DSI	04	Labor										533	533	533	1,599	1,599
6.0	0020	Data Controller S/S	001	95	DSI	06	Labor										952			952	952
7.0	0021	Experiment Development S/S	001	90	TRA	01	Labor										350	408	344	1,102	1,102
7.0	0022	Experiment Development S/S	001	90	TRA	03	Labor										40			40	40
7.0	0023	Experiment Development S/S	001	95	DSI	04	Labor											253	253	506	506
7.0	0024	Experiment Development S/S	001	95	DSI	06	Labor										624			624	624

Note: Resp 01=TRA Planned; 03=Actuals Locomotive Evaluator Program Note: Resp 04=DSI Planned; 06=Actuals

Run 11/09/79 (11:12)

WBS TSO #	Pkg Perf Package Description No. Org Dept Resp	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sub Total	Accum Hours
8.0 0025	Experiment Territory Dev. S/S 001 90 TRA 01 Labor														
8.0 0026	Experiment Territory Dev. S/S 001 90 TRA 03 Labor														
8.0 0027	Experiment Territory Dev. S/S 001 95 DSI 04 Labor										173	173	174	520	520
8.0 0028	Experiment Territory Dev. S/S 001 95 DSI 06 Labor										160			160	160
9.0 0029	Total Eval Sys Integ & Instl 001 90 TRA 01 Labor										465	546	633	1,644	1,644
9.0 0030	Total Eval Sys Integ & Instl 001 90 TRA 03 Labor										188			188	188
9.0 0031	Total Eval Sys Integ & Instl 001 95 DSI 04 Labor														
9.0 0032	Total Eval Sys Integ & Instl 001 95 DSI 06 Labor														
11.0 0033	Other Loco. Eval Progr Efforts 001 90 TRA 01 Labor									645	837	874	417	2,733	2,733
11.0 0034	Other Loco. Eval Progr Efforts 001 90 TRA 03 Labor									645	742			1,387	1,387
11.0 0035	Other Loco. Eval Progr Efforts 001 95 DSI 04 Labor										299	299	302	900	900
11.0 0036	Other Loco. Eval Progr Efforts 001 95 DSI 06 Labor										808			808	808
-	Total 01									645	4,391	4,999	5,083	15,118	15,118
-	" 03									645	1,933			2,578	2,578
-	" 04										2,649	3,062	3,150	8,861	8,861
-	" 06										5,132			5,132	5,132
-	Total 01 & 04									645	7,040	8,061	8,233	23,979	23,979
-	Total 03 & 06									645	7,065			7,710	7,710

5.7 Design Reviews

Formal design reviews are requirements of the contract. They will consist of both Preliminary and Critical Design Reviews chaired by Government representatives. The eight major subsystems: cabs, motion subsystem, visual subsystem, experiment/operator console, Logic Controller, data controller, experiment development, and experiment territory development subsystems will be subject to the reviews. In a few instances the design of one subsystem (such as the visual subsystem) uniquely determines the design of another subsystem (the Experiment Territory subsystem). In all instances the subsystem designs are closely interrelated. Care will be taken to include the discussion of these interrelationships at the appropriate design reviews because those design choices are often de facto design choices for another system.

Because of the close interrelationships of the various subsystems, a typical PDR or CDR will be broader than the name of the subsystem which it bears. The critical decision dates which have been grouped for discussion at the PDR's and CDR's now planned are shown in the Master Program Logic Network. These PDR's and CDR's are not in lieu of correspondences which transmit firm data lists describing the performance data gathered from rail industry sources to define the performance of simulated train systems. The character of the design review is cumulative and brings together design, freeze data and test procedure concepts as appropriate to the subject matter of the review. Thus the design reviews will both produce firm design freezes and confirm designs previously frozen by other actions.

5.7.1 PRELIMINARY DESIGN REVIEWS

5.7.1.1 Concept:

The Preliminary Design Reviews (PDR) constitute the formal presentation of the conceptual design. Background of trade studies, analysis which lead to the design are presented. The description of how the design meets spec, SOW requirements, conforms to proposed system, and satisfies overall objective of system is presented. Schedule impact and all interface considerations are identified.

5.7.1.2 Authority:

The PDR will be chaired by FRA Contracting Officers' Technical Representative (COTR). Approval of PDR constitutes formal authority to proceed with design. Where possible, all Purchase Requests, formal drawings and documentation will be deferred until after PDR.

5.7.1.3 Publications:

Two weeks prior to PDR, TRA/DSI will provide a detailed agenda to FRA for their approval.

At the PDR, complete, bound copies of all presentation material will be provided to all FRA attendees. A list of all attendees, and their affiliation and complete minutes will also be distributed within one week.

5.7.1.4 Preparation:

TRA technical personnel will be prepared to discuss all technical aspects of the subject design. Specialists will present all of the various technical subjects required to describe the design, as appropriate.

5.7.1.5 Attendees:

TRA/DSI attendance will be limited to those personnel required to provide full coverage of all agenda items and to maintain a continuity of the presentation.

5.7.1.6 Procedure:

(1) The TRA Program Manager - After a short preamble, introduces the FRA PDR Chairman.

(2) The FRA Chairman - Will open the meeting, introduces FRA principals, present the ground rules for the PDR (plus any pertinent remarks) and will turn the meeting over to the TRA Program Manager.

(3) The TRA Program Manager introduces TRA/DSI principals and turns the meeting over to the TRA PDR Coordinator.

(4) The Coordinator shall review the agenda, introduce each technical presenter, receive/log/process each RFA, moderate all questions/replies, and maintain the minutes.

a. Technical Presenters shall be permitted to complete their dissertation prior to any questions and/or interruptions.

b. All (FRA or TRA/DSI) discrepancies/requested changes and/or unresolved questions shall be documented on the Request For Action (RFA) form (copy attached). The Contractor will document the response on the RFA for review by the RFA Board which shall consist of the appropriate FRA and TRA Representatives capable of rendering resolution.

CLASSIFICATION

REQUEST FOR ACTION

INITIATING AGENCY		INITIATING TEAM		REQUEST NUMBER	
CES NAME		CES NUMBER		☐ PDR ☐ CDR	

FRA COMMENTS

TECHNICAL

ACTION REQUESTED

JUSTIFICATION

INITIATORS SIGNATURE			YES	NO	INITIALS
		TEAM CAPTAIN VALIDATION			
		FRA VALIDATION			

CONTRACTUAL

WITHIN SCOPE ☐	EVALUATORS SIGNATURE	
NOT WITHIN SCOPE ☐		

CLASSIFICATION

CONTRACTOR COMMENTS

TECHNICAL

EVALUATORS SIGNATURE

CONTRACTUAL

WITHIN SCOPE ☐

NOT WITHIN SCOPE ☐

EVALUATORS SIGNATURE

BOARD ACTION/COMMENTS

CATEGORY 1☐ 2☐ 3☐

BOARD CHAIRMANS SIGNATURE

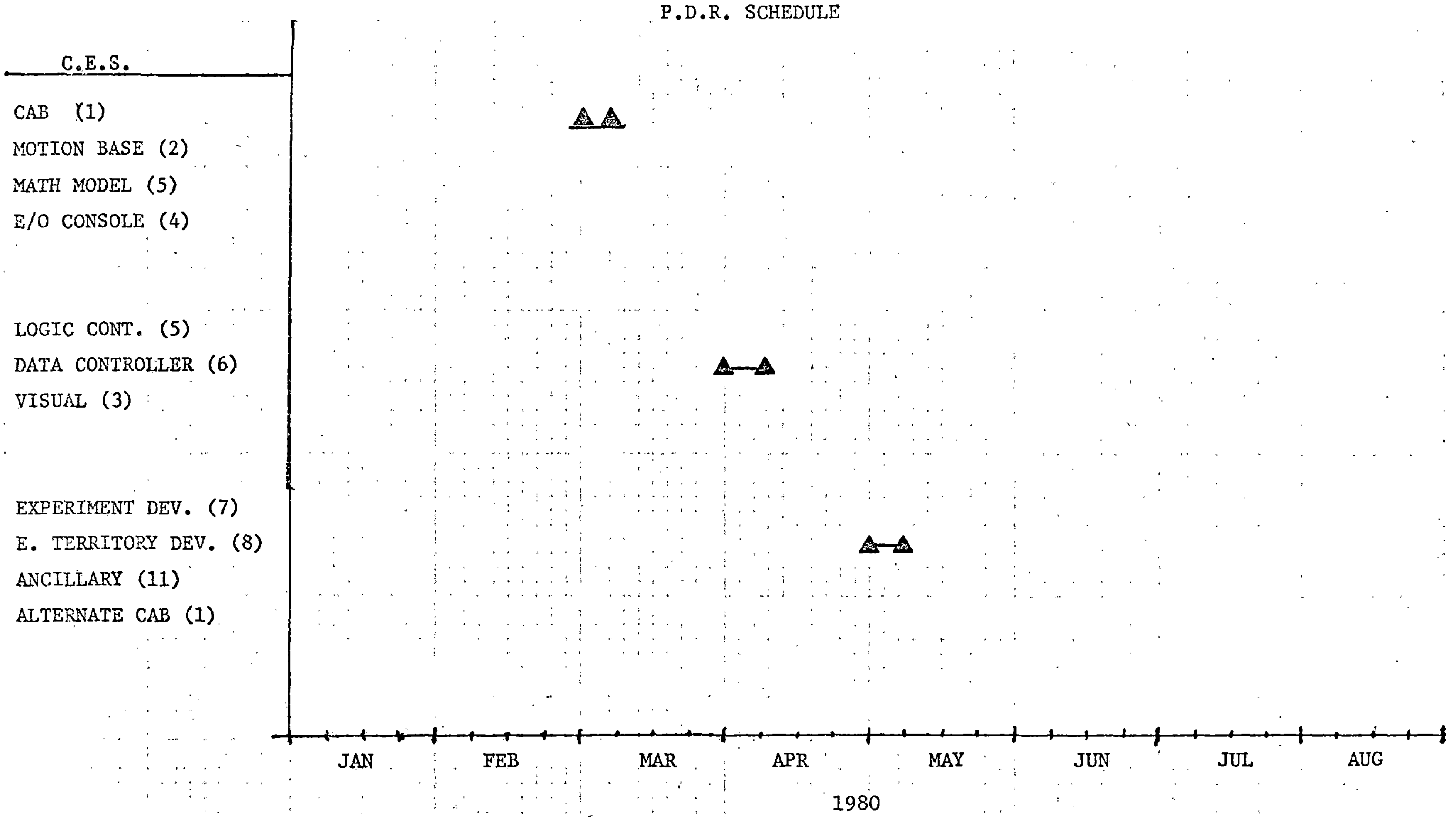


Figure 5.7.1.7-1

FIG. 5.7.1.7-1

All RFA's shall become a part of the minutes of the PDR. RFA(s) which cannot be resolved during the PDR will be assigned a date when resolution/reply will be completed.

c. The TRA Coordinator will assure conformance with the above; maintain adherence to the agenda; introduce presenters; provide minutes of the meeting; and coordinate all logistical aspects.

d. TRA shall provide a detailed agenda to the FRA a minimum of two week prior to the scheduled PDR.

(5) The FRA Chairman shall summarize all open RFA's prior to closing the meeting.

(6) TRA shall reproduce and distribute copies of the approved minutes and maintain status of unresolved/open RFA's.

5.7.1.7 P.D.R. Schedule

PDRs covering all elements of the Evaluator design can be spread over three (3) separate periods. This schedule is designed to alleviate the logistics costs of FRA personnel as well as minimize schedule impact on design activities. The proposed schedule is displayed in Figure 5.7.1.7-1.

An outline of the subject material for the first PDR follows. The first and third PDRs will be held at TRA in San Diego. The second will be conducted at DSI in Van Nuys, California.

5.7.2 Critical Design Review - TRA/DSI will present, at the CDR, revised versions of any items not agreed upon at the PDR's. Further, we will present final design documentation for the eight major subsystems which will include:

- Working drawings and specifications for all eight Evaluator Subsystems.
- Software Design Description

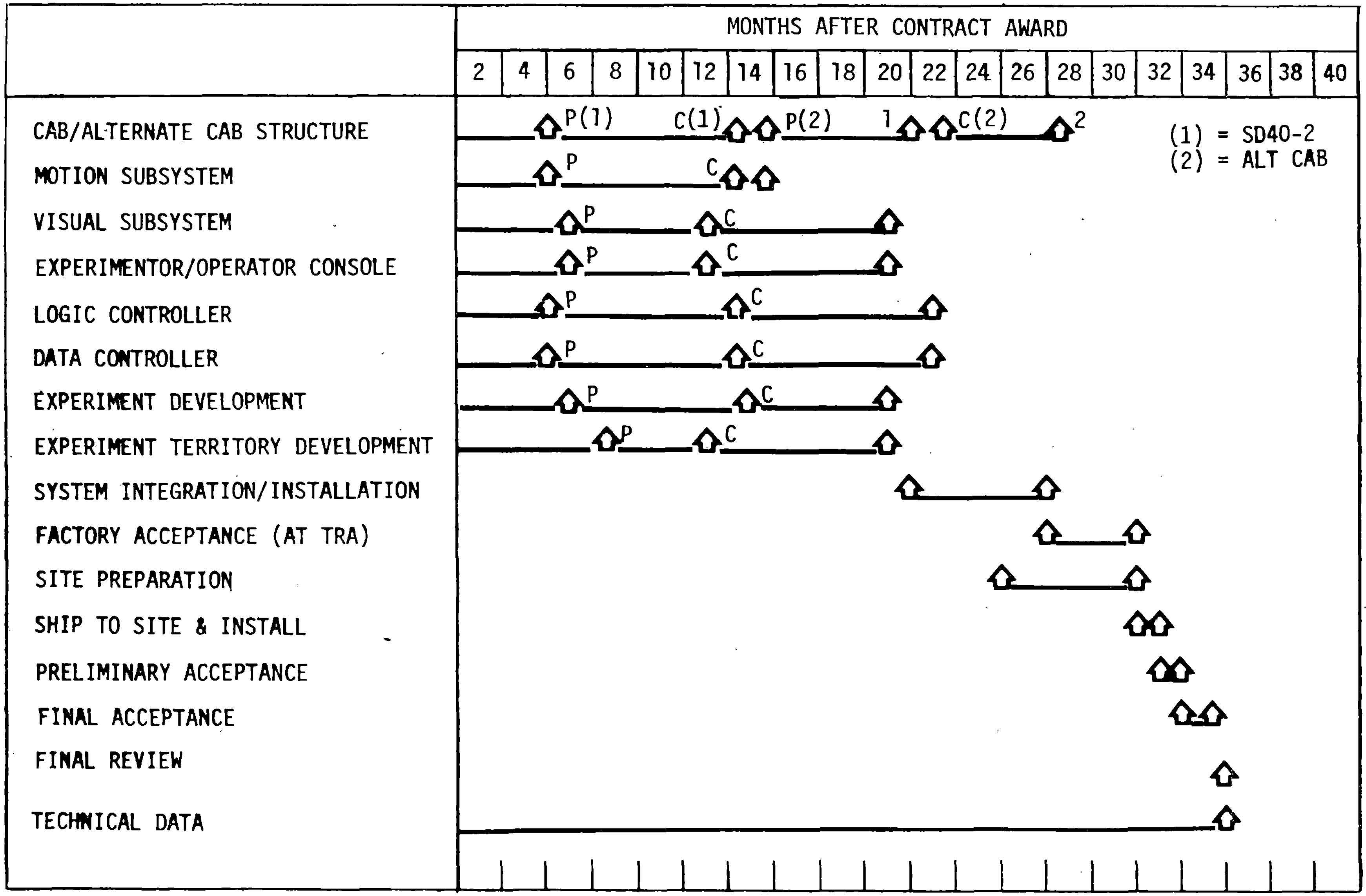
The first item shall include:

- Electrical Considerations - A complete detailed representation of all electrical equipment and interfaces at the subsystem, function, circuit board, and component level. Block diagrams and schematic drawings will be included.
- Mechanical Considerations - Layout drawings of all mechanical equipment and interface with detail dimensions, material selection, surface finishes, tolerances and fabrication techniques.

The system design presented at the CDR will be frozen after Government acceptance of the design packages. Any subsequent changes will be implemented in accordance with the Contract Changes Clause.

Review attendees will include a chairman and members of the FRA staff. TRA/DSI will establish meeting dates and agendas, keep minutes, and compile a list of action items for conconcurrence by the COTR and by the FRA technical monitor. TRA/DSI will record the minutes of these reviews and, in conjunction with FRA personnel, compile a list of action items.

The content of the system design documentation and TRA/DSI presentations at the Design Reviews will be at the engineering level. The detail provided will enable the Government to ascertain compliance with all requirements of the Statement of Work. If necessary, TRA/DSI will modify the system design after each Design Review to ensure compliance with the requirements.



P = PRELIMINARY DESIGN REVIEW
C = CRITICAL DESIGN REVIEW

PROGRAM SCHEDULE

Figure 5-7

5.8 Program Management

5.8.1 Organizational Structures

The program for the Evaluator will be a segregated, projectized organization. The organization charts in this section depict how the responsibilities are distributed.

5.8.2 The TRA Program Organization

TRA has chosen to projectize the program to ensure that team members are dedicated to one common goal. The projectized approach provides for quick response to demands of the program with minimal influence of diverse company activities. The TRA project team organization is depicted in Figure 5-8-2. The Program Manager for the Evaluator program reports directly to the TRA executive management on all technical and financial aspects. The Evaluator Program Manager's deputy is the Program Technical Manager. By job title, he is a Senior Project Systems Engineer. He is appointed, with concurrence of the Program Manager, by the Director of Engineering and has the delegated technical authorization and responsibility of the Evaluator. The Technical Manager is responsible for all of the technical decisions on the program. The only override to those decisions are when they are in conflict with financial or contractual matters and will require resolution by the Program Manager. The Program Manager and Technical Manager will operate very closely and cooperatively.

The engineers responsible for the specific technical areas listed in the organizational chart are designated as Principal Engineers. As described in other parts of this

TRA EVALUATOR PROGRAM ORGANIZATION

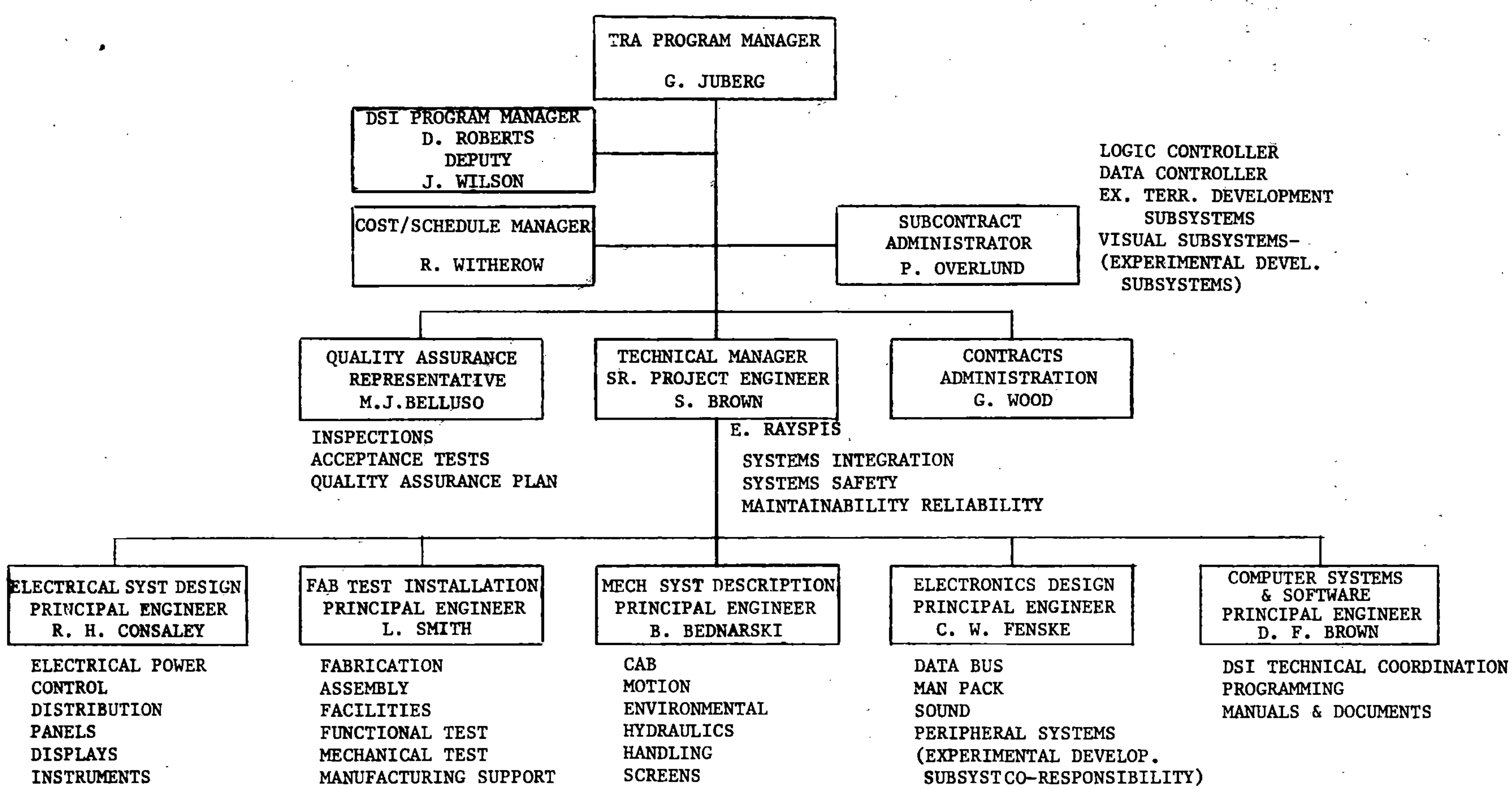


Figure 5-8-2

5.8.2 The TRA Program Organization (Continued)

plan, they are responsible to the Technical Manager for their particular technical areas.

The remaining blocks of the organizational chart are self explanatory or are described in other parts of this plan. The Program staff is intentionally kept as small as possible initially and may be increased or decreased at different points of time within the contract life.

5.8.3 The DSI Program Organization

The DSI program team is structured to provide direction to all staff in an efficient manner, while affording the visibility required by the company executive to ensure good program control. As in the TRA structure, the Program Manager has full responsibility for financial, schedule, and performance matters. The Program Manager reports directly to the office of the President of the company. The DSI Program Organization Chart is shown in Figure 5-8-3.

The detailed technical activities are directed by the Project Engineering Office in response to objectives defined by the Program Manager. Principal Engineers reporting to the Project Engineer are tasked for responsibilities as indicated on the organization chart. To ensure effective response to the prime contractor TRA, all directives from TRA to DSI are transmitted to the DSI Program Manager.

DSI EVALUATOR PROGRAM ORGANIZATION

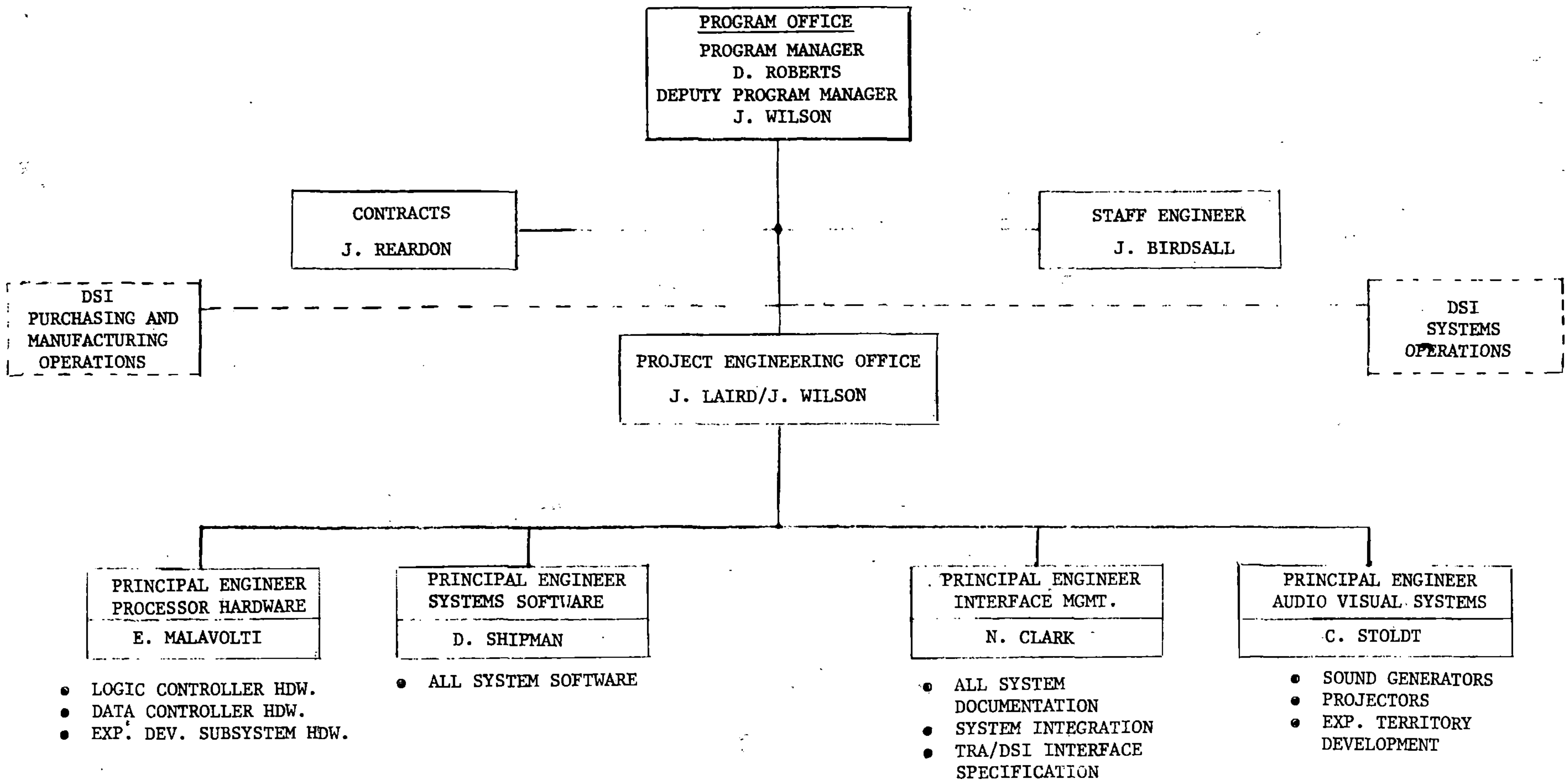


Figure 5-8-3

5.9 Program Plan

The projectized Evaluator program organization will be dedicated for both the engineering and fabrication/assembly and checkout functions. Although Engineering and Manufacturing areas wll not be co-located, they will be in close proximity. All project personnel will be centrally located.

An area is set aside in the program office area for DSI personnel while they are at TRA and visa versa. DSI will provide an office in their facilities for visiting TRA personnel. There will be a continuous and ongoing communication between the two companies. To insure effective communications, the Subcontract Administrator and the Computer Systems Principal Engineer will be primary points of contact at TRA for DSI. DSI will set up similar contact personnel. A written communications system is established and agreed upon by the two companies. This communication and other types of program information are provided in the form of Program Directives issued by the Program Manager.

The Program Manager requires rigid adherance to the contract. Therefore, any required or requested variance to the Statement of Work, Evaluator Specification, or other contract provision will be handled through TRA and FRA Contracting Officers. At no time will any changes be implemented until submitted and approved in writing by the FRA Contracting Officer.

5.9.1 Program Prime and Major Subcontractor Relationship Summary

The contractual relationship between TRA and DSI is that of prime contractor to subcontractor. As such, DSI will be required to provide TRA program management with the visibility TRA requires to fulfill its contract obligations as the prime contractor.

However, TRA recognizes the strong technical expertise of DSI, and their past contributions to these specific technologies. It is the intent of TRA to recognize DSI's leadership in this industry, and in particular, to utilize DSI's expertise in the execution of the DOT/TRA contract.

To this end, the elements where DSI has the major technical responsibility are identified in Table 1.

As shown in Table 1, the designation "major responsibility" means that the assigned organizational entity (e.g., DSI) shall be responsible for the overall design of the hardware and/or software subsystem. Such designation shall also include the generation of specifications, source control drawings (SCD's), interface drawings and/or other data required to satisfy the requirements of that particular WBS element.

Collectively, TRA and DSI are responsible for the (1) identification of technical/program problems, (2) development of recommendations, and (3) task surveillance to ensure that all tasks are within the scope of the contract.

The program will be conducted against a mutually agreed to master schedule which is included in this Project Plan. Detail schedules have been developed by DSI and TRA in accordance with the master schedule. Coordination will be maintained between TRA and DSI with respect to changes to the schedule, so that any changes reflect an integrated position with respect to the conduct of the Program.

TABLE I

LOCOMOTIVE EVALUATOR PROGRAM

WORK BREAKDOWN STRUCTURE (WBS)**

(FRA) SOW Para.	WBS No.	Title	TRA	DSI
-	0	Locomotive Evaluator Program	*X	
2.4	1.0	Cab/Alternate Cab Structure Subsystem	-	-
2.4	1.1	Standard SD-45 Cab	*X	X
2.4	1.2	Alternate Cab	*X	-
2.4	2.0	Motion Subsystem	*X	-
2.4	3.0	Visual Subsystem	X	*X
2.4	4.0	Experimenter/Operator Console Subsystem	*X	-
2.4	5.0	Logic Controller Subsystem	-	-
2.4	5.1	Logic Controller Software	X	*X
2.4	5.2	Logic Controller Hardware	X	*X
2.4	6.0	Data Controller Subsystem	-	-
2.4	6.1	Data Controller Software	X	*X
2.4	6.2	Data Controller Hardware	X	*X
2.4	7.0	Experiment Development Subsystem	X	*X
2.4	8.0	Experiment Territory Development Subsystem	X	*X
2.4	9.0	Total Evaluator System Integration & Installation	-	-
2.4	9.1	System Integration Design, Reviews, & Tests	*X	X
2.4	9.2	Site Layout	*X	-
2.4	9.3	Site Installation	*X	X
2.4	9.4	Software Mgt. & Validation	*X	-
3.0	10.0	Operation & Maintenance	-	-
-	11.0	Other Locomotive Evaluator Program Efforts	-	-
2.2	11.1	Program Mgt./Administration	*X	X
2.6.2/.3	11.3	Quality Assurance	*X	X
2.6.4	11.4	Acceptance At Site	*X	-
2.6.6	11.5	QA, Inspection, & Acceptance Test Reports	*X	X
-	11.6	Ancillary Support Equipment	*X	-
2.9	11.7	Documentation	*X	X
2.10	11.8	Software Documentation	X	*X
2.11	11.9	Reports	*X	X

* Denotes major responsibility for WBS element.
** WBS numbers are identical to CES numbers.

5.9.1 Program Prime and Major Subcontractor Relationship Summary (Continued)

The status of the program is reported to the FRA as specified in Section 5.4 which also is how DSI will report to TRA. Further, DSI's Program Manager shall review the total program Monthly Progress Reports prior to their submittal and provide his technical consultation and comments to TRA's Program Manager. DSI's inputs to the Monthly Progress Reports in the form of total dollar expenditures by CES element are to be submitted no later than seven days before the Prime Contract due date and the Program Manager's review and comments will be no later than two days prior to the submittal date. A copy of each month's submitted Monthly Progress Report will be provided to DSI no later than one week after it is submitted.

The monthly maintenance of the Project Plan shall be a joint effort by both TRA and DSI with TRA integrating all inputs and providing updated monthly versions to DSI and the FRA.

An Interface Control System (ICS) has been developed jointly by TRA and DSI. This system will provide the technical definition for all intra and inter-element interfaces. TRA and DSI will jointly define all areas requiring this ICS.

These documents will be formalized under a drawing release system, and a change control procedure will be enforced. These documents will contain narrative descriptions as well as functional diagrams, as required.

A high level of technical interface between TRA and DSI is recognized as mandatory because of DSI's expertise in this technology and due to the extreme and complicated hardware and software interfaces. TRA's technical manager and DSI's engineering manager are charged with technical interface and data exchange

5.9.1 Program Prime and Major Subcontractor Relationship Summary (Continued)

responsibility. Informal and formal documentation of interface information shall be coordinated between the technical managers and their engineering staffs. Adequate visitation facilities are available in each facility. Telephone and telex records of decision and data transmittal record procedures have been established to insure accuracy of communications. Each engineer is required to keep a program notebook up to date so that either company's technical manager can quickly assess that their or either company's engineers input data, analysis and results meet integrated program requirements.

5.10 Small Disadvantaged Business Concerns Plan

Appendix D contains a copy of TRA's Small Disadvantaged Business Concerns Subcontracting Plan which will be the basis for the LATHE contract. The plan will be implemented as written and reporting of progress will be as delineated therein. Updating may be required and will be accomplished as the need arises. The specific purchasing procedures followed are as described in another section of this Project Plan.

6.0 FUNCTIONAL ENGINEERING ACTIVITIES

The following descriptions are examples of technical activities under way or planned for the Evaluator project. Current activities descriptions are reflected in greater detail; however, definitive working documents will be developed for all functional areas, and/or C.E.S. elements.

The framework within which these activities are performed, and the general management of the work is described in Section 5.0 above.

6.1 Electrical Design

6.1.1 General - The tasks which the Electrical Group will perform fall into two distinct categories. The first category covers those tasks which are of a total systems nature and which have elements in more than one subsystem or which serve to interconnect subsystems. An example of this category task is the electrical power subsystem which has its origin at the facility power source and terminates in each of the CES/WBS subsystems. The second category of tasks are those that are confined to one CES Element of the total system.

The tasks falling into each of the two categories and the format in which these tasks will be documented are as follows:

6.1.1 (continued)

A. <u>Category No. 1, System Tasks</u>:

1. Electrical Power
2. Logic/Data Interconnection
3. Video Interconnection
4. System Definition, Integration and Interconnection.

B. <u>Category No. 2, Sub-System Tasks:</u>

1. Cab Subsystem and Alternate Cab S/S
2. Motion S/S
3. Visual S/S
4. Experimenter/Operator S/S
5. Logic Controller S/S
6. Data Controller S/S
7. Experiment Development S/S
8. Experiment Territory Dev. S/S

A. Category 1, Systems-Tasks

A.1(1) Electrical Power Subsystem Narrative Task Description -

Electrical power for the evaluator system will be derived from a facility power source. One of the initial tasks will be to summarize the total system power requirements in terms of normal and peak loads. In order to determine these loads, power consumption curves reflecting start, warm-up, intermittant and normal running loads versus time will be generated in the form of an electrical loads analysis.

Because electrically powered components of the system, such as hydraulic pump motors, will draw high current during start-up and will tend to introduce high inductance upon shut-down, it is anticipated that means of sequencing start and shut-down operations will be necessary. It will be a task of the electrical systems group to review the load profiles and determine the requirements for sequencing during start-up and/or shut-down operations. The electrical group will define the requirements necessary to implement the sequencing and will have the responsibility for designing the sequencing equipment or for establishing a source of procurement for it. Additional tasks related to power sequencing will be to establish the requirements for sensors and controls which will provide automatic shutdown under emergency conditions.

Other tasks associated with the power system will involve power distribution and power circuit protection. Power distribution will be implemented to most effectively power the using sub-systems. Data from the power analysis will be used to determine each subsystems power requirements.

Physical location of the primary elements of the power distribution system will be determined from a study of the power analysis to provide idealized locations. This will be done to preclude routing high power distribution lines thru areas not requiring high power and keeping high power line lengths to a minimum. Power monitors will be a part of the Exp/Oper Console and will have alarms and manual emergency override controls. Convenience outlets will be provided throughout the facility.

Distribution cabling will reflect use of properly sized conductors to handle electrical loads to each subsystem. Power system protection will be provided, using circuit breakers which protect each of the distribution lines to the subsystems. Power system design will include override circuitry which will allow continued operation of specific subsystems during periods of maintenance and/or repair of non-related subsystems. Safety features will be incorporated to insure against potential hazard conditions which could conceivably be present under such operations.

A.1(2) Electrical Power System - Detailed Task Summary

- Prepare Elect. Power summary
- Prepare Elect Power Analysis
- Conduct Study of Sequencing trade-off/reqmts.
- Sequencer design/search
- Determine Power Monitor requirments
- Select Power Monitor Devices
- Determine Power Controls - Requirements
- Select Power Control Devices
- Prepare Power Distribution Diagram
- Determine Power System Protection Requirements
- Select Override Controls
- Select Circuit Breaker

- Select Safety devices
- Select Alarms
- Prepare Wiring Harness Dwgs.
- Prepare Equip. Instl. Dwgs.
- Prepare Dwg Main Circuit Breaker Panel and Control Box
- Determine Physical Location of Power System Components

A.2(1) Logic/Data Interconnection Task Description -

The electrical group will be responsible for providing the interconnecting wiring from the logic controls to the associated data bus equipment and on to the logic controller. Data feedback interconnecting wiring from each sensor to the associated data bus and then to the data controller will be the responsibility of the Electrical group. Close coordination with DSI and TRA Electronic group will be required to adequately implement Logic/Data interconnection systems. Initial implementation will be determined from a systems interconnection diagram/schematic.

A.2(2) Logic/Data Interconnection Detailed Task Summary -

a. Prepare Logic/Data Interconnect Diagram

b. Participate in determining interconnect detail requirements.

c. Prepare Interconnect Wiring Harnesses

A.3(1) Video Interconnection Task Description -

Design and installation of video transmission lines will be the responsibility of the electrical group. Video coaxial transmission lines will be required between the cab and the Experimenter/Operator Console for the three prime monitors which are capable of displaying the Track Scene, and TV cameras mounted inside the Cab.

A.3(2) Video Interconnection Detailed Task Summary -

a. Prepare Video Interconnect Diagram

b. Participate in determining video interconnect detail requirements.

c. Prepare Interconnect Wiring Harness drawings or coordinate procurement.

A.4(1) System Definition & Integration Task Description -

Evaluator system electrical design tasks other than electrical power, logic/data interconnection and Video interconnector will be the responsibility of the Electrical Design Group. These will include (1) the preparation and maintaining of an Electrical Systems Manual, (2) preparation of Electrical Systems drawing breakdowns and schedules (3) assignment of systems reference designators, (4) preparation & coordination of a systems drawing procedure and (5) coordination of Electrical Systems requirements with other internal technologies and outside agencies.

A.4(2) System Definition and Integration Detailed Task Summary -

a. Prepare and maintain Electrical Systems Manual

b. Prepare Elect System Drawing breakdown and schedules

c. Prepare Ref. Designator assignment list and coordinate usage.

d. Prepare and coordinate systems drawing procedure

e. Coordinate Elect System requirements with other technologies.

B. Category 2, Sub-Systems Tasks

B.1(1) Cab-Subsystem Task Description -

The electrical group effort in the cab subsystem will include research into and definition of modifications required to each of the SD40-2 provided control and monitor panels. This will include the Engineer's control console, the Switch & Fuse Panel, the Circuit Breaker panel and the Engine Controls panel. After the modifications are defined, the Electrical Group will prepare the necessary modification drawings.

In addition to the above modifications, the MISC/Override Control Panel requirements will be investigated and defined. This panel will include environmental, illumination, motion system override and other necessary controls in the cab area. Layouts and fabrication drawings will be prepared for this panel.

Requirements related to the Bio-Data Acquisition Pack, the Radio-Telephone, the Video Cameras the noxious odor system and the Advance Development Display will be investigated. It is anticipated that no electrical group effort will be necessary relative to these components, other than providing for their installation and wiring interfaces. If minor modifications are required to any of them, the electrical group will prepare modification drawings, defining the required changes.

In coordination with the Electronics Design Group, the electrical group will investigate the physical and electrical interface requirements of the CAMAC (Data Bus) Assy. It is anticipated that this assembly will be an off-the-shelf purchased item. If minor modifications or assembly build-up drawings are required the electrical group will prepare them.

The cab electrical interconnection task will be coordinated and documented by the elect. group. Necessary interconnection and Schematic diagrams and Wiring Harness Assemblies will be prepared.

Electrical and Electronic equipment and Wiring Harness installation requirements will be coordinated by the Electrical group. Installation drawings will be prepared to document the equipment and wiring installations.

B.1(2) Cab-Subsystem Detailed Task Summary -

a. Engineer's Control Console

(1) Determine modifications required to engineers' Console controls.

(2) Provide drawings to reflect required mods.

(3) Select vendor or determine feasibility of TRA performed modifications

(4) Coordinate modifications

b. Switch & Fuse Panel:

(1) Determine modifications required

(2) Provide drawings/instruction for modifications

(3) Participate in "make" or "buy" modifications

(4) Coordinate modifications

c. Circuit Breaker Panel:

(1) Determine modifications required to controls

(2) Provide drawings to reflect required modifications

(3) Select vendor or determine feasibility of TRA performed modifications.

(4) Coordinate modifications

d. Engine Control Panel:

(1) Determine modifications required to controls.

(2) Provide drawings to reflect required modifications

(3) Select vendor or determine feasibility of TRA performed modifications.

(4) Coordinate modifications.

e. Misc/Override Control Panel:

(1) Determine requirement for environmental controls, illumination controls, motion system override control and other misc. candidate components for this panel.

(2) Select components, in coordination with DSI and electronic subsystems.

(3) Make panel layout

(4) Prepare Schematic/Wiring Diagram

(5) Prepare Panel Assy drawing

(6) Coordinate components procurement

f. CAMAC (Data Bus) Assy:

(1) Determine requirements of Cab located Data Bus Assy.
(2) Prepare Ass'y drawing (if required).

g. Bio-Data Acqusition:

(1) Provide wiring

h. Radio Telephone:

(1) Provide wiring

i. Video Cameras

Provide wiring

j. Advance Development Display

Provide wiring

k. Cab Interconnection:

(1) Prepare Cab Interconnect diagram
(2) Prepare Cab Schematic diagram
(3) Prepare Cab Interconnecting Wiring Harness Drawings

l. Equipment & Wiring Instl:

(1) Prepare Elect. Equipment Instal layout in cab area
(2) Prepare Elect Equipment and Wiring Harness Instl. drawing -cab
(3) Coordinate structural provisions required for electrical and wiring installations.

B.2.(1) Motion Subsystem Task Description -

The electrical control and monitoring of the motion subsystem will be investigated. Necessary control, monitor and alarm components will be selected. An override control panel for emergency shutdown will be designed for the motion subsystem area. An electrical schematic of the motion subsystem will be prepared.

B.2.(2) Motion Subsystem Detailed Task Summary -

a. Prepare motion subsystem electrical requirements.

b. Prepare motion subsystem schematic diagram.

c. Override Control Panel:

(1) Document panel requirements
(2) Prepare panel schematic diagram
(3) Select panel components
(4) Prepare panel layout drawing
(5) Coordinate components procurement
(6) Prepare panel assy. drawing

B.3(1) Visual Subsystem Task Description -

Initial design criteria requires no electrical group effort in this area.

B.3(2) Visual Subsystem Detailed Task Summary -

Same as B.3(1).

B.4(1) Experimenter/Operator Subsystem Task Description -

Initial tasks relative to the experimenter/Operator subsystem will entail a coordinated effort involving DSI and each of the TRA LATHE subsystems groups to define the detailed requirements. After initial control and display requirements are defined, a review of the configuration will be conducted. Human factor considerations will be applied to the idealized location of each control and monitor. When preliminary criteria has been established, it will be the responsibility of the Electrical Subsystems group to prepare a console layout and individual panel layouts for those control and monitor panels which are not purchased items.

It is planned to provide a six bay standard panel (19") console to house all the elements of the subsystem, except the two Video Cassette Recorders. They will be installed in an auxilliary cabinet attached to the console.

A list of the sub-assemblies which are anticipated for inclusion in the subsystem are shown on attached Table 6.1-1. An (*) denotes those assemblies which are not purchased items. Upon systems engineering layout approval of each of the console mounted assemblies (panels), the Electrical group will prepare panel fabrication drawings. Component selection for each of the panels will be the general responsibility of the Electrical group. Special controls and instruments will be recommended by part number and vendor by the responsible subsystem group.

Console and auxilliary cabinet selection will be the responsibility of the Electrical group.

A console assembly drawing will be prepared by the Electrical group. This drawing will assemble all of the panels and other sub-assemblies into the console and will install the Video Cassette Recorders into the auxilliary cabinet. A Wiring Installation drawing will be prepared to interconnect all the panels and sub-assemblies of the console.

B.4(2) Experimenter/Operator Subsystem Detailed Task Summary -

a. Prepare detailed definition of all the requirements of the Exp/Opr. subsystem and flag Electrical group responsible areas.

b. Prepare Console Layout

c. Conduct Human Factor review

d. Prepare layouts of following:

(1) Experimenter Inter-Comm & Communication Panel

(2) Operator Inter-Comm/Radio Telephone Panel

(3) Motion Base Control Panel

TABLE 6.1-1

REFERENCE LIST OF EXP/OPER CONSOLE CONTROL & DISPLAY PANELS

	REF DES.
Experimenter CRT Panel	4AIVT5
Experimenter Keyboard	4AIVT1
* Experimenter Inter-Com and Cab Communications Panel	4AIA4
Operator CRT Panel	4AIVT6
Operator Keyboard	4AIAT2
* Operator Inter-Com Panel	4AIA13
* Motion Base Control Panel	4AIA11
* Cab Environment Control Panel (Odor,Audio,Temp, Humidity)	4AIA10
* Power Sequencer Panel	4AIA12
* General Purpose Programmable Meter Display Panel	4AIA1
* Locomotive/Train Controller Replication Panel	4AIA& A-9
* Summary Annunciator Panel	4AIA7
* System Malfunction Panel	4AIA6
* Strip Chart Control Panel	4AIA3
Six Channel Strip Chart Recorder A	4AIA&SR1
Six Channel Strip Chart Recorder B	4AI&R2
Cab Camera Control Panel	4AIA2
Video Control Panel	4AIA5
Video Monitor A	4AIVT1
Video Monitor B	4AIVT2
Video Monitor C	4AIVT3
Video Monitor D	4AIVT4
Video Data Selector Switch Module	4AIA14
Video Sync Generator and Test Signal	4AIA11
SMPTE Time Frame Code Generator	4AIA&A2
Four Channel Video Graphics Controller	4AIVC1
Video Cassette Recorder A	4A2VR1
Video Cassette Recorder B	4A2VR2
Data Bus Installation	4AIA31

* To be designed and fabricated by TRA.

(4) Cab Environment Control Panel (odor, Audio, Temperature).

(5) Power Sequencer panel

(6) General Purpose programmable meter display panel

(7) Loco/Train Controller Replication panel

(8) Summary Annunicator Panel

(9) System malfunction panel

(10) Strip chart control panel

(11) Auxilliary cabinet showing VCR installation.

e. Select components and/or verify component characteristics for sub-assemblies (1) thru (11) under "d" above.

f. Prepare Panel assembly drawings for items "d(1)" above.

g. Prepare Wiring Installation drawings for items "d(1)" thru "d(11)" above.

h. Prepare Console Assembly drawing.

i. Prepare Console Wiring Installation drawing.

j. Procure all dimensional and wiring information on purchased rack mounted displays (panels, monitors, etc.) (18 panel mounted components).

B.5(1) Logic Controller S/S Narrative Task Description - Provide interconnecting wiring

B.5.(2) Logic Controller S/S Detailed Task Summary - Provide interconnecting wiring

B.6(1) Data Controller S/S Narrative Task Description - Provide interconnecting wiring

B.6(2) Data Controller S/S Detailed Task Summary - Provide interconnecting wiring

B.7(1) Experiment Development S/S Task Description -

Electrical power and control will be required for the Experiment Development S/S and will be the responsibility of TRA Electrical Group. This task is defined in the Category 1 section of this document under Electrical power subsystem.

The Experiment/Development Subsystem will include a control and monitoring console (3 bay). This console will be selected and assembled by TRA. It will be necessary to coordinate with DSI to determine subsystem interface and console configuration and to define these requirements.

TRA will prepare interconnection wiring harness drawings, control and monitoring panel drawings, console assembly drawing and subsystem installation drawing.

B.7(2) Experiment Development Subsystem Detailed Task Summary -

a. Coordinate console and interfacing requirements with DSI
b. Define by Specification Control, Source Control or off-shelf part number.
c. Define control and monitor panel design requirements.
d. Define development center interconnection requirements.
e. Prepare sketch layout of console
f. Prepare console assembly/wiring drawings
g. Prepare control panel drawings
h. Prepare wiring harness drawings
i. Prepare development center installation drawing

B.8(1) Experiment Territory Development Subsystem Task Description -

This subsystem is totally the responsibility of DSI and, therefore, no effort on the part of TRA Electrical group is anticipated.

B.8(2) Experiment Territory Development Subsystem Detailed Task Description -

(See Task Description above).

6.2 Mechanical Design

The bulk of the effort required of the mechanical group will be invested in the Cab and motion base C.E.S. elements. Our objective will be to develop these items together as a single working entity which will meet all of the contract specifications and fulfill the more general objective of providing realistic cab motion.

These objectives will be accomplished by selecting a motion base which will provide the jerk and acceleration required and by designing the cab structures such that they will not limit the motion base. A conservative weight and mass distribution budget will be stringently enforced.

Other tasks include the design, procurement and installation of the screens, the mounting of the aspheric mirror, and the development of various ancillary hardware.

Various important aspects of the Mechanical Design group's activities are discussed below.

6.2.1 Cabs - The primary TRA mechanical design task will be the design of the two cabs and their interfaces. The SD40-2 Cab will utilize a considerable number of components/parts used in actual locomotives. Integration of these sub-assemblies with TRA designed parts to provide a realistic simulation of an actual cab while yet minimizing the overall weight will be made. The design will provide a reliable structure that is versatile and capable of easy maintenance and quick change. Systems interfaces, in addition to the motion base, are the electrical/electronics and environmental control subsystem.

6.2.1 Cabs (Continued)

Analysis of loads, stress, thermodynamics, and weights with centers of gravity will be accomplished to ensure meeting the specification requirements.

The analysis will also have to be performed to determine the floor loading that the Evaluator will place on the facility. This information will be required as an input into the facilities plan. These analyses will not require formal documentation, and if less costly, tests will be performed instead.

The mechanical design requirements will also be provided as inputs to the necessary procurement and interface specifications that will be written. This will include the hydraulics and environmental subsystems.

A system for interchanging cabs and handling devices for the two cabs during maintenance activities will be required. These devices are to be designed so they meet the maintenance plan requirements as well as the one day cab change requirement.

6.2.2 Environmental Design - The environmental subsystem design is a subset of the mechanical design function. The environment subsystem is a subsystem of the cab's design along with its odor subsystems. These subsystems will be purchased items but will be under the technical control and direction of the mechanical design. Mechanical design is

6.2.2 <u>Environmental Design</u> (Continued)

also responsible for the analysis necessary to ensure the purchased subsystems will provide proper environmental conditioning as well as the reliability and maintainability aspects of the Evaluator specification. Mechanical design has the responsibility to provide necessary documentation for support to the Technical Manual preparation.

An interface is required between the two cabs and a remote location for the environmental subsystem. This interface responsibility lies within the mechanical design area and care will be taken that the interface design maintainability time requirements.

6.2.3 <u>Motion System Design</u> - The motion system is an off-the-shelf design which will be purchased. It is the mechanical design responsibility for the technical management of this procurement and for the motion system interface between the cabs and with the government facility. The hydraulic pumps subsystem will be remotely located from the motion base. It is the mechanical design responsibility to see that it is properly located to meet the mechanical and environmental interface requirements. The mechanical design will coordinate with the electrical design to make sure that all Evaluator specification requirements are met. These include safety and maintainability as well as reliability.

6.2.3 Motion System Design (Continued)

Mechanical design has the responsibility to see that all necessary documentation is provided for the Technical Manuals for the motion system. These materials will be needed to prepare and conduct subsystems and integration tests as well as acceptance tests.

6.3 Electronic Design

Electronic Design is responsible for the electronic subsystems in the Experimenter/Operator (E/O) console and in the Cab. The major electronic subsystems are the video, the biophysiological manpack, the digital data bus and data bus interfaces and the audio. The video subsystems include the cab TV cameras and control, the monitors in the E/O console, the graphics generator, the video data selector, the video recorders, and the time-code/synch generators. Electronic Design will specify/select the components of the video subsystem and provide technical cognizance for operation and integration into the Evaluator system. Electronic Design will specify and select components for the biological manpack monitoring and telemetry subsystem. This includes the antenna design, the receiver and acquisition sensors. Electronic Design will have technical cognizance of all the electronic subsystems and interfaces enumerated below. In this capacity, they will design, specify, select, document, integrate and coordinate as required to ensure electronic subsystems performing in accordance with the Evaluator Specification.

6.3.1 Data Bus

The digital data bus is the communication link for interconnecting the logic controller, the cab and the E/O console. The digital data bus also interconnects the data controller, the strip-chart recorders and the E/O console. Electronic Design will determine the most cost effective type of bus for the Evaluator and select and/or design all of the data bus interfaces. The two major options for the Evaluator digital data bus are:

1) The Computer Automated Measurement and Control (CAMAC) data bus is an internationally accepted instrumentation and interface system widely used in industrial and research applications. Interface and control modules are available off-the-shelf from multiple suppliers.

2) The MIL-STD-1553 data bus is a military standard used generally for avionics systems. Components of this system are available off-the-shelf, but the interfaces for converting to/from data bus format must be designed, developed and fabricated by TRA.

A cost/schedule evaluation process to determine the most cost effective data bus approach will be complete by PDR.

6.3.2 Interstation Communication

This consists of the two-way audio communication network between the E/O console and other stations. Electronic Design will specify and select components for the interstation communication network.

6.3.3 EMI/EMC Compatibility

Electronic Design has the responsibility to ensure EMI/EMC compatibility of the overall Evaluator system throughout all of the design, integration, testing and installation. In addition, Electronic Design will provide all the necessary documentation to support the system manuals, training and spares determination for the electronic component/subsystems. They will support, by data and/or manpower all of the integration and test phases of the program through final acceptance tests at the customer's facility.

6.3.4 Cab Instrumentation

6.3.4.1 Introduction - The cab instrumentation system will 1) monitor and/or control all applicable cab controls, switches, circuit breakers, lamps, valves and gauges, 2) Monitor the engineman performance via video and bio-physiological instrumentation.

6.3.4.2 Purpose - The purpose of the cab instrumentation system is to sense the position of all the controls, switches, valves and circuit breakers normally operated by the engineman. The cab instrumentation system will control the visual and audible indicators normally monitored by the engineman such as gauges, lights, circuit breakers and warning alarm. The instrumentation will provide a visual monitor of the engineman via the TV camera and a biophysiological monitor via the manpack sensors and telemetry system.

6.3.4.3 Major Elements - The major elements of the cab instrumentation system are:

Video Subsystem - two B/W TV cameras
one color TV camera
Infrared Illumination

Manpack Subsystem - Sensors
Transmitter/Receiver

Engineer Control Console

Engine Control Panel

Switch and Fuse Panel

Circuit Breaker Panel

Data Bus Interface

Plug-In Advanced Display

6.3.4.4 Specific Functions - The following functions are representative of the devices included in the Cab instrumentation.

Indicators

- Speedometer
- Main Reservoir Pressure
- Locomotive Brake Cylinder Pressure
- Equalizing Reservoir Pressure
- Brake Pipe Pressure
- Brake Pipe Flow Meter
- Loadmeter

Controls

- Dynamic Brake
- Throttle
- Reverse
- Sanding Wobble Stick
- Sanding No. 1 Track Switch
- Trainline Air Pressure Valve
- Multiple Unit Valve
- Cutoff Valve
- Automatic Airbrake Valve
- Independent Airbrake Valve
- Bell Ringer
- Air Horn Valve

Lights

- Wheel Slip
- PCP Open
- Sand
- Brake Warn
- Test
- Ground Relay
- Gov Down
- No Power/Charge
- Turbo Pump
- Filt Motor Trip
- Lock Wheel

Circuit Breakers

- Dynamic Brake
- Turbo
- Fuel Pump
- Control
- Local Control
- Aux. Gen Field
- Module Control
- Rev Control
- AC Control
- Brake Trans Control
- Generator Field
- Auxiliary Generator
- Cab Heater
- Lights
- Headlights
- Radio

6.3.4.5 <u>Implementation</u> - TRA will purchase actual EMD built hardware for the engineer control console, engine control panel, switch and fuse panel and circuit breaker panel. This hardware will be modified (or instrumented) to interface with the data bus which subsequently links to the Logic Controller.

6.4 Fabrication, Assembly and Testing

The focal point for all fabrication, assembly and test activities is the TRA designated in-plant LATHE Assembly Area at San Diego, California. This area will be dedicated to the program and contain sufficient floor space and overhead clearance for total assembly and operation of the evaluator. Inventory storage space will be included in this area for collection of all purchased parts providing direct access to the assembly process. Detail parts fabricated by manufacturing shops within the TRA facility will be delivered to this storage area pending their need in the assembly process.

Where components or subassemblies require tests prior to assembly or system integration, they will be released for test to adjacent facilities and returned to this area at the completion of the test.

As the hardware assembly evolves and nears completion the pre-acceptance functional testing of the subsystems and the total system will occur in this same area.

The LATHE assembly area must be a practical duplication of the ultimate evaluator site in Oklahoma City. That is, the general floor plan will provide locations of the various subsystems approximating the floor plan of the permanent site. For example, electrical power capabilities and outlets, mechanical interface points, line of site viewpoints, lighting characteristics, safety controls, partitions and relative positioning of equipment will be simulated wherever practical.

6.4.1 Fabrication and Assembly - The manufacturing facilities within TRA are oriented toward multiple-quantity production and of necessity, require a high degree of formalized manufacturing planning and inspection activity. Since the Evaluator is a single deliverable system requiring engineering development and test, it is not practical or desirable to impose these formal activities. Therefore, as a general rule, most detail parts to be used will be purchased from outside commercial sources. Several exceptions to this rule exist, however, as follows:

1) Where mockup is essential to the establishment of firm design, the Program Office may elect to use mockup oriented engineering personnel and quick reaction capabilities within the TRA manufacturing organization.

2) Where outside sources cannot reasonably respond to requests for procurement, the program may elect to fabricate in-plant using a quick-response manufacturing approach.

3) For assembly of purchased hardware into the unique requirements of the Evaluator, engineering technicians and mechanics will be utilized, with the assistance of personnel from the various manufacturing and tool departments.

When in-plant fabrication is elected, the Fabrication Principal Engineer, through his designated representatives, will enlist the aid of the appropriate manufacturing facility foreman. All work of this type will be authorized and controlled through the use of an Engineering Shop Work Request (see Program Management, Section 5.0) to provide documented evidence of the manufacturing process, including quality verification.

As the purchased or in-plant fabricated parts are delivered to the assembly area, the assembly process will take place at the designated subsystem locations. This technique affords the opportunity to identify and resolve interface problems as they arise resulting in a compatible evolution of the total evaluator.

During the fabrication and assembly process, the quality control representatives and applicable responsible design engineers will monitor progress, not only in their areas of responsibility but in the interfacing of related subsystems.

6.4.2 Testing

Testing of the various levels of components, subassemblies and assemblies will be conducted in several stages, generally categorized as follows:

1. Development
2. Verification
3. Integration
4. Acceptance

Development testing will consist of any form of bench level tests required by designers to evaluate the performance of specific components or subassemblies prior to integration into a subsystem. Such tests would include, for example, electrical or electronic circuitry design evaluation, mechanism or structural evaluation or hydraulic pumping system pressure and flow evaluation. These tests will be performed as a matter of course to assist designers in problem resolution. Formal test procedures will not be prepared for these tests, but the results will be documented by internal memorandum.

The requirements for other testing will be generated principally by design engineers through the use of drawing notes, vendor or procurement specifications or in some cases, design memorandum.

Verification testing will consist of any form of component or subassembly test deemed critical by the individual designers, to the successful operation as an integral part of the Evaluator System. Such tests would include, for example, proof loading of finalized structural assemblies or end-to-end operational verification of electrical or electronic assemblies.

EVALUATOR TESTING

TEST CATEGORY	HARDWARE LEVEL	REQUIREMENT	RESULT
I. DEVELOPMENT	COMPONENT, SUBASSEMBLY	DESIGN EVALUATION	CONFIRM DESIGN CONCEPT
II. VERIFICATION	COMPONENT, SUBASSEMBLY OR SUBSYSTEM	DESIGN SPECIFIED	VERIFY OPERATION TO SPECIFICATION
III. INTEGRATION	SUBASSEMBLY OR SUBSYSTEM & SUBSYSTEM INTERFACE	PRE-ACCEPTANCE	VERIFY EQUIPMENT INTERFACE & PROCEDURE
IV. ACCEPTANCE	ASSEMBLY	SYSTEM ACCEPTANCE TEST PLAN	VERIFY SYSTEM OPERATION TO SPECIFICATIONS VALIDATE PROCEDURES

Verification testing will also include the tests conducted as materials are received from outside sources, whether these tests are conducted at the vendor's site with TRA quality witnesses or at the TRA San Diego facility as a part of the receiving process. The results of these tests will be documented by Quality representatives through the use of receiving reports, memorandum test reports or other forms of quality conformance verification.

Integration testing will consist of those tests required to ensure the proper interfacing of equipments either within a subsystem or between two or more subsystems. The concept of integration testing will be used to develop the procedures to be used for system acceptance testing. Therefore, it will be necessary to start with a "draft" of the procedure to be used, employing a mark up approach to improve procedures and to develop a final systems acceptance representatives and the results of these tests will be documented by design and quality signatures on the finalized procedures.

Acceptance testing will consist of the system level testing required to verify satisfactory operation of the total evaluator system. The System Acceptance Test Plan will be the governing document for this level of test. The test will be conducted on three occasions when it has been determined that the system is ready for assembled operation, as follows:

1. By TRA/DSI at the San Diego facility as a final verification of procedures and integrated operation.
2. By TRA/DSI at the San Diego facility for preliminary acceptance by the Government.
3. By TRA/DSI at the Oklahoma City site for final acceptance by the Government.

Upon satisfactory completion of the first step by TRA/DSI, Government witnesses will be asked to formally verify that operation at San Diego. The results of these two tests will serve to finalize the System Acceptance Test Plan to be used during the final acceptance test at the operating site. Upon satisfactory completion of the final test, a System Acceptance Test report will be prepared and submitted for government approval.

6.5 Audio/Visual System

The projection element of the visual display system encompasses elements of the visual system, the cab and the motion systems. The elements from the cab and motion systems are passive constraints, as opposed to active elements which are contributed by the visual system. For example, the angular coverage provided by the forward screen image can be sized by one of three operational assumptions applied to the cab window size: 1) the cab is at mid-motion and the subject is seated facing forward; 2) the cab can move through small angles and displacements under the control of the motion base and the subject can move his head about in doing his work; and 3) the cab can be moved to any combination of extreme limits of the motion system and the subject is free to roam about the cab at will. Each of these assumptions leads to a different calculation of the required size of the forward image. The larger the size of the forward image the poorer will be its resolution, color saturation and projection stability. Alternatively, making the image smaller than needed to cover the window expanse runs the risk of impairing the face validity of the visual scene. Another factor in this consideration is the possible window configuration of yet undefined future cabs which may be candidates for Evaluator research.

In total, the visual display system design task network embodies a large number of seemingly independent considerations that are in fact decidedly interrelated in non-trivial ways. For this reason, these tasks often extend through more than one CES element and cannot be considered alone. An easy example of this pervasive reach is the clear effect that the image size analysis just described has on the selection of the focal length of the camera lens in the Experiment Territory Development Subsystem.

6.5 Audio/Visual System (Continued)

The audio subsystem integrates most closely with the Cab subsystem in its performance aspects and with the Logic Controller in its functional aspects. The fundamental performance requirement of the audio system is to generate the sounds that recreate the aural environment of a locomotive cab. This choice can be approached on three events; pre-recording and playback-on-cue of sounds on magnetic tape, synthetic creation of sounds by general purpose audio devices, and a hybrid approach using general purpose hardware and predetermined sound representations in software. The hybrid approach yields a solution of the required fidelity and with the desired flexibility. The steps from gathering the required sound recordings to generating and placing in software a proper representation of the recorded sound are highly complex but well understood. The hardware to playback the recorded software is similar in principle, but not in scope, to earlier commercial units produced by DSI. The expansion of the previous units and the integration of their control into the Logic Controller are the principal audio tasks in the audio/visual system.

6.6 Systems Software

The software will be developed using a top down approach. This means that the functional requirements of the system are developed first. Trade studies determine which functions are to be performed with software and which with hardware. After the software functional requirements are established, their interface with hardware and other software components is defined. These interfaces are documented by an Interface Control Document which can be changed only through a formal Engineering Change Order cycle.

The test plan is created from the requirements defined at this point. This test plan lists the tests to be run to insure that all of the requirements have been satisfied. After the requirements and test plan are defined the programmer knows what is expected of his program and the manner in which it will be tested. At this point, final program size and timing estimates are made for the software module being designed.

The requirements definition document includes a HIPO (heirarchial input-process-output) diagram which specifies the inputs to the software, the outputs expected from the software and the means by which the outputs are to be generated (for example, equations or logical processes to be performed). Depending upon the nature of the problem the programmer may also need to generate flowcharts to bridge between the requirements and the actual code that is generated.

Updates to both the program and the documentation are kept in a central library accessible to all people working on the program as the code is being generated. The evolving program is thus reviewed and cummunicated to other team members. Any proposed changes must be made through a formal change procedure.

When the coding is finished, the tests that were previously specified and approved are run. The results of those tests (expected values plotted against actual values produced) are recorded. Once the tests are successfully completed, the program is ready for integration into the overall software system. The overall software system may not be complete at this point and software stubs may be required to act as dummies for modules or subsystems that are not yet integrated. As the software modules and subsystems become available the actual software replaces the stubs. As the process of replacing stubs with subsystems proceeds the system is filled out. Final documentation is written upon successful testing of the software module. When the final documentation is approved the software module is officially accepted into the system.

If at any point during the integration process a software module appears to be causing problems, the original tests can be re-run and the results compared to the original results. In this fashion integration problems are isolated and solved.

6.7 Processor Hardware

There are two types of processor hardware systems in the Evaluator. One type can be likened to a usual kind of general purpose computer complex. It has conventional peripheral devices with which it communicates in usual ways. Typical of this processor hardware type is the processing hardware of the Data Controller and the Experiment Development Subsystem. The other type of processor hardware used in the Evaluator is still of the general purpose processor family, but it communicates in a non-usual fashion.

6.7 Processor Hardware (Continued)

The reason for the unusual arrangement of the inter-processor communications linkages is the multi-task computation chores to which individual processing elements are dedicated. By distributing the processing task in this manner, it is possible to handle the expected computing load in real time while other larger and more expensive processor systems have failed to meet that objective. The uniqueness of the communication linkages lies in the way they are applied and not in their technology. Thus there is no development risk in this design approach because all of the required hardware exists in production form.

DSI has successfully applied this intercomputer communications technology to other multi-processor arrays and the engineers and technicians who produced these designs will adopt that proven architecture to the Evaluator program.

6.8 Interface Management

During the Evaluator program there will be correspondence and data exchanges between DSI and several other organizations. The most obvious are with TRA and the FRA. There are also other interfaces with suppliers, subcontractors, consultants and other divisions and departments within DSI. It is patently clear that such correspondences and data exchanges must be efficient and especially accurate. These requirements make it necessary that a great deal of care be used in the formalization and presentation of the information that is exchanged across these interfaces. However, a similar requirement exists for wholly internal correspondences and data exchanges so the two functions have been consolidated into a single Interface Management function.

Besides the control of correspondence and data exchanges the Interface Management function is also charged with the tracking of time phased requirements and compliance with all contractual requirements concerning data transmittals and reports. By the exercise of single point interface control it is assured that both the quality of the interchange and its responsiveness to the needs of others are properly managed.

6.9 Systems Integration

6.9.1 Integration Philosophy - Planning for system integration begins at the earliest design stages when the engineer sets out the initial performance statements for his system and begins the process of subdividing into subsystems, units, assemblies, etc. At the same time, the system integration plan is established to direct the downstream assembly and checkout of the various components in a logical order. The thoroughness and competency with which this pre-design phase is addressed does much to establish the groundwork for a smooth integration of the final system design. Fortunately, several aspects of the LATHE Evaluator will serve to insure a smooth final integration process.

First, the total LATHE system divides functionally into a number of well defined and familiar subsystems. The functional requirements for each of these can be clearly stated in terms of subsystem test procedures to be applied to the stand alone unit.

Second, the LATHE system is being designed as a general purpose evaluator. Except for special instances, all signal flow throughout the subsystem elements is via a digital data bus. The bus signals may be easily modified to meet future demands placed on the evaluator system. The implication of this during integration can be understood by comparing standard hardwire interconnection to a general purpose patchboard type of connection. The ease with which the patchboard can be modified serves to greatly simplify the correction of any discrepancies which may arise during system integration. The digital data bus in the LATHE system can be viewed as a large patchboard interconnecting the system.

Third, the use of the digital data bus supports a distributed checkout intelligence. That is, microprocessors will be utilized to check each digital data bus port as a stand alone element. Consider a meter panel which will ultimately be driven by the Logic Controller via the digital data bus. The meter panel will be tested as a stand alone element by providing all of the data bus signals as they will appear in the final system.

Finally, the bulk of the LATHE system intelligence will reside in 2 subsystems, the Logic Controller and the Data Controller computer systems. From the viewpoint of final system integration, the remaining non-computer subsystems present a functionally straightforward and minimum complexity interface. For example, the motion base subsystem receives a small number of command input signals and functions to provide the desired cab motion. Of itself, the motion base does not simulate train motion, it only serves to move it's load (the cab) in a certain manner. As another example, the cab, as a stand alone unit, does not simulate a train. It only resembles a train locomotive cab and contains certain instruments and controls which are replications of those found in a train cab. All of the remaining non-computer subsystems can be viewed in this manner, and will be tested as stand alone units using the digital data bus logic discussed previously.

Based upon the foregoing discussion, the final system integration is really a two step process. First, the various subsystems are interconnected to prove the electrical/mechanical interface compatibility. Due to the well defined and straightforward interface requirements, as well as the prior stand alone testing which will have been completed at this point, the final interconnection should present a minimum of difficulty.

The second phase of final integration is the key test when the entire LATHE system is operated as a train. This is the real test of the Logic Controller software, as it must now generate signals to and coordinate all of the required subsystem functions in concert. It may not function properly the first time, but based upon the care and thoroughness with which the individual subsystems have been tested and integrated, the fault must lie in the orchestration implemented in the Logic Controller software. The offending software module will be corrected and the final system integration tests will continue.

Hence, it is clear that the LATHE system final integration process is much more than a hardware integration. In fact, due to factors previously discussed, it is anticipated that the hardware integration will proceed with a minimum of disruptions. The key integration phase will begin when the LATHE system is viewed as a train simulator, and finally as a train evaluator. But, by this time the system will consist of proven subsystems with well defined functions. Hence, the focus of any changes required in these final phases will be the system software.

These concepts are presented in greater detail in the following paragraphs.

6.9.2 Integration Planning - It is easier to visualize how this procedure works by showing how it applies to a typical system design. The system chosen for this example contains elements that are produced by DSI. The process involves three major integration points: design integration; unit hardware and software integration; and final integration into the total Evaluator system. It is the express objective of the planning of the first two integration phases to minimize the effort required for the third phase. It would be desirable for the final integration phase to consist of no more than the electrical check-out of cables and connections. However, it is recognized that this cannot be achieved in total because it is only during final integration that it is first seen how some separate systems "play together". For example, one could have a perfectly valid motion simulation that was demonstrated with no visual display present, and, a perfectly valid visual display that was demonstrated without motion, which when combined could produce subjective cues that can be in conflict or appear excessive or inappropriate when encountered in the total Evaluator context. Recognizing that such final integration problems can arise emphasizes the importance of knowing that subsystem hardware and software have been previously proved at the subsystem level. With this knowledge the final integration procedure is one of adjusting the response of already proven subsystems and checking cables and connections as previously mentioned. If the final integration phase were entered without the assurance that subsystem hardware and software had been thoughly proven it would be extremely difficult to isolate and solve the problems encountered.

6.9.3 Design Integration - From a hardware point-of-view the design and integration of the Experimenter/Operator console is simple and straightforward. The electrical design of the console consists of wiring the components directly to power distribution buses and their control lines directly to a logic bus controller module. Because the system functions of the console are handled by software there is no need for special wiring hook-ups in the console. When it has been decided at PDR what specific hardware, in the way of switches and display devices, will be provided, and, the particular arrangement of the panels on the console is established, there is no constraint on the manufacture of the console.

At the design level the Experimenter/Operator Console integration starts with the definition of each function to be controlled or displayed at the console. These controls and displays appear as input or output requirements of the subsystems which interface with the console. These requirements are documented in the Systems Manuals of the various subsystems. The software and hardware design of the various subsystems that interface with the console contain the intellegence which operates the console functions. Thus the fabrication of the console and its functional design progress on different paths.

6.9.4 Subassembly Integration - When the console is fabricated and wired it can be "rung out" without any Evaluator functional software or hardware being present. This is accomplished with the aid of a piece of test equipment that operates the console bus controller. Every wire, control or display in the console can be tested by this means. On the other hand the pieces of software intellegence which operate the console functions can be tested individually with software "stubs" to replace the controls and displays on the console. As the individual software systems modules are debugged they are integrated into the total Logic Controller software package. When this happens the "stubs" which previously simulated the presence of other hardware or software functions are replaced with real functional programs and the integration continues. When the Logic Controller Coordinator hardware is available the integrated software is run on the Logic Controller hardware. This is another step in the unit hardware and software integration process.

6.9.5 Subsystem Level Integration - The logic network in the TRA/DSI program plan shows that when the Logic Controller hardware and the Experimenter/Operator console are finished the console will be delivered to DSI for unit integration. This integration step requires neither the presence of all interface software from the systems which function with the console nor all hardware systems which function with the console. For the hardware and software systems that are complete, the integration tests demonstrate that the console functions like the "stub" it replaces. For the ones that are not complete there "stubs" respond to or initiate console functions. It is a definition that when all "stubs" have been replaced unit integration is complete. Thus the console will have been in operation with the other Evaluator systems well before the start of final integration at TRA. All of the Acceptance Test Procedures for individual subsystem will have been run and the test results logged. When the console and Logic Controller are delivered to TRA for final integration along with the other DSI produced hardware and software all will have been integrated at the functional system level which means that the integration has extended across CES element lines to include a total system performance demonstration. The hardware that was manufactured at TRA and remained at TRA will have been checked with bus drive units and fully functionally tested before final integration.

6.9.6 Multiple Subsystem Level Integration - The integration of the Experimenter/Operator subsystem is a good example of this process at work. The Experimenter/Operator console is a separate stand alone unit. Its connection to the rest of the Evaluator is primarily via a digital bus to the Logic Controller. However, its interface with the rest of the Evaluator is much broader. It interfaces with the Cab to monitor the train control status; it interfaces with the train model to monitor in-train forces or set-up car and locomotive parameters; it interfaces with the Data Controller to display experiment parameters; it interfaces with the motion system to control start-up and shut down functions and provide status checks; it interfaces with the sound system to insert operator controlled sound cues; and so forth. Thus the interfaces, and therefore the integration, of the Experimenter/Operator Subsystem extends well beyond the boundaries of the console and its simple connection to the Logic Controller.

6.9.7 System Integration - Final integration of the LATHE Evaluator System will be performed at the Teledyne Ryan Aeronautical Company facility in San Diego, California. The system integration site will duplicate, to the degree required, the final system complex as it will be installed at the customer's facility. The site will be prepared beforehand to accept the motion base, visual system, computer installation, and experimenter/operator console. The site preparation will include electrical power as well as other special facilities requirements.

System integration will be accomplished as an ongoing series of installations and tests of the mechanical, electrical and electronic interfaces as the major subsystems are received and assembled into the Evaluator system. The Fabrication and Test Principal Engineer will be responsible for all of the integration tests and will receive close coordination and support from the other LATHE program Principal Engineers.

During integration, the equipment will be operated in accordance with appropriate procedures in an effort to search out deficiencies in either the equipment design and construction or in the specified operating procedures. All problems which are encountered will be logged, discussed, and resolved during the system integration task. The solutions which are implemented will receive special attention to insure that they are fully incorporated into the final documentation and operation package. Control procedures will be instituted to insure that any system which requires redesign or modification will receive full testing and documentation verification prior to completion of the integration task.

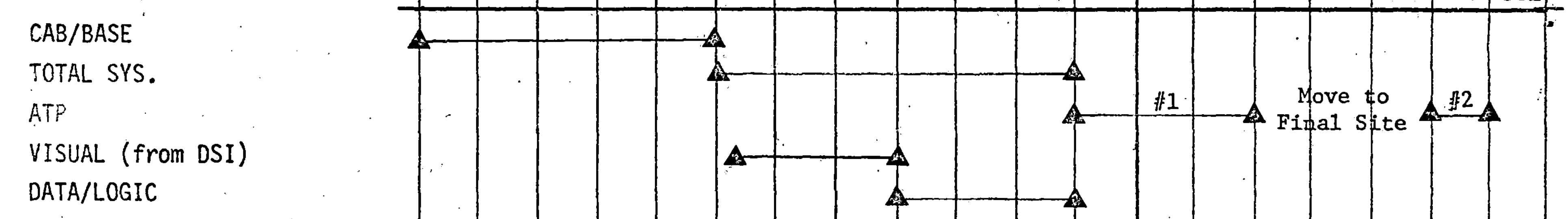
By this plan it is intended that final integration tests will consist of checking the interconnecting wiring and adjusting subjective system interactions which could not be established by objective testing at the subsystem level. These interactions are few in number but important. To be able to properly accommodate those adjustments there must have been a properly working system which is working as it is designed. This integration procedure which extends from design integration through unit integration to final integration is structured to accomplish that goal and support a success oriented Evaluator program.

6.9.8 Staffing for Integration Phase

The enclosed Figure 6.9.8.1 entitled "Integration Phase Skill Application Plan" depicts an approximate skill application to the program during the complete integration and testing phase.

As described above, the various design specialists will assist in the integration and testing phases, as well as coordinate the development of the supporting literature.

Cost limits prohibit the maintenance of all skills through the program, however, those principals will remain on call, and will be available as required.



	1981 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1982 JAN	FEB	MAR	APR	MAY	JUN	JUL
TRA:																			
ENGR MGMT	3	3	3	3	3	1	1	1	1	1	1	1	1	1	0	0	0	0	
MECH. DSGN	4	3	2	2	2	2	2	1	1	1	1	1	1	1	0	0	0	0	
ELEC. DSGN	3	2	1.5	1.5	1.5	1.5	1.5	1	1	1	1	1	1	1	0	0	0	0	
ETRN DSN	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
SYS. ANALYST	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.	.5	.5
TECHNICIAN	2	3	3	3	3	2	1	2	2	2	2	2	2	2	1	1	1	.5	.5
TEST ENGR	2	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
MISC. SUPPORT	1	2	1.5	1.5	1.5	1.5	.5	1	1	1	1	1	1	1	0	0	0	0	
DSI:																			
PROM	1	1	1	1	1	.5	.4	.5	.5	.5	1	2	1.3	1.3	.5	.5	.3	.3	
SENS	.2	.2	.2	.2	.2	.3	.3	-	-	-	-	-	-	-	-	-	-	-	
ENSP	1.2	1.2	1.2	1.0	1.0	.5	.3	.2	1.2	1.2	2	-	-	-	1.5	1.5	1.2	1.0	
SMTS	2	2.3	3.4	3	3	2	1.1	2	-	-	-	-	2.5	2.5	-	-	-	-	
MTCS	7	7	5.5	4.5	4.5	2	1.6	.8	2.3	2.3	4	6	-	-	3	3	2.5	1.7	
AMTS	.4	.4	1.0	.4	.4	.4	.3	.4	-	-	-	-	1.2	1.2	-	-	-	-	
TECH	1.8	2	2	1.3	1.3	1	.7	.1	-	-	-	-	-	-	-	-	-	-	
MFGA	1.6	1.9	.2	.2	.2	.1	.1	-	-	-	-	-	-	-	-	-	-	-	
DSNR	.4	.4	.5	.4	.4	.2	.2	-	-	-	-	-	-	-	-	-	-	-	
TRA TOTAL	17	18	16	16	15	12	10	10	10	9	9	9	9	9	4	4	4	2	2
DSI TOTAL	15.6	16.4	15	12	12	7	5	4	4	4	7	8	5	5	5	5	4	3	

Fig. 6.9.8.1 - Integration Phase Skill Application Plan

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APPENDIX A

1.0 PURPOSE AND USE OF THE EVALUATOR

In order to provide a comprehensive treatment of the Evaluator in this Project Plan, the following background and detail material is presented.

1.1 BACKGROUND

The Evaluator will be a research tool for providing data on the performance of engine crews during simulated train operation. As a research tool, the Evaluator will have extensive capabilities for collecting data on physiological response of engine crew members and their performance in controlling the train. The Evaluator will be flexible so that the effects of different operator procedures, operator aids, locomotive cab environments, and work rest cycles on engine crew performance can be determined. A major design objective is to make the engine crews' environment, as created by the Evaluator, realistic so that the experimental results will be valid when used in the field.

The Evaluator will differ from existing locomotive training simulators in several ways:

- State-of-the-Art computer models of train operation and train performance will be used,
- Visual, sound, and odor producing systems will be more realistic,
- The system will be more flexible in providing for tests of operating procedures, equipment, cabs, and other devices not currently in use in the railroad industry,
- The system will have extensive data collection capabilities.

1.2 USES OF THE EVALUATOR

The Government's intended uses of data derived from experiments using the Evaluator include:

Safety

- Improved Train Control
- Improved Operating Techniques
- Reduction of Derailments
- Improved Accident Investigation

Systems Development

- Improved Cab Concepts
- Improved Train Controls
- Develop Better Operation Aids

Economy

- Increased Fuel Conservation
- Reduction of Breakaparts
- Reduction of Lading Damage
- Increased Operator Proficiency

1.2.1 Develop Improved Operator Aids and Train Handling Procedures to Reduce In-Train Forces. Key in-train dynamics include the magnitude of draft buff forces and the ratio of lateral over vertical forces. Such forces, when excessive, can lead to derailments, breakaparts, lading damage and damage to equipment. The control of these forces is often difficult when some of the following conditions are present: long trains, loads at the trailing end/empties up front, RCE (Remotely Controlled Engine) locomotive in the middle, helper locomotive on the trailing end, severe curves, undulating territory, and engineer fatigue.

To minimize these forces while operating the train under such conditions, the engineer has a variety of controls over train brakes and power. Engineers apply the controls based on such factors as visual observation of the track (curves, grade), prior knowledge of the train, "feel" of the locomotive and readings of train instruments.

The Evaluator will be used to test different operator aids and procedures in simulated train operation. To get valid data the Evaluator will have controls and instruments that correctly respond to engineers actions, a locomotive cab that gives the engineer a realistic sensation of grades, curves, acceleration and other train forces, and a visual presentation of track conditions.

There is often a gap between operating aids developed as a result of an R&D program and devices actually used by the railroad industry. The Evaluator can be used to close this gap by providing an environment to optimize the design of a device and providing data on the conditions under which the device will be useful enough to justify its cost.

An example of Evaluator use in developing and evaluating the performance of a draft-buff indicator is presented below.

A draft-buff indicator is a device that can provide an engineer with quantitative indications of draft and/or buff forces at various places in a train. However, questions remain on the implementation of such a device, such as:

What is the best way to present information to the train engineer to optimize train handling? Draft and buff forces could be input to a computer model of the train, the model could compare alternative actions and give the engineer instructions on what to do; or draft and buff forces could be displayed to the engineer. Both approaches can be tried with the Evaluator for a variety of train engineers and operational situations. Data collected can then be analyzed to determine which approach is more effective.

Given the most effective approach, the device can then be evaluated to determine when it pays for itself. The Evaluator will be used to create a realistic environment for many engineers to handle trains under observable and controlled conditions. Performance with and without the draft-buff indicator can be determined for different operating conditions. The results should indicate under what conditions purchasing the device is justified.

1.2.2 Improve the Work Environment of the Engine Crew and Reduce Adverse Impacts on the Engine Crew's Control of the Train.

The engine crew's work environment includes many factors such as noise, temperature, humidity and vibration. In some cases variations in these factors will affect the ability of the crew to properly control the train. (NOTE: "proper" control includes: minimizing disruptive forces, correctly observing and reacting to signals, sounding the whistle at grade crossings, etc.). The Evaluator may be used to conduct experiments on the effect of variations in environment on performance.

Visual observations of objects such as wayside signals directly affect actions of the engine crew. Visual observations and cab motions are expected to have a major effect on the alertness of the engine crew. Consequently, there is a major emphasis on realistic visual and motion simulation for these types of experiments.

1.2.3 Determine the Impact of Variations in Work-Rest Cycles on the Performance of Engine Crews

Work-rest cycles refer to time patterns for activities such as work, rest, sleep, and eating. There are many questions as to how variations in these patterns affect the performance of engine crews. An example of a question on work-rest cycles would be: How do late night work shifts affect performance?

1.2.4 Resolve Dilemmas in Accident Investigation by Reconstructing Circumstances in which Human Error May be a Major Accident Cause.

An Evaluator can be used to recreate pre-accident conditions in a safe and realistic manner. The observation capabilities of the Evaluator can be used to obtain accurate and detailed descriptions of one or more engine crew's reactions to such conditions.

1.2.5 Other Potential Uses of Evaluator

Develop and evaluate alternative devices and progress for training engine crews.

Evaluate methods of improving communications systems such as displays of signal aspects.

APPENDIX B

1.0 SYSTEM ELEMENT DESCRIPTIONS

This portion of the Project Plan defines the various subsystems which, together constitute the Evaluator system.

The Evaluator system, of course, will entail more than the collection of the individual subsystems. At every step in the design evolution, and in the system integration phase, special consideration will be given to the interfaces of the element to the whole, and to the final objective of the Evaluator.

The subsystems are described in the order of the original Cost Estimating System (CES) element list.

1.1 CAB SUBSYSTEM

The Cab Subsystem is the primary interface between the engineer and the Evaluator and thus has major impact upon experiment validity. It consists of the two specified cab replicas, standard SD40-2 and Boeing clean cab. It includes systems to reproduce the sounds heard by the engineman and odors present in an actual cab.

The specified cabs exhibit major differences in external configuration and driver fields of view and substantial variations in interior layout and equipment installations. It is evident that considerable ingenuity must be exercised in the replication of widely divergent prototypes so that Evaluator cabs are interchangeable with a minimum reconfiguration of other Evaluator subsystems elements with which they must interface. The cab subsystem will provide a convincing representation of the locomotive engineer's working environment. The exterior/interior appearance and "feel" of Evaluator cabs must convey authentic impressioons to an individual who has spent a considerable portion of his life in such surroundings. The requirement for realism must however be reconciled with separate and sometimes conflicting engineering considerations arising from the cabs function as an integral element of the total Evaluator system.

Some obvious conflicts are apparent. The cab must feature the normal locomotive complement of controls, instruments, and furnishings. These must be housed in conjunction with specialized design features and equipment installations required for the performance of Evaluator system research missions. Audio system components, and environmental control provisions will be sized and located to faithfully reproduce a wide range of operational territory conditions. TV cameras, special cab lighting equipment and biophysiological equipment will be integrated in the most unobtrusive manner consistent with satisfactory performance of their research data-gathering functions. Different experiments may call for alternate arrangements of monitoring devices. Design solutions must therefore permit the flexible reconfiguration of cab layout and equipment installation.

The cab structural assembly will provide for sling attachment points, lift truck fork entries, and tie down rings appropriate to long distance transport operations. The same provisions will be utilized for handling/transfer movements in and around the Evaluator building. One maintenance/transfer dolly is provided for each cab. The cabs are stored on the dollies when not installed on the motion base, using the same securement provisions provided for motion base installation. The low profile of the dolly supports the cab at a safe, convenient working height for internal and external maintenance. Cab transportation hoist/tie-down rings are used in transferring the cab from the dolly to the motion base. The cab structure design considers ease of motion base installation. Simulated sub base doors, locomotive underframe components, access ladders, etc., which would interfere with a straight-forward cab up/down load operation, are quickly removable or eliminated from the design where considerations of external realism permit.

The cabs are essentially man-carrying vehicles, and as such will be designed with due regard for occupant safety. The specified motion base induced accelerations are sufficient to unseat an unsuspecting engineer when suddenly applied. Equipment items should be located in positions minimizing possibility of injury to a falling occupant. Glazing materials should resist accidential impacts and be of non-hazardous shattering type. The cab load carrying structure and equipment mountings will be soundly engineered to withstand rationally analyzed acceleration-induced loadings with due regard to long term fatigue effects. Cab structural materials must not only possess appropriate strength/weight characteristics, but they must be fire-retardant, resistant to extremes of temperature and humidity, and have desirable thermal/acoustic insulation properties. The Evaluator cabs are equipped with the fire extinguishers found in real locomotives. Cab internal wiring and electrical component installations will be made in accordance with appropriate safety codes and specifications. Provisions will be made for rapid emergency exit.

1.1.1 CAB Environment Control System.

The Cabs will be controlled environmentally from an externally located Air Conditioning/Heating subsystem which will be capable of providing any Cab temperature between $0^{\circ}C$ and $50^{\circ}C$. Steam Injection and dessicant drying will provide qualitative humidity control.

1.2 MOTION SUBSYSTEM

An existing, off-the-shelf, highly reliable motion subsystem with proven safety features faithfully reproduces locomotive accelerations.

The motion subsystem consists of:

- A six degree of freedom motion base unit,
- A hydraulic power supply unit, and
- A floor standing motion control cabinet with built-in test panel.

The subsystem meets the FRA requirements for five degrees of freedom without change. A similar system is currently in use with NASA (Ames) flight simulator operations. This particular concept, providing an infinitely variable kinematic capability, became the obvious choice when compared with the current translatory slide/pivot system.

The motion base responds to 5 degree of freedom commands from the motion base controller. The program it executes computes servo actuator commands that cause the motion unit to move in response to locomotive motions calculated in the logic controller. There are two computation sets that are executed to drive the motion base.

One set converts motion commands in train axes to six actuator length commands in the motion base system axes. The other performs cue conditioning calculations which are the key to successful motion simulation. Cues are calculated in locomotive axes because they are intended to be correct for the engineer in the Cab.

In the longitudinal axis there can be short term acceleration cues due to slack run-in which are not immediately followed by a reverse cue as is always the case in, for example, the roll axis. The effect of those accelerations is to jolt the locomotive and produce a short term residual change in speed that can be as high as 1 mile per hourt. The change in residual train speed is reflected by accumulators are sized to satisfy peak power demands and are pre-charged such that pressure will not drop below 70 percent of the nominal operating pressure.

1.2.2 Motion Subsystem Interfaces

The principal interfaces are as follows:

a. Utility Power Supply: The hydraulic pump/motors require 220 volt 3 phase 60 Hz current. Estimated surge power is 60 KVA with steady state demand at 40 KVA approximately.

b. Motion Base to Cab: The motion base cradle frame incorporates three cab support adaptors. These adaptors are compatible with both the SD40-2 and the "clean cab" floor frame configurations. The adaptors are removable to provide flexibility for future interface changes.

c. Motion Base Control Cabinet (MBCC) to the Motion Subsystem Controller (MSC), part of the logic control subsystem: The MBCC interfaces with the MSC by receiving DC voltage positional commands. The MBCC transmits servo actuator position and velocity feedback signals to the MSC for controller monitoring purposes. On/Off switching commands from the controller are fed through the MBCC for normal operation and for emergency shutdown.

d. Motion Base to the Hydraulic Power Unit: The motion base is connected to the remotely located pump unit by flexible hydraulic hoses for the system delivery and return flows.

e. Hydraulic Power Unit to Motion Subsystem Controller: This interface provides for feedback of hydraulic parametric information such as pump delivery pressure, reservoir fluid level and temperature, and filter pressure drop status.

1.2.3 <u>Hydraulic Power Unit</u>.

The hydraulic power unit consists of two motors and pumps, reservoir, high pressure relief valve, low pressure warning switch, oil cooler and an oil heating recirculation valve. This portion of the hydraulic system is remotely located to eliminate noise and appearances extraneous to the locomotive environment.

The two 3 phase, 60 Hz, 220 volt AC electrically driven motor pumps are each rated at 20 HP/20 GPM and are variable flow pressure compensated. They normally operate in parallel at 1500 psi although designed for 3000 psi, enhancing their cycle life and reliability. In the event of a single pump failure the remaining pump continues to power the actuation system at lower levels without interruption. A pump accumulator dampens pressure ripple and surge.

An unpressurized reservoir with a capacity of 100 gallons of oil supplies the pumping system with hydraulic fluid. The reservoir is equipped with a filtered air vent, screened filler cap, oil level indicator and magnetic trap. Switches are provided to monitor oil level and temperature. Oil capacity is sufficient for fluid thermal expansion, compressibility, differential volumes and a generous leakage allowable.

All delivery and return fluid is filtered by full flow 10 micron nominally rated filters. Both filters are equipped with differential pressure switches. In the case of the return flow filter the switch is set to signal before the filter bypass valve is opened. The high pressure filter is a non-bypass type. All system filters have replaceable (throwaway) elements to ensure against inadvertent system contamination.

In response to the specification requirement 3.4.7.5 for oil to water cooling and since sufficient cooling water is not available on a year round basis, it is necessary that a closed loop cooling system be provided. This system is designed to limit the hydraulic fluid temperature to $+120^{\circ}F$.

1.2.4 Safety

A safe motion subsystem and its effect on the operating environment is an important factor in the design. The subsystem provides safety interlocks. The interlocks ensure that it shall not be possible to engage the motion subsystem unless all safety interlocks are in the safe position. If an interlock circuit is broken when the subsystem is engaged, the subsystem immediately disengages and goes smoothly to a level egress position.

The motion base mechanism geometry is "fail safe" designed to preclude an unsafe condition such as overcenter locking under any combination of actuator travels.

1.3 Visual Subsystem

The Evaluator Visual System consists of two major operational elements and two support elements. The support elements are independent systems known as the Experiment Development System and the Experiment Territory Development System. The operational elements are the forward and side view visual systems. The side view visual systems provide the illusion of motion past the right and left side windows of the cab and an image of the track ballast below the engineer's window. These displays are driven by the Logic Controller and change the visual representation of motion streamers as a function of train speed.

The forward visual display system provides a high fidelety color motion picture representation of the track in front of the locomotive. This display is also driven by the Logic Controller, but in a more complex manner than the side view display. Two variable speed flickerless motion picture projectors carry and project the forward visual film. The precise motion of the film is carefully controlled so that there is positive reinforcement of the visual, motion, sound and train action cues generated in the total simulation. The two projectors are also interlocked to permit interaction between main line and alternate event displays.

The optical elements of the forward display system project the film image on a spherical segment screen centered at the engineer's eyepoint. The resultant 100 degree field of view encompasses the real world scene the engineer would see through the front windows of the locomotive.

1.4 Experimenter/Operator Console

The requirements for the LATHE Experimentor/Operator system are based upon it's use as the center for manual and override control and monitoring of experiments to be performed by the Evaluator system.

Since the Evaluator concept is based upon the system's capability to present typical locomotive and train handling problems to the engineer under test and to then observe, record and evaluate the engineer's reactions, the Experimenter/Operator Console becomes a very important segment of the overall system.

The philosophy used to make the evaluator a truly research tool is to subject a representative number of engineers to identical operational situations and observe and record (pertinent segments of) their reactions. Post operation analysis of these reactions would then be conducted and the statistical results used toward enhancement of future rail operations and designs. It follows that the logic controlled by the Exp/Operator console and the data monitored by the console must be of good accuracy and high quality and that the criteria be specifically oriented toward presenting meaningful situations and observing and recording pertinent data.

Preliminary studies of the Evaluator system concept relative to situation presentation and data monitoring indicate the following general requirements to be of primary importance to the design of the Experimenter/Operator console.

1. Experiment presentations - the Exp/Oper console will interface with the logic controller to provide experiment criteria for the cab and motion base. To serve this interface function, means of setting up and changing the simulated train make-up and motion parameters is required. Additional requirements of the EXP/OPR console include the capability to provide control of the cab environment.

2. Monitoring - means of observing the subject engineer under test by visual means is a requirement of the EXP/OPR console. In order to properly monitor the operation and the subject's reactions, displays relative to the engineers physiological reactions, the cab instruments and the motion base performance will be provided. Other monitoring requirements are associated with system malfunction displays and alarms.

3. Recording - because it will be necessary to have a record for post operation analysis of pertinent segments of the experiments, a means of providing permanent records of these selected segments will be provided. Control of the recording devices will also be a requirement of the EXP/OPR Console.

4. Operational - operation of the Evaluator system will be from the EXP/OPR Console and will therefore, dictate that control and monitoring means be provided for visual observation equip, system malfunctions, emergency shutdown and electrical power equipment. Pre-operational set-up and calibration will be required for the system as a part of EXP/OPR Console. Provisions will be made for communications throughout the evaluation system. The control and monitoring of communications will be done at the EXP/OPR Console.

5. Physical Implementation - The functional requirements of the Experimenter/Operator Subsystem will be physically implemented in a two-man console. Placement of the necessary controls and displays and the positions of the operators will be subjected to extensive human factors studies to insure best man/machine interface.

6. Servicing and Maintenance - Requirements of the EXP/OPR system not directly associated with the conduct of experiments are necessary to insure a minimum of turn-around time between operations. These are associated with component reliability, console serviceability and maintainability. Diagnostic equipment will be required to insure proper service and maintenance.

1.4.1 Experiment Presentations

The control console is interfaced to both the logic controller and the data controller. The logic controller's primary task is to provide train operations and dynamics solutions to generate visual, sound and cab motion subsystem commands. Indications that these functions are operational are present on appropriate control console command and monitor panels.

The operator has individual control of the logic controller subsystem and its data files via an ASCII keyboard and interactive CRT. The experimenter has control of the data controller subsystem and its data files by his ASCII keyboard and interactive CRT. Dedicated control panels are also used for selected functions. All train action alternate events are selected by the operator's keyboard.

Locomotive cab temperature, selected sound and odor and gas fumes environment are controlled by the operator's keyboard.

In addition, a cab environment monitor/control panel, provides manual override for some functions. Either keyboards can be used to call up lists of all prestored display formats.

All locomotive power unit malfunction problems are selected by the operator's keyboard or single key executions. Activated by one of 16 dedicated keys. Malfunctions can also be preprogrammed for automatic entry by the data controller.

Cab Environment Controls

Cab environmental system remote control and status reporting is provided. The environmental control system is controlled by the logic controller via the digital data bus to automatically operate the cab environmental system.

Locomotive Cab Hydraulic Motion Base Controls and Instruments

A console mounted dedicated hydraulic status and control panel displays and provides override control of selected critical hydraulic motion subsystem parameters. The mechanization of this data interface is different than any other data bus mechanization used in the Evaluator. The logic controller is the primary interface to the hydraulic subsystem. A digital processor is used for all motion subsystem interface control.

Instrumentation transducers are installed in the hydraulic system to satisfy the display requirements. These transducers are conventional high quality industrial units.

1.4.2 Monitoring

In order to visually observe the cab occupants and cab environment, television cameras in the cab and TV monitors in the EXP/OPR console are provided. The projected display to which the engineer is subjected will be viewed by an additional camera mounted on or above the cab and will be displayed on a monitor in the console. These monitors will consist of, two 17 inch black and white, and one 19 inch color monitors. The color monitor is usaully assigned to the forward looing color TV camera, but any monitor can be switched to any video source.

The black and white monitors provide 880 line center resolution, and, the color monitor will provide 700 line center resolution, which provide excellent graphics and television image definition. All have internal voltage regulation to provide unvarying picture size and brightness over wide power line variations.

Inasmuch as the signal format is compatible, the color monitor can display black and white information. Video from any color or monochrome camera is routed directly to individual remote camera control units located in the experimenter/operator control. All camera video is then routed to the video data selector switch for subsequent display on any selected CRT.

System Malfunction Indicators

The console contains a centrally located, well marked, system malfunction panel. These indicators advise of anamolies in the following subsystems:

- Hydraulic system/motion base
- Movie projector #1
- Movie Projector #2
- TV color camera forward view
- TV camera in Cab #1
- TV camera in Cab #2

These indicators are supported from subsystem logic, determined in the logic controller.

System malfunction indicators together with supporting summary status is displayed on the panel. This indicator panel displays supporting status of the projectors, controllers, hydraulic, facility power, and the three side view projectors. When the two forward scene projectors are in use, this annunciator displays other essential data such as miles to go to the next decision point, individual projector status; on line, running, next up, etc. These data are obtained from the logic controller through the digital data bus. All television camera monitor tally lights are displayed to indicate that camera beam voltage is applied and that the system is functional.

Engineman's performance data is computed in the logic controller. This data is transferred in block format to the data controller for processing and formatting. It is then sent to the graphics controller which generates the video signal and to the video data selector switch for distribution to any CRT display.

The monitor display system can present a variety of formats including real time histogram presentations of electrophysiological and train related events as on a strip chart recorder.

1.4.3 Recording

Strip Chart Recorders and Controls

A high quality direct rectilinear writing, pressure inking, general purpose recorder is provided. This recorder provide simultaneous recording of 12 channels of data. Chart paper speeds of from .05 to 200 m/sec, is pushbutton selectable from the recorder front panel, and the run/standby operation switch is remoted to both a console mounted switch and a data controller interface. The recorder time code marker pen is driven by SMPTE time code/frame code generator providing a system time reference to simplify the data reduction process.

The minimum frequency response of the recorder is in excess of 50 Hz with full scale (±100 mm) pen deflection. The frequency response improves to just under 200 Hz with 10 mm pen deflection.

The strip chart recorder is located in the control console. It is connected to the data controller through the digital data bus interface. All performance data are contained in the data controller magnetic tape or disc pack recorders. These data are recalled, processed and sent to individual strip chart recorder channels via the data bus.

Video Recorders

Two video tape recorders have their record and playback ports connected to the video switch. Either tape recorder may be connected to any program source video input. Oscillographic presentations are generated from data contained in the data controller magnetic tape or disc pack recorders. These data are recalled, processed and sent to the graphics generator. The graphics generator can provide oscillographic variable time base video presentations to any desired scaling. This video output is then routed to the video data selector switch for distribution to any CRT for display.

1.4.4 Operation

The functions necessary to operate the EXP/OPR system which are not directly related to experiment presentation, monitoring and recording are listed below with the planned means of implementing them.

Communications Systems

The communications system provides two way communications to the required areas.

The control console has two microphones which are keyed from a foot switch. To initiate communications, a station selection is made on the communication console panel and the press to talk switch actuated.

Console Lighting Controls

The experimenter/operator console is provided with variable panel and display lighting. Panel lighting is provided by dimmable incandescent lamps mounted in directional reflectors so as to preclude the panel light from impinging on the large CRT monitors. All single action switches have integral display lighting, however, the emergency control function switch lights are not dimmable. The final location of the panel light assemblies will be determined at the console mockup review.

Emergency Controls

Controls are provided to quickly shut down subsystems in an emergency.

The experimenter/operator console contains a centrally located panel which permits status monitoring. The operator uses this panel to initiate emergency shutdown. Two independant circuits are used. One circuit is a hardwired direct command line to the subsystem being addressed while the second addresses the same subsystem by means of a multiplexed digital data bus control line through the bus controller. This duplication permits the data controller to be informed of any emergency action taken and thereby modify any internal software routines associated with any emergency.

Several hardwire links are included in the system design. Each of the four primary subsystems listed in the RFP include both hardwire and data link control (main power, environmental control, motion base, and motion.

Power Control

Power control for the Evaluator consists of all necessary controls, status monitors, failure alarms, and subsystem power sequencers. All major power bus assignments are controlled by the operator. The power bus mechanization will consists of 220 volt, 60 Hz control and switching equipment. Load centers are located near each major equipment. Magnetic breakers are used to permit remote start up from the control console. A STOP circuit loop is used so that any location having a STOP push button station can shut down that subsection.

Failure Alarm

In the event any bus is shut down intentionally, or dropped, in a fault, that bus status is displayed on the operator's console panel, and a sound alert failure alarm is activated. The sound alert is a small 1000 Hz sound source with a 60 db sound pressure level capability that is used in industrial applications to alert operators of unsatisfactory conditions.

Circuit Breaker Panels

The load and distribution panel contains all system circuit breakers which are less than 100 amperes. Larger circuit breakers require more massive switching equipment and are used only as a service entrance to each major subsystem. The load center breaker distribution panel accepts a master override of any circuit in that subgroup.

Power Sequencer

The high current starting surges experienced with large motors, cooling systems, and visual system projector Xenon arc lamps can introduce large voltage transients. Therefore, power sequencing is provided. An automatic power on/off sequencer is employed to inhibit simultaneous peaking of voltages. The power-on sequence will normally be:

1. Any air conditioning loads
2. Hydraulic pump motors, motion base subsystem (less controllers)
3. Projector arc lamps

The experimenter/operator console and logic or data controllers may be brought on-line or turned off at any time without upset to other systems.

Power Monitor

Within the operator's console, all system power voltages are monitored and displayed on the power status panel. Manual emergency controls are provided on the console which override any power control circuit.

Diagnostics Control

Controller initiated diagnostics permits rapid prerun calibration and checkout, yielding high Evaluator system availability. Diagnostic programs entered by trained Evaluator people via a high speed magnetic tape unit for the logic controller and the magnetic tape unit for the data controller.

Controller subsystems diagnostics are performed at the appropriate machine terminal in the computer room to verify all controllers and peripherals.

However, they will not be run daily, but on a planned, regularly scheduled preventive maintenance program.

The remaining controller subsystems diagnostics, such as the motion projector/sound, dynamics array elements, and the console are run from the operating system terminals at the experimenter/operator console. The majority of these subsystem diagnostics run automatically, although, in some instances, operator interaction is required. For example, the graphics display package diagnostic routine is self-contained, but requires the operator to interpret the displayed graphic patterns.

Operator interaction is also required for diagnostics of the console panel or locomotive cab in response to visual cues, like indicator lights, etc.

1.4.5 Physical Implementation of Requirements

The means of physically implementing the Experimenter/Operator system is planned to be via a console containing the necessary controls and displays. This console will be designed to emphasize efficient performance by the operator and experimenter, using human factors considerations for placement of the operators relative to the controls and displays.

The console will be a 4 bay main cabinet with canted "wings" on either side. These "wings will be 2 bay cabinets. All bays will be for standard 19 inch racks and panels.

Table 1.4.5-1 is a listing of the panels and racks which are anticipated for inclusion in the console.

REFERENCE LIST OF EXP/OPER CONSOLE CONTROL & DISPLAY PANELS

	REF DES.
Experimenter CRT Panel	4AIVT5
Experimenter Keyboard	4AIVT1
* Experimenter Inter-Com and Cab Communications Panel	4AIA4
Operator CRT Panel	4AIVT6
Operator Keyboard	4AIAT2
* Operator Inter-Com Panel	4AIA13
* Motion Base Control Panel	4AIA11
* Cab Environment Control Panel (Odor,Audio,Temp, Humidity)	4AIA10
* Power Sequencer Panel	4AIA12
* General Purpose Programmable Meter Display Panel	4AIA1
* Locomotive/Train Controller Replication Panel	4AIA& A-9
* Summary Annunciator Panel	4AIA7
* System Malfunction Panel	4AIA6
* Strip Chart Control Panel	4AIA3
Six Channel Strip Chart Recorder A	4AIA&SR1
Six Channel Strip Chart Recorder B	4AI&R2
Cab Camera Control Panel	4AIA2
Video Control Panel	4AIA5
Video Monitor A	4AIVT1
Video Monitor B	4AIVT2
Video Monitor C	4AIVT3
Video Monitor D	4AIVT4
Video Data Selector Switch Module	4AIA14
Video Sync Generator and Test Signal	4AIA11
SMPTE Time Frame Code Generator	4AIA&A2
Four Channel Video Graphics Controller	4AIVC1
Video Cassette Recorder A	4A2VR1
Video Cassette Recorder B	4A2VR2
Data Bus Installation	4AIA31

* To be designed and fabricated by TRA.

TABLE 1.4.5-1

1.4.6 Performance, Service and Maintenance

Design of the Experimenter/Operator system will be commensurate with reliable performance within the practical limits of good design and economy. This will entail Reliability and Maintainability studies to insure that potential problem areas and their failure modes are analyzed and classified.

Special design emphasis will be applied to those areas (such as electrical power system failure and data bus failure) where single point failure may cause system shutdown.

Other potential failures which would cause degradation of performance will be evaluated and kept to a minimum through application of good design practices.

The system design, component selection and fabrication techniques to be employed must be those which will insure a high MTBF and provide reliable system operation.

The EX/OP Console, all data processing equipment, the experiment development and experiment territory development subsystem equipment will require a controlled facility ambient.of 15°C to 32°C and 20% to 80% Relative Humidity.

1.5 Logic Controller Subsystem

Simulation of the dynamics of the train and all its cars is the primary task of the Logic Controller. Within the Logic Controller processing network there are three functional divisions. The first division looks after the calculation of locomotive and brake systems. The second is concerned with the computation of individual longitudinal car motions and forces and the third calculates the lateral, or rock-n-roll, performance of selected cars. The functional partitioning of the train dynamics problem permits special design considerations to be brought to bear on the processing elements thereby producing an optimal architecture for each segment of the problem. The most approach sensitive solution is the longitudinal car dynamics solution. In the computation, up to six hundred (600) state variable must be integrated simultaneously and in real time. This can be considered a three hundred (300) degree-of-freedom solution, and when it is recognized that the Appolo Mission Simulator solved a twenty-four degree of freedom problem, the power required for the longitudinal train dynamics calculation can be appreciated. The lateral car model has fewer integrations than the longitudinal car model but there are many coordinate transforms to be calculated to properly relate the car body, its two trucks and the suspension system. Since lateral car dynamic are important contributors to L/V and excessive L/V is a primary contributor to derailment, it is important that the lateral dynamics equations will be properly computed.

The Logic Controller Subsystem, as well as the data controller subsystem will require facility ambient conditions of 15°C to 32°C and 20% to 80% Relative Humidity.

1.6 DATA CONTROLLER SUBSYSTEM

The Data Controller Subsystem is the major physical manifestation of the difference between the Evaluator and more ordinary train simulators. The difference, of course, is far more pervasive than that simple distinction, but the Data Controller Subsystem is the heart of the experimental research function of the Evaluator. The Data Controller Subsystem provides the means to monitor, analyze, display and reduce on-line human factors and train performance data. In a sense, the Data Controller Subsystem is a data management plan. However, its direct on-line connection to the experiment hardware, software and subject gives it a very unique character.

The basic Data Controller units are: sensors which measure physical phenomena, software calling routines which retrieve computed variables, data reduction and display algorithms, bulk storage devices and processing elements which coordinate and control the data management processes.

1.7 EXPERIMENT DEVELOPMENT SUBSYSTEM

There are two experiment development functions which are supported by the Experiment Development Subsystem. The first is the development of experiments to be run on the Evaluator. This consists of planning train runs over selected tracks, selecting and programming mission events, preparing display and data reduction routines, and providing for the man control and management functions necessary for the successful completion of a meaningful experiment. The second function of the Experiment Development Subsystem is supporting the development of experiment modules to be installed on the Evaluator. These modules can be hardware, software or both. An example is the creation of a new car performance package to permit the study of the effect on train performance of the introduction of cars with different suspension characteristics. Another quite different example is the cueing and coding of a new experiment territory film record so the sound, motion and visual stimuli are all properly related to the grade and curvature properties of the new territory. There are several other examples of the usefulness of this very powerful subsystem.

The basic hardware on the Experiment Development Subsystem is a central control console, a visual projector and a central controller and its peripheral equipment. From this common hardware core all of the basic functions of the subsystem are generated. This flexibility of purpose is achieved through a sophisticated software package that is highly user oriented.

1.8 EXPERIMENT TERRITORY DEVELOPMENT SUBSYSTEM

The most basic element of the Evaluator, with the possible exception of the locomotive cab, is the representation of the track and terrain. The Experiment Territory Development Subsystem is the unit that captures that representation. It consists of a pair of highly sophisticated computer controlled motion picture cameras with special exposure control devices. It also includes data logging devices to coordinate visual and distance records as well as support and control units to make the total system a reliable and useful tool.

A big part of the effort in territory development is the planning and management of the actual filming task. This effort will coordinate railway traffic, signal status, mission plans with alternate event, right-of-way clearances, casual traffic on and off the railway and be sensitive to variation in weather and even time of day. Another large part of the experiment development effort is directly related cinematic considerations so that there is no need to go back and refilm segments, of the mission. Sometimes it is not possible to go back because the environment has changed, a truck has been moved, brush has been cut along the roadway, a farmhouse has been painted or the season has changed and the leaves are off the trees. For these and other reasons it is important that the Experiment Territory Development Subsystem will be carefully designed for both reliability of operation and suitability of intended purpose.

APPENDIX C

SYSTEM MANUAL OUTLINE

COVER PAGE

TABLE OF CONTENTS

INDEX OF ACTIVE SHEETS

1.0 INTRODUCTION

The name of the system and its broad purpose.

1.1 Scope

What is the explicit purpose of the system ? What are its major elements ?

This section shall define the functional capabilities of the system being described.

1.2 Reference Data List

1.2.1 DSI Drawings - List of company drawings, schematics, manuals, etc., that describe system elements (e.g., a control panel) including revision letter and date.

1.2.2 Subcontract or Purchased Parts Drawings - List of drawings, SCDs, manuals for vendor parts, etc., used in the system. (On the Evaluator Project this list will also include Ryan data.)

1.2.3 Performance Data - List of the data which describes the performance of the system being simulated (e.g., Westinghouse drawings or reports describing the air brake, EMD drawings describing cab instruments, Southern Pacific maps describing the roadway).

The data listed in this section is the only data that will be used for design. It is important that any missing information be asked for so that the simulation will be accurate. It is very important that the revision and date of any data in this list be identified.

2.0 PERFORMANCE DESCRIPTION

2.1 Specification References

This is a list of the paragraph numbers and their titles which apply to this system.

2.2 System Performance

The object of this section is to rigorously define the functional requirements, constraints, and performance expected from the system. The functional requirements are defined so that the result may serve as a design base for development of the system being described. This is a narrative description of how the system responds to all inputs and how its outputs are supplied to to other systems, how they are displayed or how they show their effect on the operator's perception of his environment. This section is as long as necessary to specifically describe how the system being simulated operates in regular use and under abnormal conditions which are within the scope of the simulation (e.g., operator-induced malfunctions such as power failure).

2.3 Analysis

This section contains the statement and derivation of all equations and/or transfer functions which describe the operation of the system. The derivations can be algebraic or geometric or a mixture, but they must be complete. If an explicit function is given as a graph and it is chosen to reduce that function to an algebraic equation or table, both the orginal graph and its derived representation will be included in this section. When simplifying assumptions are made they will be noted in the derivations. All symbols used in the resulting equations or in stating original parameters will be defined. The symbols used in this section shall be algebraic and need not resemble the computer mnemonic that will later be assigned.

This section should also specify iteration rates to be used and address computer memory requirements for worst case execution of the problem. Whenever possible, throughput requirements should also be analyzed.

2:4 System Block Diagram

This block diagram will show the distribution of the simulated system throughout the units of the simulator. For example, inputs may come from the cab and the logic controller disc file, be processed by the logic controller, handed off to the data controller, and some outputs recorded while others are used to drive the visual system. It is important to identify the name of every parameter that crosses any unit interface. The units should be named and tagged with their zone number from the zone map. It is also important to note the solution rate required for any equation being solved by any digital processor in the total simulator. Also any communication link between computers should be specified as to type of link and data rate requirements across that link. All computer peripherals should be specified in this section. It is not necessary to identify pin numbers or cable groupings on this block diagram.

3.0 PHYSICAL DESCRIPTION

3.1 Controls and Displays

This section contains sketches of all panels, instruments, or other hardware devices which contain elements (switches, lights or motors) that provide inputs or respond to outputs of the system. On any unit shown, all elements must be named and their function described (e.g., power switch) and identified pictorially. It is not necessary for these sketches to be mechanical drawings but if drawings or photographs exist they can be used when properly annotated. Both the name and zone map designation of all units will be clearly marked on the sketch.

3.2 System Schematic

This schematic will include every line connecting units of the system except for general power and ground wiring. However, power and grounding requirements for each system will be noted on the schematic. ~~Every line on~~ the schematic will give the zone designation of every connection in the line down to and including the pin number of the connector. The signal carried by each line will also be clearly identiifed.

4.0 SOFTWARE DESCRIPTION

4.1 Symbol Table

The symbol table will define every symbol used in the software simulation of the system. A table will be produced giving at least the following information, as applicable, about every symbol used in the simulation of the system.

Math Symbol	Mnemonic	Input/Output Table Reference	Scaling	Iteration Rate	Source/ Destination	Description

The table will be divided into groups according to whether the functions appear in the I/O Table or are used only within the processor. Mnemonics and scaling will not be arbitrarily chosen. The software engineer in charge of all program mnemonics will asign the final mnemonic to be used.

4.2 Program Description

The program will be described in the manner most appropriate to its structure. The two most common choices will be HIPO disgrams or flow charts or both. The software designer should be given the final decision as to the form of the software description.

A HIPO (Hierarchy plus Input/Output) Diagram is similar to a transfer function in that it describes each functional module in a software system in terms of its input, what processes take place on/with this input and what is produced by it as output. These diagrams are most useful in helping to define the purpose of the functional modules of a system undergoing top-down design. That is, when the structure of a software system is defined down to the lowest level modules, a HIPO diagram depicting the inputs to a given module, a description of its intended processing function(s) and the outputs from the module is a most useful and succinct means of documenting the detailed design of such a system. These HIPO diagrams are not only useful as a part of the overall software system documentation, but also turn out to be a significant design tool during the actual software development process.

4.3 Program Listing

A clean compiled (assembled) listing of the computer program will be included. The listing should be easy to read and generously commented.

The program should be broken down so that the lowest level modules require a maximum of one page of source code. Mnemonic names used within the program should be meaningful and aid in understanding the source code.

5.0 TEST PROCEDURES

5.1 Acceptance Test Procedures

A test procedure to demonstrate that the total system simulation (hardware and software) complies with the specification and performs in accordance with the Performance Data (Section 2.2) will be prepared. The test procedure will, as a minimum, list every step of the test in the order it is performed, state the desired result, and the tolerance on the result, if any. The procedure should also list the minimum hardware and software needed for the test to be run successfully.

The test procedure should be written in such a way as to refer directly to the performance requirements. In this way someone who is not familar with the mechanics of the process being performed can still verify that the proposed test actually shows compliance with the stated requirements.

All sections of the software must be tested, thus all possible branches must be exercised by the proposed acceptance test.

5.2 Other Test Procedures

If subsidiary test procedures or driver routines are required to develop or test the system, they should be included in this section.

As part of subsystem verification testing any module should be exercised under maximum, minimum and nominal cases. Also verification of all possible error conditions should be made.

APPENDIX D

Small Disadvantaged Business Concerns Plan

The attached copy of TRA's Small Disadvantaged Business Concerns Subcontracting Plan will be the basis for the LATHE contract. The plan will be implemented as written and reporting of progress will be as delineated therein. Updating may be required and will be accomplished as the need arises. The specific purchasing procedures followed are as described in Section 5.0 of this Project Plan.

COMPREHENSIVE

SMALL DISADVANTAGED BUSINESS CONCERNS

SUBCONTRACTING PROGRAM PLAN

SECTION I

PURPOSE OF PLAN

A. The purpose of this Plan is to establish goals, requirements and responsibilities to be accomplished by Teledyne Ryan Aeronautical in performance of Federal Railroad Administration (FRA) contract number DOT-FR-9142 for the Research Locomotive and Train Handling Evaluator.

SECTION II

GENERAL POLICY

A. For the purposes of this Plan, a Small Disadvantaged Business Concerns (SDBC) is a business at least 50 percent of which is owned by minority group members or, in the case of publicly-owned businesses, at least 51 percent of the stock of which is owned by minority group members. For the purpose of this definition, minority group members include Black Americans, Hispanic Americans, Native Americans (such as American Indians, Eskimos, Alents and Native Hawaiians), and other minorities.

B. Teledyne Ryan recognizes the importance of the U. S. Government's Small Disadvantaged Business Concern Program. It is the policy of TRA to support fully this program by maximizing the use of SDBC as subcontractors under all programs and particularly in performance of FRA contract DOT-FR-9142.

C. All personnel involved in performance under this Plan shall, to the extent applicable, fully comply with the following TRA directives, copies of which are attached hereto:

1. General Policy Statement 21 revised March 14, 1972 (Attachment 1).

2. Standard Procedure 469 revised March 13, 1972 (Attachment 2).

3. Procurement Department Routine 110 revised January 12, 1979 (Attachment 3).

4. Procurement Department Routine 260 revised June 9, 1978 (Attachment 4).

D. In order to perform their subcontracts, SDBC may require professional assistance from TRA in such areas as engineering, manufacturing, quality assurance, contracting and accounting. Departments involved shall provide assistance as required.

SECTION III

SDBC SUBCONTRACTING GOALS

A. TRA's SDBC subcontracting goal is $200,000.

B. Dynamic Sciences, Inc. (DSI), as a subcontractor to TRA, will be responsible for performing approximately fifty (50) percent of the prime contract requirements. The SDBC subcontracting goal for DSI under their subcontract shall also be $200,000.

SECTION IV

REQUIREMENTS AND RESPONSIBILITIES

A. SDBC Administrator.

1. Mr. Charles Nord is assigned as TRA Small Disadvantaged Business Concern Administrator.

2. Duties of the MBE Administrator are defined in TRA Standard Procedure 469 (Attachment 2 to this Plan).

B. Program Manager.

1. The Locomotive Evaluator Program Manager is responsible for assuring that all TRA departments involved are fully aware of their SDBC subcontracting program responsibilities, to monitor their actual performance and to report to top management.

2. The Contract Statement of Work for Phase II for the Research Locomotive and Train Handling Evaluator requires the conduct of periodic preliminary design reviews (PDRs) and critical design reviews (CDRs) and the submission of monthly program reports. The status of SDBC subcontracting, including that of Dynamic Sciences, Inc., will be covered during PDRs and CDRs and in the monthly program reports. As a minimum the SDBC Subcontracting Status Report shall include:

   a. A current list of candidate items and services for SDBC Subcontracting. (See Attachment 7)

   b. A list of procurements in process with identification of SDBC firms solicited.

   c. A priced list of subcontracts awarded to SDBC firms.

3. The Program Manager will present to top level management at TRA, including the president and executive vice president, a detailed report on the status of the Locomotive Evaluator program at least once every two (2) weeks. A complete report on the status of the SDBC subcontracting program will be included in the presentation.

4. Attachment 7 is a list of items and services which are potential candidates for SDBC subcontracting. This list shall be maintained by the Program Manager and expanded as new items and services are identified.

C. Director, Aerospace Engineering Department.

The Director of the Aerospace Engineering Department is responsible for TRA's engineering, fabrication, assembly and test of the Locomotive Evaluator.

1. Design

a. The Locomotive Evaluator design will be developed during contract performance. The success of the SDBC Subcontracting Program will depend heavily on the performance of Engineering Senior Project Engineer and personnel involved in the design effort.

b. Design activity shall be accomplished with the intent of not only meeting contractual technical requirements but also to identify systems and subsystems of the Evaluator which would be within the manufacturing capabilities of SDBC firms.

2. Manufacturing

a. Manufacturing activities required in performance of the Locomotive Evaluator contract offer substantial opportunities for SDBC subcontracting. Product Test Group will be the key to maximizing these opportunities.

b. During their processing of design plans, drawings, etc., Product Test shall be responsible for the identification of fabrication, assembly and test tasks or processes which can be subcontracted to SDBC firms.

3. Make or Buy

a. The Procurement Administrator and Sr. Project Engineer will be responsible for manufacturing make or buy decisions in performance of the Locomotive Evaluator contract. All such decisions shall be made on the basis of TRA's policy to buy as many items or services as possible from SDBC firms.

4. Engineering

a. All Engineering Department personnel involved in the above decision making on the Locomotive Evaluator contract shall be briefed on the requirements of the SDBC subcontracting program and the part they must play in its success.

D. Manager, Procurement Department

a. Attachment 5 to this Plan is a Bidders List of potential SDBC subcontractors for the Locomotive Evaluator program. The Procurement Department is responsible for the identification of as many additional SDBC sources as possible. To accomplish this, the Procurement Department will, as a minimum, use the following sources:

(1) Federal Railroad Administration Minority Business Resource Center.

(2) National Minority Purchasing Council.

(3) California Minority Business Enterprises Directory.

(4) U. S. Small Business Administration.

(5) Federal, state and local government offices involved in SDBC programs.

(6) Other Government contractors.

Procurement Department personnel will distribute the Bidders List and work closely with the Program Manager and Engineering Department personnel to match requirements with SDBC subcontractor capabilities.

b. Attachment 8 is a list of "buy" items which have already been identified and submitted to the following office for assistance in locating SDBC suppliers:

Federal Railroad Administration
Minority Business Resource Center
Attn: Mr. Miles Washington

Follow-up shall be conducted to identify those items which can be supplied by SDBC firms.

c. Every effort shall be made to identify qualified SDBC firms to be solicited on all competitive procurements of items and services. Attachment 7 is a list of items and services which appear to be particularly appropriate for SDBC subcontracting. This list will be maintained and expanded by the Program Manager. Items or services on this list may not be purchased from other than SDBC firms without the personal approval of the

Manager of the Procurement Department. The Manager shall assure that every effort has been made to obtain SDBC participation and that the subcontract file fully documents the situation.

d. TRA is committed to providing professional assistance which SDBC subcontractors require to perform their subcontracts (see Section II, paragraph D of this Plan). The Procurement Department is responsible for the identification of such requirements and the coordination of them with the Program Manager and the appropriate TRA department.

e. Approximately fifty (50) percent of the prime contract requirements will be performed by Dynamic Sciences, Inc. (DSI) under a TRA subcontract. It is therefore essential that DSI have a SDBC Subcontracting Program comparable to TRA's. Attachment 6 is DSI's Plan which shall be incorporated in their subcontract.

ATTACHMENTS

1. General Policy Statement 21

2. Standard Procedure 469

3. Procurement Department Routine 110

4. Procurement Department Routine 260

5. Small Disadvantaged Business Concerns Bidders List for the Locomotive Evaluator Program

6. Dynamic Sciences, Inc. Minority Business Enterprise Subcontracting Program Plan

7. List of Candidate Items and Services for SDBC Subcontracting

8. Identified "Buy" Items

ATTACHMENT 1

GENERAL POLICY STATEMENT 21

Revised March 14, 1972

TELEDYNE RYAN AERONAUTICAL

GENERAL POLICY STATEMENT

SUBJECT PROCUREMENT POLICY	GPS NUMBER 21 REVISION NO 9 EFFECTIVE Mar. 14, 1972
MAJOR FUNCTION AFFECTED All Departments	PAGE 1 OF 2 PAGES
DISTRIBUTION All Manuals	✱ ITEMS REVISED ✕ ITEMS ADDED

It is the policy of Teledyne Ryan Aeronautical that:

Authority to commit the Company to a purchase contract is vested solely in Procurement. Commitments or changes made by other departments, directly or indirectly, are invalid.

No mandatory sources will be established without prior approval of the Vice President in charge of the activity generating the requirement <u>and</u> the Director of Procurement.

* The maximum amount of subcontracting found to be consistent with the efficient performance of the contract shall be placed with small business concerns, labor surplus area concerns and minority business enterprises. The Company shall establish programs to assure that such concerns and enterprises will be given an equitable opportunity to compete and will be considered fairly as subcontractors. Such programs shall be coordinated and implemented by an appointed Small Business and Minority Business Enterprises Liaison Officer, in accordance with RSP 469, "Small Business, Labor Surplus Area and Minority Business Enterprises Programs."

All contact with vendors shall be coordinated by Procurement. These include, but are not limited to, correspondence of a purely technical nature with established vendors which must be approved by Procurement before release.

The nature and extent of investigation conducted in the selection of qualified vendors shall be dependent upon the type of supplies or services and the vendor's demonstrated capability to perform the proposed task. In the process of vendor evaluation, Procurement shall consider the following factors:

- Production capacity
- Quality control
- Financial responsibility
- Relationship with customers
- Ability to deliver on schedule
- Technical competence

When a vendor becomes qualified, the effectiveness and integrity of its management controls shall be assessed and reviewed at intervals consistent with the type of supplies or services, as well as complexity and quantity of product or service. All applicable requirements shall be properly included or referenced in all purchase orders for products or services.

Teledyne Ryan personnel shall not accept gratuities in any form.

Vendors shall be instructed to address all correspondence of any nature to the attention of Procurement. When correspondence is received by any other department directly, it shall be sent immediately to Procurement. Procurement shall make prompt distribution of all correspondence received affecting other departments.

GPS No. 5, "Conflict of Interest - Vendors," contains policies covering:

a. A vendor in which a Teledyne Ryan employee has a proprietary or beneficial interest.

b. A vendor that has hired a former Teledyne Ryan employee.

Purchases from subsidiaries or affiliates shall be based strictly on individual competitive merit, considering quality, service, price and delivery. Competition will include obtaining quotations on an equal basis from subsidiaries or affiliates and one or more outside sources which normally produce the item or its equivalent in significant quantity.

Raw materials or purchased parts out of Teledyne Ryan stores or raw materials or parts from Teledyne Ryan vendors will not be furnished to a Teledyne Ryan subcontractor when such raw materials or parts can be purchased by the subcontractor from his own vendors. Exceptions to this policy will require the approval of the Vice President, Plant Operations or his authorized delegate, Director of Procurement. When the value of the furnished material exceeds $1,000, approval is also required by the Vice President, Finance and Controller or his authorized delegate, the Assistant Controller.

ATTACHMENT 2

STANDARD PROCEDURE 469

Revised March 13, 1972

TELEDYNE RYAN AERONAUTICAL

STANDARD PROCEDURE

SUBJECT	
SMALL BUSINESS, LABOR SURPLUS AREA AND MINORITY BUSINESS ENTERPRISES PROGRAMS	R.S.P. NO. 469 REV. NO. 4 EFFECTIVE Mar. 13, 1972 PAGE 1 OF 3 PAGES
MAJOR FUNCTION AFFECTED Procurement, Accounts Payable	* ITEMS REVISED X ITEMS ADDED

I. PURPOSE

* To establish Small Business (SB), Labor Surplus Area (LSA) and Minority Business Enterprises (MBE) programs.

II. DEFINITIONS

A. Small Business Concern - A concern, including its affiliates, which is independently owned and operated, is not dominant in the field of operation in which it is bidding on Government contracts, and can further qualify under the criteria established by the Small Business Administration (SBA) and set forth in Armed Services Procurement Regulations (ASPR).

B. Labor Surplus Area Concern - A concern which will perform, or cause to be performed, a substantial proportion of any contract awarded to it (1) in or near "Sections of concentrated unemployment or underemployment" as a certified-eligible concern; (2) in "Areas of persistent labor surplus;" or (3) in "Areas of substantial labor surplus" as designated by the Department of Labor.

C. Labor Surplus Area - An area listed by the U. S. Department of Labor as an area of substantial labor surplus or an area of substantial and persistent labor surplus.

X. D. Minority Business Enterprise - A business at least 50 percent of which is owned by minority group members or, in the case of publicly-owned businesses, at least 51 percent of the stock of which is owned by minority group members. For purpose of this definition, minority group members are Negroes, Spanish-speaking American persons, American Orientals, American Indians, American Eskimos and American Aleuts.

III. GENERAL

X A. The SB, LSA and MBE programs are established by the Company to assure that small business concerns, labor surplus area concerns and minority business enterprises will have an equitable opportunity to compete and will be considered fairly as subcontractors.

X B. The Small Business and Minority Business Enterprise Liaison Officer will coordinate and manage the Company's SB, LSA, and MBE programs (ref. GPS 21, "Procurement Policy"). The Director of Procurement will serve as the Small Business and Minority Business Enterprises Liaison Office for the Company. He will appoint a Small Business and Minority Business Enterprises Administrator who will administer the above programs and maintain liaison with U.S. Government representatives in accordance with contract requirements, U.S. Government regulations, this RSP, and applicable procurement routines.

IV. RESPONSIBILITIES AND PROCEDURE

A. Small Business and Minority Business Enterprises Administrator

* 1. Maintain liaison between the SBA, the Defense or NASA procuring activity and the Company when SB, LSA and MBE programs are involved.

X 2. Prepare SB, LSA and MBE program reports that are required by Government procurement agencies or that are requested by prime contractors when Teledyne Ryan is the subcontractor.

* 3. File required consolidated SB, LSA and MBE programs reports for the Company. Perform all distribution of copies within Company.

* 4. Coordinate operation of SB, LSA and MBE programs at all facilities.

B. Procurement

* 1. Conduct procurement activities in such a manner as to encourage maximum participation by small business concerns, labor surplus area concerns and minority business enterprises consistent with contract requirements and in accordance with GPS 21 and applicable department routines.

* 2. Maintain records for preparation of reports covering plant purchases which are required by Defense or NASA procuring activities and prime contractors. Forward reports to Accounts Payable.

C. Accounts Payable

* 1. Assist in the preparation of applicable reports required by Defense or NASA procuring activities.

ATTACHMENT 3

PROCUREMENT DEPARTMENT ROUTINE 110

Revised January 12, 1979

SUBJECT: GOVERNMENT SOCIO-ECONOMIC PROGRAMS

APPROVED: [signature] DEPARTMENT HEAD

*ITEMS REVISED X ITEMS ADDED

I. PURPOSE:

To describe procurement policy with respect to the Government's Socio-Economic Programs and the methods to be used to support these programs.

II. POLICY:

Teledyne Ryan Aeronautical fully supports each of the Government's Socio-Economic Programs described in this Department Routine and considers similar support by its suppliers and subcontractors to be mutually advantageous in the successful conduct of both Government and non-Government business.

III. GENERAL:

A. The Socio-Economic Programs to which Teledyne Ryan Aeronautical and its suppliers and subcontractors are contractually bound in performance of Government business are:

1. Equal Employment Opportunity: This program is intended to promote the full realization of equal employment opportunity for all persons, regardless of race, color, religion, sex or national origin. Executive Order No. 11246 of September 24, 1965 (30FR12319), Executive Order No. 11375 of October 13, 1967 (32FR14303), and the rules and regulations of the Secretary of Labor (41CFR Chapter 60) require that the Equal Opportunity Clause (ASPR 7-103.18) be included in all Government contracts at all tiers of performance regardless of dollar amount.

2. Small Business, Women-owned Business and Minority-owned Business Concerns: It is the objective of these programs that these sectors of the economy shall have the maximum practicable opportunity to participate in Government contracts. Particular attention is given in those programs to the effective implementation by Prime Contractors who are large businesses in providing a maximum of opportunity for small business, women-owned business and minority-owned business concerns to participate as subcontractors and suppliers. The Armed Services Procurement Act, as amended (10USC2301); the Small Business Act, as amended (15USC631), Executive Order No. 11458 of Mar. 5, 1969 and Executive Order No. 11625 of Oct. 13, 1971 set forth policy and procedures governing awards of all Government subcontracts and the opportunities afforded Small business, women-owned business and minority-owned business concerns.

3. Labor Surplus Area Concerns and Depressed Industries: These programs are intended to encourage placement of Government subcontracts with concerns which will perform such contracts substantially in labor surplus areas and when an entire industry is depressed to establish measures on an industry-wide, rather than on an area, basis.

   Regulations issued by the U.S. Dept. of Labor (29CFR654) and the provisions of Defense Manpower Policy No. 4A of October 27, 1977 (32ACFR134) contractually impose in Government contracts of $10,000 or more an obligation for contractors to exercise their best efforts to establish facilities in labor surplus areas and by placement of subcontracts to encourage and assist such areas in making the best use of their available resources. At the present time there are no contractual obligations imposed on Government contractors with respect to providing assistance to "Depressed Industries".

4. Preservation of Domestic Industrial Base: To insure the continued existence of an industrial mobilization base necessary for national defense and in the public interest. This program has been developed to restrict purchases of (a) jewel bearings and related items, (b) miniature and instrument ball bearings, and (c) precision components for mechanical time devices used in the performance of Government contracts to products manufactured in Canada and the United States, exclusive of its territories and possessions.

   The contractual clauses contained in Government contracts and subcontracts held by TRA impose the above noted restriction in all procurement regardless of dollar value.

5. Environmental Protection - It is the policy of the Federal Government to improve and enhance environmental quality. In furtherance of that policy the Government has developed a program to assure that procurement activities are used in a manner that will result in effective enforcement of the Clean Air Act (Public Law 91-604) and the Federal Water Pollution Control Act (Public Law 92-500).

Contractual provisions of Government contracts and subcontracts held by TRA prohibit the award of any subcontract or purchase order in amount of $10,000 or more to a firm proposing to use in the performance thereof a facility which is listed in the Environmental Protection Agency List of Violating Facilities (See Attachment "A").

6. Employment of the Handicapped - The implementation of this program requires Government contractors and subcontractors to take affirmative action to employ and advance in employment, qualified handicapped individuals without discrimination as to their physical or mental handicap.

The provisions of the Rehabilitation Act of 1973 (Public Law 93-516) and the regulations of the Secretary of Labor (41 CFR Chapter 60) effective May 17, 1976 require TRA to incorporate a designated affirmative action clause in all Government Subcontracts and Purchase Orders in amount of $2,500.00 or more.

7. Affirmative Action for Disabled and Vietnam Veterans - This program requires Government contractors and subcontractors to list all suitable employment openings and to take affirmative action to employ, and advance in employment and otherwise treat qualified disabled veterans and veterans of the Vietnam era without discrimination based upon their disability or veteran's status.

The requirements of the Vietnam Era Veterans Readjustment Assistance Act of 1972 (Public Law 93-508) and the regulations of the Secretary of Labor (41 CFR Chapter 60) require that each Government subcontract or purchase order awarded by TRA in an amount in excess of $10,000 include the clause set forth under ASPR 7-103.27.

8. Buy American Act - This act requires that in the Government's procurement of supplies and services, only domestic source end products shall be acquired except (a) when such items have been determined by the Secretary of Defense to be of a class or kind not mined, produced or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality (see attachment "B");

(b) When it is determined by the Secretary of Defense that the cost of a domestic source end product would be unreasonable; or (c) when it is determined by the Secretary of Defense that acquisition of a domestic source end product would be inconsistent with the public interest. It should be noted that the Secretary of Defense has determined that it would be inconsistent with the public interest to apply the restrictions of the Buy American to procurement of supplies of a military character or for use in programs of mutual interest to the United States and Canada in the defense of North America.

Pursuant to the Buy American Act (41USC 10) and the policies set forth in Executive Order 10582 dated December 17, 1954, all G vernment subcontracts and purchase orders awarded by TRA shall include the clause entitled "Buy American Act" as set forth under ASPR 7-104.3 and in subcontract and purchase orders the clause entitled "Duty-Free Entry-Canadian Supplies" as set forth under ASPR 7-104.32 shall also be included unless the Buyer is reasonably certain that no supplies will be imported from Canada by the subcontractor or supplier or any of his lower-tier subcontractors or suppliers.

9. Appropriation Act Restrictions - The Defense Appropriations Act for FY 1973 (Public Law 92-570) imposes several restrictions upon all Government prime and sub-tier contracts. The principal restrictions are as follows:

(a) Except under certain specific conditions, procurement of specialty metals, synthetic fabric, coated synthetic fabric, supplies containing mohair or cotton, food, clothing, woven silk and woven silk blends, or spun silk yarn for cartridge cloth shall be made only if the item is grown, reprocessed, reused, melted, or produced in the United States or its possessions, and

(b) No procurement for research and development in connection with any weapon system or other military equipment shall be made from a foreign source when there is a domestic source who can carry out such research and development and is willing to do so at a lower cost.

10. Protection of Individual Privacy - Officers and employees of the Government, of prime contractors, and of sub-tier contractors may be civilly liable and be criminally liable under the provisions of the Privacy Act of 1974 (Public Law 93-579) if they fail to design, develop, operate or maintain a system of records on individuals on behalf of any Government Department or agency in conformance with the requirements of the act. Any procurement proposed by TRA that has as one of its purposes the design, development, operation or maintenance of system of records on individuals regardless, therefore, must be approved by TRA Legal Department in advance of issuing any solicitation for quotations or proposals.

11. Walsh-Healey Public Contracts Act - This act is applicable to all Government subcontracts and purchase orders awarded by TRA in an amount of $10,000 or more. The provisions of this act require that such subcontracts be awarded only to manufacturers or regular dealers as defined in the act (See attachment "C"). The act also incorporates certain stipulation pertaining to such matters as minimum wages to be paid, maximum hours to be worked, the use of child or convict labor, and safe and sanitary working conditions in performance of such subcontracts and purchase orders.

12. Geographic Distribution of Procurement Dollars - The Defense Appropriation Act for FY 1978 requires every Government prime and sub-tier contractor to notify the Department of Defense of the award of each subcontract or purchase order in an amount of $10,000 or more. This notice must be provided within five (5) days following award of the subcontract or purchase order and must specify (a) the source receiving the award; (b) the amount of the award; (c) the type of effort involved; (d) the applicable Government contract; (e) where the work will be performed, (f) whether the source is a large or small business; and (g) whether the source is or is not a minority business.

13. Safety Precautions for Hazardous Materials - The rules and regulations promulgated by the Secretary of Defense pertaining to contracts and subcontracts involving ammunition or explosives are contained in the contract clause entitled "ASPR 7-104.79 Safety Precautions for Ammunition and Explosives".

Similarly, the rules and regulations promulgated by the Occupational Safety and Health Administration pertaining to other hazardous materials are contained in the contract clause entitled "ASPR 7-104.98 Hazardous Material Identification and Material Safety Data".

TRA is contractually obligated to incorporate these clauses to the extent each is applicable in all subcontracts or purchase orders which require the delivery of hazardous substances as listed in Attachment "D" or require work, use, handling, manufacture, packaging, transportation, storage, inspection or disposal of, or any other use which will involve exposure to such hazardous materials.

14. Convict Labor, Contract Work Hours and Safety Standards Fair Labor Standards Act of 1938, Nondiscrimination because of Age and Service Contract Act of 1965.

Each of the above listed topics are incorporated in Government contracts held by TRA either by unique contract clauses or by statute. Because the Walsh Healey Public Contracts Act pertains, in part, to such matters as minimum wages, maximum hours, child labor, convict labor, and safe and sanitary working conditions, the listed topics are not usually separately incorporated in Government contracts and subcontracts. However, in Government sub-contracts exceeding $10,000 certain special contractual provisions may be required when the Walsh-Healey provisions are not applicable.

B. Procurement from the Blind and Other Severely Handicapped.

The Committee for Purchases from the Blind and Other Severely Handicapped was established by the Wagner-O'Day Act (41 U.S.C.46) dated June 25, 1938 and amended by Public Law 92-28 (Dated June 23, 1971). This Committee is an independent activity of the Federal Government whose members are appointed by the President of the United States.

The Committee is responsible for determining the materials and supplies which shall be procured by all entities of the Government from agencies for the blind and other severely handicapped and the prices to be paid for these items. The Committee and the Department of Defense encourage Government contractors to take advantage of this method for procurement in the public interest.

It is the policy of TRA to cooperate and assist the Committee by procuring the items listed on Attachment "E" from the blind and other severely handicapped.

IV. PROCEDURES:

A. Buying personnel shall take affirmative action to locate and identify responsible small business concerns, labor surplus area concerns and minority business enterprises possessing the financial resources and other qualifications necessary to furnish the goods and services required by TRA.

B. Each Buyer shall maintain a list of those small business concerns, labor surplus area concerns and minority business enterprises which have been determined to be responsible and qualified sources of supply for the types of goods and services he normally purchases. The Buyer shall undertake those efforts he deems necessary to maximize opportunity for participation by these sources in all procurement actions.

C. In connection with documentation for award of firm fixed price purchase orders less than $10,000 in value, Buyers shall record on the "Quotation Summary/Order Justification and Approvals", TRA Form R-110D, each small business concern, labor surplus area concern, and/or minority business enterprise solicited for the procurement. In connection with documentation for award of any other purchase order the Buyer shall complete "Small Business/ Minority Check List", Form R-4306D" by listing the (i) number of quotations solicited from large business concerns, small business concerns and minority business enterprises, (ii) reasons for not soliciting small or minority business (if applicable) and (iii) reasons for small or minority business not receiving award, when solicited.

D. Prior to awarding any purchase order of $2,500 or more the Buyer shall obtain from the selected source each of the appropriately executed representations or certifications as listed in Attachment "F".

In connection with purchase orders other than firm, fixed price orders less than $10,000 total value, each appropriately executed certification or representation shall be filed in the permanent file for the procurement and its location listed on the Procurement Documentation Check List (Form R-4789D).

E. Whenever it is anticipated a proposed procurement to be awarded under authorization of a Government prime or sub-tier contract may exceed one million dollars ($1,000,000) the Buyer shall obtain in writing from the Contracting Officer a clearance that the proposed subcontractor is in compliance with the Government's Equal Opportunity requirements and, therefore, is eligible for award of the proposed procurement (ASPR 7-104.22). Because a period of 30 days is normally required by the Contracting Officer to determine compliance by the selected source, this clearance should be requested at the earliest practicable stage in the procurement.

F. The Buyer shall make certain the socio-economic contract clauses are incorporated in all subcontracts/purchase orders authorized under Government prime or sub-tier contracts in accordance with the instructions provided in Attachment "G".

G. In all procurement actions anticipated to exceed $10,000 which will require consent to placement by the Contracting Officer, the Buyer shall notify the Contracting Officer in writing before soliciting quotations whenever it is anticipated no small business concern is to be solicited. This notice shall state the reasons small business concerns are not being solicited. The notice shall be given as early as possible in the procurement cycle in order to provide the Contracting Officer with a reasonable period to suggest potentially qualified small business concerns for consideration by the Buyer. However, the Buyer shall not hold up the procurement action, if, in the judgement of the Purchasing Agent, such action would delay TRA's performance under the authorizing Government prime or sub-tier contract.

The basis justifying such decision by the Purchasing Agent shall be explained in writing and included in the documentation of the purchase order file.

H. Periodic reviews by Procurement Supervision shall be made of each Buyer's individual efforts to energetically support the Small Business and Minority Business Enterprise Subcontracting Program.

In summarizing the review of Procurement actions under $5,000.00 total value (See DR No. 575) Procurement Management shall give particular consideration to any unusual effort which the Buyer displays in awarding procurements to small or minority business concerns. Conversely, failure or unwillingness on the part of a Buyer to support TRA's Small Business or Minority Business Enterprises policies shall be identified in the summary.

I. Procurement Services shall maintain a list of all vendors used for Procurement of goods and services (See DR No. 152). This list shall identify whether a vendor is a small business, a large business, a foreign concern, or a not-for-profit organization and, if a small or large business, whether it is a minority business enterprise (see DR No. 153).

J. The Administrator of Small Business and Minority Business Subcontracting Programs shall maintain records with respect to solicitation of bids and quotations and the award of subcontracts and purchase orders as specified in the Government contracts held by TRA (See ASPR 7-104.14, 7-104.20 and 7-104.36). The Administrator shall also prepare Form 1140-1, Form 524 and Form 745 on a quarterly basis for submittal by TRA's Chief Operating Officer to the Dept. of Defense, the National Aeronautics and Space Administration, and to the Small Business Administration.

TELEDYNE RYAN AERONAUTICAL

PROCUREMENT DEPARTMENT	ROUTINE NO. 110	REVISION 1
	EFFECTIVE 1/12/79	PAGE 1 OF 1

SUBJECT:	
GOVERNMENT SOCIO-ECONOMIC PROGRAMS ATTACHMENT "A" - FACILITIES LISTED IN THE ENVIRONMENTAL PROTECTION AGENCY LIST OF VIOLATING FACILITIES	APPROVED: G. Cardin DEPARTMENT HEAD *ITEMS REVISED X ITEMS ADDED

The following are currently listed by the Environmental Protective Agency as being violators of the Clean Air Act (P.L. 91-604) and/or the Federal Water Pollution Control Act (P.L.92-500).

FACILITY	DATE OF LISTING
ITT RAYONIER, INC.	9/12/78
FERNANDINA BEACH, FLA.	(FR DOC. 78-25668)

TELEDYNE RYAN AERONAUTICAL

PROCUREMENT DEPARTMENT	ROUTINE NO. 110	REVISION 1
	EFFECTIVE 1/12/79	PAGE 1 OF 3
SUBJECT: GOVERNMENT SOCIO-ECONOMIC PROGRAMS ATTACHMENT "B" - LIST OF ARTICLES, MATERIALS AND SUPPLIES EXCEPTED FROM THE PROVISIONS OF THE BUY AMERICAN ACT (REV. 7/1/76).	APPROVED: G.J. Carlson DEPARTMENT HEAD •ITEMS REVISED X ITEMS ADDED	

It has been determined by the Secretary of Defense that the articles, materials and supplies listed below, when purchased as end items or components, are not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality. When required to be incorporated into an end product to be delivered by TRA to the United States these items or components may be regarded as being of domestic origin.

Acetylene black
Asbestos, amosite
Bananas
Beef extract
Bizmuth
Brazil nuts, unroasted
Cadmium ores and flue dust
Calcium cyanamide
Capers
Cashew nuts
Chestnuts
Chicle
Chrome ore or chromite
Cinchona bark
Cobalt, in cathodes, rondelles, or other primary forms
Cocoa beans
Coconut and coconut meat, unsweetened,in shredded, desiccated, or similarly prepared form.
Coffee, raw or green bean
Cork, wood or bark and waste
Diamonds, industrial, stones
Emetine, bulk
Ergot, crude
Fair linen, altar
Fibers of the following types: Abace, agave, coir, flax, jute and palmyra
Goat and kid skins
Graphite, natural
Hand sewing needles
Hog bristles for brushes
Hyoscine, bulk
Ipecac, root
Leather, Sheepskin, Hair Type
Menthol, natural bulk
Mica
Nickel, primary, in ingots, pigs, shot, cathodes, or similar forms: nickel oxide and nickel salts.
Nitroguanidine (also known as picrite)
Olive Oil

Olives(green), pitted or stuffed in bulk
Opim, crude
* Petroleum, crude oil, unfinished oils and finished products

* Petroleu... Definitions,as used in this part

(a) Crude oil means crude petroleum as it is produced at the wellhead and liquids(under atmospheric conditions) that have been recovered from mixtures of hydrocarbons which existed in a vaporous phase in a reservoir and that are not natural gas products.

(b) Finished products means any one or more of the following petroleum oils, or a mixture or combination of such oils, which are to be used without further processing except blending by mechanical means:

(i) liquefied gases - hydrocarbon gases recoverd from natural gas or produced from petroleum refining and kept under pressure to maintain a liquid state at ambient temperatures;
(ii) Gasoline - a refined petroleum distillate which by its composition, is suitable for use as a carburant in internal combustion engines;
(iii) Jet fuel - a refined petroleum distillate used to fuel jet propulsion engines;
(iv) Naptha - a refined petroleum distillate falling within a distillation range overlapping the higher gasoline and the lower kerosenes;
(v) Fuel oil - a liquid or liquefiable petroleum product burned for lighting or for the generation of heat or power and derived directly or indirectly fr m crude oil, such as kerosene, range oil, distillate fuel oils, gas oil, diesel fuel, topped crude oil, residues;
(vi) Lubricating oil - a refined petroleum distillate or specially treated petroleum rsidue used to lessen friction between surfaces;
(vii) Residual fuel oil - a topped crude oil or viscous residuum which, as obtained in refining or after blending with other fuel oil, meets or is the equivalent of Military Specification MIL-F-859 for Navy Special Fuel Oil and any other more viscous fuei oil, such as No. 5 or Bunker C;
(viii) Asphalt - a solid or semi-solid cementitious material which gradually liquefies when heated, in which the predominating constituents are bitumins, and which is obtained in refining crude oil;
(ix) Natural gas products - liquids (under atmospheric conditions), including natural gasoline, which are recoved by a process of absorption, adsorption, compression, refrigeration, cycling, or a combination of such processes, from mixtures of hydrocarbons that existed in a vaporous phase in a reservoir and which, when recovered and without processing in a refinery, otherwise fall within any of the definitions of products

contained in (ii) through (v), inclusive, of this paragraph (b).

(c) Unfinished oils means one or more of the petroleum oils listed in (b) above, or a mixture or combination of such oils, which are to be further processed other than by blending by mechanical means.

Platinum and platinum group metals, refined, as sponge, powder, ingots, or cast bars.
Pyrethrum flowers
Quartz crystals
Quebracho
Radium salts
Rosettes
Rubber, crude and latex
Rutile
Silk, raw
Sperm oil
Spices and herbs in bulk
Sugars, raw
Talc, block, steatite
Tapioca flour and cassava
Tartar, crude; tartaric acid and cream of tartar in bulk
Tea in bulk
Thread, metallic (gold)
Tin
Vanilla beans
Venom, cobra
Wax, carnauba
Woods of the following species: Angelique, balsa, ekki, greenheart, lignum vitae, mahogany and teak.

(A) Manufacturer: - is a person who owns, operates, or maintains a factory or establishment that produces on the premises the materials, supplies, articles, or equipment required under the contract and of the general character described by the specifications. In order to qualify as a manufacturer, a bidder must be able to show before the award that he is (i) an established manufacturer of the particular goods or goods of the general character sought by the Government, and (ii) if he is newly entering into such manufacturing activity, that he has made all necessary prior arrangements for space, equipment and personnel to perform the manufacturing operations required for the fulfillment of the contract. A new firm which, prior to the award of the contract, has made such definite commitments in order to enter a manufacturing business which will later qualify it, shall not be barred from receiving the award because it has not yet done any manufacturing.

(B) Regular Dealer.

(a) Except as set forth in (b) below, a regular dealer is a person who owns, operates, or maintains a store, warehouse, or other establishment in which materials, supplies, articles, or equipment of the general character described by the specifications and required under the contract are bought, kept in stock, and sold to the public in the usual course of business. In order to qualify as a regular dealer, a bidder must be able to show before the award:

(i) that he has an establishment or leased or assigned space in which he regularly maintains a stock of goods in which he claims to be a dealer; if the space is in a public warehouse, it must be maintained on a continuing, and not on a demand, basis;

(ii) that the stock maintained is a true inventory from which sales are made; the requirement is not satisfied by a stock of sample or display goods; or by a stock consisting of surplus goods remaining from prior orders, or by a stock unrelated to the supplies which are the subject of the bid, or by a stock maintained primarily for the purpose of token compliance with the Act from which few, if any, sales are made;

(iii) that the goods stocked are of the same general character as the goods to be supplied under the contract; to be of the same general character, the items to be supplied must be either identical with those in stock or be goods for which dealers in the same line of business would be an obvious source;

(iv) that sales are made regularly from stock on a recurring basis;they cannot be only occasional and constitute an exception to the usual operations of the business; the proportion of sales from stock that will satisfy the requirements will depend upon the character of the business;

(v) that sales are made regularly in the usual course of business to the public, i.e., to purchasers other than Federal, State, or local government agencies; this requirement is not satisfied if the contractor merely seeks to sell to the public but has not yet made such sales; if government agencies are the sole purchasers, the bidder will not qualify as a regular dealer; the number and amount of sales which must be made to the public will necessarily vary with the amount of total sales and the nature of the business; and,

(vi) that his business is an established and going concern; it is not sufficient to show that arrangements have been made to set up such a business.

(b) For certain specific products (lumber and lumber products, machine tools, hay, grain, feed or straw, raw cotton, green coffee, petroleum, agricultural liming materials, tea, and raw or unmanufactured cotton linters), there are alternative definitions of regular dealers. The qualifications required under the alternative definitions are listed in the regulations of the Secretary of Labor (41 C.F.R.50-201.101(b)).

SUBJECT: GOVERNMENT SOCIO-ECONOMIC PROGRAMS
ATTACHMENT "D" - HAZARDOUS SUBSTANCES

APPROVED: [signature]
DEPARTMENT HEAD

*ITEMS REVISED X ITEMS ADDED

The following items are identified in Appendix "A" of Federal Standard No. 313A (Rev. 6/4/76) as being "hazardous substances".

TABLE I FEDERAL SUPPLY CLASSES IN WHICH ALL ITEMS MUST BE IDENTIFIED AND CERTIFIED

FEDERAL SUPPLY CLASS	
6810	Chemicals
6820	Dyes
6830	Gases; Compressed and Liquified
6840	Pest Control Agents and Disinfectants
6850	Miscellaneous Chemical Specialties
7930	Cleaning and Polishing Compounds and Preparations
8010	Paints, Dopes, Varnishes and Related Products
8030	Preservative and Sealing Compounds
8040	Adhesives
Group 91	(Packaged Products only)
9110	Fuels, Solid
9130	Liquids Propellants and Fuels, Petroleum Base
9135	Liquid Propellants Fuels and Oxidizers, Chemical Base
9140	Fuel Oils
9150	Oils and Greases:Cutting,Lubricating, and Hydraulic
9160	Miscellaneous Waxes, Oils and Fats

TABLE II FEDERAL SUPPLY CLASSES IN WHICH ONLY HAZARDOUS ITEMS NEED TO BE IDENTIFILD

FEDERAL SUPPLY CLASS	TITLE	HAZARDOUS ITEMS REQUIRING IDENTIFICATION
1370	Pyrotechnics	Warning fuses, fire starter
1375	Demolition Materials	Explosive device
3439	Welding and Brazing supplies	Only hazardous items such as cleaners, acids, flux and supplies that contain or produce hazardous fumes

TELEDYNE RYAN AERONAUTICAL

PROCUREMENT DEPARTMENT	ROUTINE NO. 110	REVISION 1
	EFFECTIVE 1/12/79	PAGE 2 OF 3
SUBJECT: GOVERNMENT SOCIO-ECONOMIC PROGRAMS ATTACHMENT "D" - HAZARDOUS SUBSTANCES	APPROVED: [signature] DEPARTMENT HEAD	
	*ITEMS REVISED	X ITEMS ADDED

FEDERAL SUPPLY CLASS	TITLE	HAZARDOUS ITEMS REQUIRING IDENTIFICATION
3610	Printing, duplicating and bookbinding equipment.	Flammable or toxic lithographic solutions
5610	Mineral construction materials, bulk	Hazardous Items such as cutback asphalt, deck and floor covering, deck and surface underlay compound, sealing compound, flight deck compounds
5640	Wallboard, building paper, and thermal insulation materials	Asbestos cloth which has loose fibers or flyings that may become airborne.
6135	Batteries, Primary	Lead-acid, and mercury batteries and alkaline (with electrolyte)
6505	Drugs, Biologicals, and official reagents	Only hazardous items
6750	Photographic Supplies	Only items containing hazardous chemicals, solvents, thinners and cements
6780	Photographic sets, kits and outfits	(See FSC 6750)
7510	Office supplies	Only hazardous items, such as solvents, thinners, cleaning fluids, flammable inks and varnishes.
8510	Perfumes, Toilet preparations, and powders	Shipping containers and pressurized containers with flammable propellants only
8520	Toilet Soap, Shaving preparations, and Dentifrices	(See FSC 8510)

SUBJECT: GOVERNMENT SOCIO-ECONOMIC PROGRAMS
ATTACHMENT "D" - HAZARDOUS SUBSTANCES

APPROVED: [signature]
DEPARTMENT HEAD

*ITEMS REVISED X ITEMS ADDED

FEDERAL SUPPLY CLASS	TITLE	HAZARDOUS ITEMS REQUIRING IDENTIFICATION
8720	Fertilizers	Only items containing weed and pest control or other harmful ingredients, or because of their composition, are hazardous
9920	Smoker's Articles and matches	Lighter Fuel and matches only

ATTACHMENT 4

PROCUREMENT DEPARTMENT ROUTINE 260

Revised June 19, 1978

TELEDYNE RYAN AERONAUTICAL

PROCUREMENT DEPARTMENT	ROUTINE NO. 260	REVISION 2
	EFFECTIVE 6/19/78	PAGE 1 OF 4
SUBJECT: PURCHASE ORDER DOCUMENTATION	APPROVED [signature] DEPARTMENT HEAD *ITEMS REVISED X ITEMS ADDED	

I. PURPOSE

To outline the requirements and procedures for Purchase Order Documentation.

II. REFERENCES

A. Purchase Order Documentation and Approval (Form R-110D) (Attached)

B. Procurement Documentation Checklist (Form R-4789D) (Attached)

C. Purchase Summary and/or Justification (Forms P-3652D and R-3652-1D) (Attached).

D. Appendix A and B. (Attached).

III. GENERAL:

A. Purchase Order files shall be documented to the extent necessary to provide a complete and accurate history of the procurement transaction. Low dollar purchases need not, and in fact, should not be documented to the same degree as a large dollar procurement. Similarly, high dollar purchases awarded to the low bidder on a strictly competitive price basis do not require as much documentation as awards made on a single or sole source basis. However, in all cases the file must show both why the specific source was selected and why the price established was determined reasonable.

B. The following is a list of those documents which normally shall be included in purchase order files:

1. An exact copy of the purchase order document as forwarded to the vendor together with the vendor's executed acknowledgement thereof when applicable.

2. The authorizing Purchase Requisition (Form R-100) as specified in D.R. 200.

NOTE: Copies of authorizing Traveling Purchase Requisitions (TPR's) shall generally be included in files for high dollar procurements.

3. The Request for Quotations, showing all bidders solicited.

4. The Vendor's priced quotations, and bid tabulation sheets summarizing the quotations received and providing a comparison of prices offered.

5. Vendor survey or facilities capability reports, including financial evaluation.

6. Source selection justification whenever the procurement is made on a sole or single source basis or is awarded to other than the lowest bidder.

7. Price/Cost Analysis Data performed on any procurement awarded other than on a strict price competition basis to the lowest bidder.

8. Negotiation Plan and Summary whenever negotiations are conducted.

9. Information as to use of special contractual provisions and approval for such use.

10. Evidence of consideration given to requirements of Small Business and Minority Business Programs.

11. Copies of, or reference to, technical data, such as:

    (a) Engineering technical evaluation.

    (b) Performance specifications and drawings.

    (c) Test specifications and inspection requirements.

    (d) Lists of special tooling or special test equipment required.

12. Correspondence between Purchasing and the bidders.

13. Basis for selection of contract type if not clearly indicated in the foregoing items.

14. Purchase summary clearly stating justification for the award together with departmental and management approvals as required.

15. Advance notification to ACO of intent to place a subcontract and evidence of consent to placement when required.

IV. PROCEDURES:

A. Documentation of fixed price purchase orders $10,000.00 and under.

1. Include all applicable items listed in Paragraph III B. of this D.R.

2. Summarize the pertinent data by using the Purchase Order Documentation and Approval (Form R-110D). Complete the form by applying the following information in the corresponding spaces noted on Appendix A of this D.R.

   a) Enter purchase order identification number.

   b) Check whether oral or written quotations were obtained.

   c) Enter names of sources solicited.

   d) Enter name of person offering quotation and date quoted.

   e) Provide information applicable to prior procurements.

   f) Identify type of business solicited.

   g), h), i), j), K) and l) provide information pertaining to quotation received.

   m) and n) Enter data pertaining to award of the Procurement.

   o) Enter the delivery schedule negotiated.

   p), q) and r) Check box applicable to the procurement under consideration. (check one and only one box under "A" and "C". Check one box only under "B" when applicable).

   s) Enter information as needed to support previous statements.

   t) Obtain approvals as specified in Appendix "B".

B. Documentation of Purchase Orders over $10,000.00 or other than fixed price:

1. Include all applicable items listed in Paragraph III B of this D.R.

2. Complete the Procurement Documentation Checklist (Form R-4789D) in accordance with instructions noted on the form.

3. Summarize the pertinent data by using Purchase Summary and/or Justification (Form R-3652D and Form R-3652-1D). Complete the form using as a guide information noted in the outline below.

   a. Section I - Requirements

Include such information as:

(1) Quantity, part number and part description.

(2) The end use of the part (e.g., used on the Model 790 Program).

(3) Authority for procurement (e.g., Requisition Number, Sales Order number, and Prime Contract number).

b. Section II - Small Business and Minority Business Enterprises

Describe effort made to assure that small business concerns and minority business enterprises were given an equitable opportunity to compete for the procurement.

c. Section III - Selected Source

Include reasons why the particular vendor was selected. (e.g., low bidder, only source qualified, only source with adequate tooling, etc.).

d. Section IV - Type of Subcontract and Value

(self-explanatory)

e. Section V - Performance/Delivery Schedule

Include the DOD priority, if applicable, along with the performance period of the contract.

f. Section VI - Pricing

Include adequate information to confirm that the pricing is fair and reasonable.

ATTACHMENT "A" D.R. 260

QUOTATION SUMMARY/ORDER
JUSTIFICATION & APPROVALS (ON REVERSE)

PURCHASE ORDER NO. (1)

2(a) ☐ ORAL QUOTATION(S) 2(b) ☐ WRITTEN QUOTATION(S) ATTACHED

SOURCES SOLICITED		QUOTATIONS RECEIVED			
1	NAME & ADDRESS OR VENDOR CODE NO.	ITEM	1	2	3
(3)		QUANTITY	(4)	(4)	(4)
		UNIT PRICE	(4)	(4)	(4)
QUOTED BY: (5)	DATE: (6)	EXTENDED PRICE	(4)	(4)	(4)
PRIOR PROCUREMENT SAME/LIKE ITEMS P.O. NO. (8)	BUSINESS TYPE ☐ SMALL (7)	TOTAL QUOTED PRICE	(4)		
THIS SOURCE SOLICITED (9) ☐ YES (9) ☐ NO	☐ LARGE	FOB	(4)		
THIS SOURCE AWARDED ORDER (10) ☐ YES (10) ☐ NO	☐ MINORITY ☐ LABOR SURPLUS	PAYMENT TERMS	(4)		
2	NAME & ADDRESS OR VENDOR CODE NO.	ITEM	1	2	3
(3)		QUANTITY	(4)	(4)	(4)
		UNIT PRICE	(4)	(4)	(4)
QUOTED BY: (5)	DATE: (6)	EXTENDED PRICE	(4)	(4)	(4)
PRIOR PROCUREMENT SAME/LIKE ITEMS P.O. NO. (8)	BUSINESS TYPE ☐ SMALL (7)	TOTAL QUOTED PRICE	(4)		
THIS SOURCE SOLICITED (9) ☐ YES (9) ☐ NO	☐ LARGE	FOB	(4)		
THIS SOURCE AWARDED ORDER (10) ☐ YES (10) ☐ NO	☐ MINORITY ☐ LABOR SURPLUS	PAYMENT TERMS	(4)		
3	NAME & ADDRESS OR VENDOR CODE NO.	ITEM	1	2	3
(3)		QUANTITY	(4)	(4)	(4)
		UNIT PRICE	(4)	(4)	(4)
QUOTED BY: (5)	DATE: (6)	EXTENDED PRICE	(4)	(4)	(4)
PRIOR PROCUREMENT SAME/LIKE ITEMS P.O. NO. (8)	BUSINESS TYPE (7) ☐ SMALL	TOTAL QUOTED PRICE	(4)		
THIS SOURCE SOLICITED (9) ☐ YES (9) ☐ NO	☐ LARGE	FOB	(4)		
THIS SOURCE AWARDED ORDER (10) ☐ YES (10) ☐ NO	☐ MINORITY ☐ LABOR SURPLUS	PAYMENT TERMS	(4)		

PURCHASE ORDER DATA

CIRCLE SOURCE AWARDED ORDER: 1 2 3		PROMISED DELIVERY			
(11) DATE AWARDED (13)	CONFIRMED TO (14)	ITEM	1	2	3
"P" CLAUSES/ REMARKS: (15)		AT FOB	(12)	(12)	(12)
		TRA ON DOCK (VSP)	(12)	(12)	(12)

R-1100 REV. 11-77

PURCHASE JUSTIFICATION (FIRM FIXED PRICE ORDERS LESS THAN $10,000)

(A) PRICING ESTABLISHED AND DETERMINED REASONABLE

(16)

(a) ☐ AS RESULT OF ADEQUATE PRICE COMPETITION

(b) ☐ BECAUSE PRICES HAVE BEEN DETERMINED TO BE ESTABLISHED CATALOG PRICES OF COMMERCIAL ITEMS SOLD IN SUBSTANTIAL QUANTITIES TO THE GENERAL PUBLIC.

(c) ☐ AS RESULT OF PRICE ANALYSIS DESCRIBED IN PART "D" BELOW

(d) REF: CATALOG ______ DATED ______ PAGE ______

☐ FOR OTHER REASONS DESCRIBED IN PART "D" BELOW

(B) QUOTATION(S) SOLICITED FROM ONLY ONE SOURCE

.17

(a) ☐ BECAUSE TOTAL VALUE OF PURCHASE IS LESS THAN $500

(b) ☐ BECAUSE SOLICITED SOURCE IS ONLY SOURCE ACCEPTABLE TO ☐ TRA ENGINEERING/ ☐ TRA'S CUSTOMER AS DOCUMENTED

BY: DRAWING/SPECIFICATION NO. ______

REVISION NO. ______ DATED ______, OR

BY: ______

(c) ☐ FOR OTHER REASONS DESCRIBED IN PART "D" BELOW

(18)

(C) PRICE NEGOTIATIONS (a) ☐ WERE (b) ☐ WERE NOT CONDUCTED. IF CONDUCTED DESCRIBE IN PART "D" BELOW

(19)

(D) ______

AUTHORIZATION TO AWARD PURCHASE

QUOTATION SUMMARY AND PURCHASE JUSTIFICATION PREPARED BY:

(20)

(BUYER) (DATE) (20)

AND REVIEWED AND APPROVED BY (CHECK BLOCK WHEN REQUIRED):

(21) ☐ ______ (21)

(Senior Buyer) (DATE)

☐ (22) ______ (23)

(PURCHASING AGENT) (DATE)

(23) ☐ ______ (23)

(PROCUREMENT ANALYST) (DATE)

APPROVAL REQUIREMENTS FOR FIXED

PRICE PURCHASE ORDERS UNDER $10,000.00

	COMPETITIVE			NON-COMPETITIVE		
	TO $5000	OVER $5000	BUT AWARDED TO OTHER THAN LOW BIDDER	TO $1000	$1000 TO $5000	OVER $5000
BUYER	X *	X *	X *	X *	X *	X *
PURCHASING AGENT		X *	X *		X *	X *
MANAGER		X *	X *			X *
PROCUREMENT ADMINISTRATION			X			X

X = DOCUMENTATION APPROVAL SIGNATURE REQUIRED ON FORM R110D (REV. 12-74)

* = 1. SIGNATURE BY HIGHEST AUTHORIZED INDIVIDUAL ON THE PURCHASE ORDER.
2. INITIALS BY THOSE INDIVIDUALS NOT AT THE HIGHEST DESIGNATED LEVEL (i.e. OVER $5000 REQUIRES FULL SIGNATURE OF MANAGER FOLLOWING APPROVAL INITIALS OF BUYER AND PURCHASING AGENT).

APPROVED: G S Cadice

G. S. Cadice
Director of Procurement

ATTACHMENT 5

SMALL DISADVANTAGED BUSINESS CONCERNS LISTING

ATTACHMENT NO. 5

APPLIED ELECTRO TECHNOLOGY, INC.
Santa Ana, Ca. 92704

APPLIED TECHNOLOGY ASSOCIATES
San Diego, Ca. 92111

BASZILE METALS SERVICES
Los Angeles, Ca. 90058

BURKS ELECTRONICS, INC.
San Diego, Ca. 92111

CHICOS BLUEPRINT COMPANY
San Diego, Ca. 92110

CONTRACT SYSTEMS ASSOCIATES
San Diego, Ca. 92173

GEARY TOOL & ENGINEERING
San Diego, Ca. 92121

GOAL CHEMICAL SEALANTS CORP.
Los Angeles, Ca. 90023

GOLDEN STATE FASTENERS & SUPPLY, INC.
Montebello, Ca. 90640

GORDON'S BUILDING SUPPLY
San Diego, Ca. 92113

HAYAKAWA ASSOCIATES
Los Angeles, Ca. 90035

HUMAN GRAPHICS
San Diego, Ca. 92103

INTERNATIONAL ELECTRONICS
El Paso, Tex. 79925

INTERNATIONAL TECHNISYSTEMS, INC.
Newport Beach, Ca. 92660

KIRK-MAYER, INC.
Los Angeles, Ca. 90025

LEE ENGINEERING CORP
Sunnyvale, Ca. 94086

METAL SUPPLY, INC.
Los Angeles, Ca. 90058

MICROWAVE RESEARCH CORPORATION
North Andover, Ma. 01845

N.H. RESEARCH, INC.
Santa Ana, Ca. 92705

OJIBWA INDUSTRIES, INC.
Detroit, Mi 48204

OKLAHOMA AEROTRONICS, INC.
Hartshorne, Ok. 74547

OPTICAL ELECTRONICS, INC.
Los Angeles, Ca. 90032

P.B. METALS & SUPPLY CO.
Maywood, Ca. 90270

PIONEER-WESTERN PAINT CORP
Los Angeles, Ca. 90062

QUANTUM DYNAMICS, INC.
Tarzana, Ca. 91356

RHODES & MAINE, INC.
Anaheim, Ca. 92801

SAM'S ELECTRONICS, INC.
National City, Ca. 92050

SOLID STATE TECHNOLOGY, INC.
Santa Clara, Ca. 95050

TECHNOLOGY DEVELOPMENT CORP
Sunnyvale, Ca. 94086

THERMAL DEVICES, INC.
Northridge, Ca. 91324

TIDE ELECTRONICS, INC.
Hackensack, N.J. 07601

TOYAMA COMPANY
Harbor City, Ca. 90710

TREVINO ELECTRONICS, INC.
Dallas, Tx. 75229

U.S. ENGINEERING CO., INC.
Sherman Oaks, Ca. 91403

WELCO ELECTRONICS, INC.
Los Angeles, Ca. 90041

WESTERN SWITCHES & CONTROLS, INC.
Tustin, Ca. 92680

WESTERN TECHNICAL ASSOCIATES, INC.
San Diego, Ca. 92112

ATTACHMENT 6

SMALL DISADVANTAGED BUSINESS CONCERNS PLAN
SUMMARY

MINORITY BUSINESS ENTERPRISE

SUBCONTRACTING PLAN SUMMARY

1.0 REQUIREMENT

This Minority Business Enterprise Subcontracting Plan Summary is submitted in accordance with U. S. Department of Transportation Request for Proposal Number DOT-FR-4384/sa, Part 6, and Teledyne Ryan Aeronautical Request for Quotation Number T-4860.

2.0 BACKGROUND

2.1 Dynamic Sciences has been supportive of the Government's Minority Business Enterprise Program since the company was formed in 1972. Indicative of our support has been the establishment of policies dictating the use of minority subcontracting, appended herewith:

2.1.1 Minority Business Enterprise Program Policy Number 208, dated July 7, 1977, Revision 1.

2.2 Mr. Tom Appleton of our Procurement Department is assigned as DSI's Minority Business Enterprises Liaison Officer. His duties for contracting with minority firms are outlined in DSI's Policy No. 208.

3.0 PROGRAM PLAN

DSI's involvement in the DOT Locomotive Evaluator Program lends itself to minority subcontracting in the areas of electronic hardware and software design.

3.1 Numerous minority businesses are located in the Los Angeles area. DSI has contacted three specific firms for possible involvement in this program as follows:

AVW Electronics Systems, Inc.
25 Ash Avenue
Inglewood, CA 90301

AMEX Systems, Inc.
3355 El Segundo Boulevard
Hawthorne, CA 90250

Computer Software Analysts, Inc.
3701 Stocker Street, Suite 202
Los Angeles, CA 90008

Specific involvement will be in the FRA CES numbers 5.0 and 6.0 dealing with the Logic and Data Controllers. It is DSI's goal to award approximately $200,000 in subcontracts to minority firms.

3.2 Program reporting of minority subcontracts to upper management will be the responsibility of the Program Manager, who will ensure that all engineering departments identify specific tasks that can be subcontracted to minority enterprises. This requirement is in addition to the responsibilities of the Minority Business Enterprises Liaison Officer.

3.2.1 Reporting of minority subcontracts will be provided to TRA and DOT representatives at the scheduled PDR's, CDR, and in the monthly status reports.

3.2.2 Additional minority enterprises will be identified for potential work as the program develops, if applicable. Sources for possible consideration will be obtained from the following:

3.2.2.1 Federal Railroad Administration Minority Business Resource Center;

3.2.2.2 National Minority Purchasing Council;

3.2.2.3 California Minority Business Enterprises Directory.

COMPANY PROCEDURE

MINORITY BUSINESS ENTERPRISES PROGRAM

PURPOSE

To define the practice for establishing the Minoroty Business Subcontracting Program as an integral part of the procurement decision-making process.

REFERENCES

Minority Business Enterprises Program Policy No. 208.

DEFINITION

A Minority Business Enterprise is a firm that is owned at least 50% by Negroes, Spanish-speaking American persons, American-Orientals, American-Indians, American-Eskimos, or American Aleuts, or, in the case of a publicly-owned business, at least 51% of the stock is owned by such minority group members. For statistical reporting purposes, all minority firms, regardless of size, are classified as Small Business concern.

ACTIVITIES AFFECTED

All Activities.

PRACTICE

The Material Activity, as a matter of Company policy, participates in the Minority Business Enterprises Program as declared by the Congress.

A special effort will be made to identify, create procurement opportunities, solicit, and fairly consider minority businesses for subcontracting, within the limits of their capabilities and consistent with efficient contract performance. To this end:

(a) solicitations, time periods for bidding, and delivery schedules will be set to enable known minority businesses to compete;

(b) procurements will be reviewed for possible breakout into economic quantities suitable for procurement from known minority business concerns;

(c) make-or-buy deliberations will include adequate and timely consideration of known minority business capabilities.

(d) Developmental work likely to lead to production will be examined for possible placement with known minority business concerns.

(e) Specifications, drawings, and other relevant data will be made available so that qualified known minority business concerns are not handicapped in preparing bids.

(f) To the extent possible, counseling or other forms of proper assistance will be given to help known minority businessmen obtain awards for which they can qualify, and relations with minority suppliers will be supportive.

The Minority Business Liaison Officer, designated by DSI will be responsible for:

(1) Maintenance of records showing procedures which have been adopted to comply with ASPR provisions.

(2) Providing adequate and timely consideration of the potentialities of known MBE firms in all "Make or Buy" decisions.

(3) Establishment of a source list of MBE firms.

(4) Maintain records on awards to MBE firms on the source list and undertake specific efforts to identify and award contracts to such firms.

(5) Cooperate with the Contracting Officer in any studies and surveys of Company's Minority Business Enrerprises procedures and practices that the Contracting Officer may from time to time conduct.

(6) Submit periodic reports of subcontracting to known MBE firms with respect to the records referred to (1) above.

The Company contractually obligates its major suppliers to execute minority business programs as a condition of being awarded the following types of purchase orders:

* $5,000 or more (Actual or Potential)	Company Purchase Order General Provisions contain the ASPR Clause 7-104.36(a), "Utilization of Minority Business Enterprises," which urges suppliers to establish Minority Business Programs.
* $500,000 or more and judged by Material Management to offer substantial subcontracting possibilities	Company Purchase Order General Provisions contain the ASPR Clause 7-104.36(b). "Minority Business Enterprises Subcontracting Program," which requires suppliers to establish Minority Business Programs.

Subcontracts which are to be performed entirely outside the United States, its possessions, and Puerto Rico, and purchase orders for services which are personal in nature are exempt from the requirements of this Practice.

COMPANY PROCEDURE	PAGE 1 of 1	NUMBER 208	REV.
	EFFECTIVE DATE July 7, 1977	RELEASE DATE July 7, 19—	
MINORITY BUSINESS ENTERPRISES PROGRAM	APPROVED BY		

PURPOSE

The define the policy relevant to the establishment of and participation in a Minority Business Enterprises Program.

ACTIVITIES AFFECTED

All activities.

GENERAL

Minority group members comprise more than 20% of the nation's population. To develop their participation in the free-enterprise system as entrepreneurs is a significant national goal. DSI, as a Government contractor, is pledged to help develop these entrepreneurs by providing maximum practicable opportunities to participate in the performance of Government contracts.

POLICY

It is the policy of DSI to participate fully in the Government's Minority Business Enterprises Program. A special effort will be made to identify, create procurement opportunities, solicit, and fairly consider minority business for subcontracting, consistent with efficient contract performance.

DSI shall appoint a Minority Business Liaison Officer and implement an affirmative Minority Business Enterprises Program. It is the specific responsibility of Directors and all other applicable managerial and operating personnel to adhere to, and actively support, the Company's Minority Business Enterprises Program goals and requirements.

Material will maintain records of Minority Business Enterprises activity for quarterly data submission to the Small Business Administration and DCASR.

ATTACHMENT 7

SMALL DISADVANTAGED BUSINESS CONCERNS

LATHE TASKS AND SERVICES
AND PROSPECTIVE SUBCONTRACTORS

ATTACHMENT 7

PART I SDBC KNOWN TASKS AND SERVICES

A. Technical Manuals

1. Writing

2. Illustrating and Photos

3. Typing

4. Printing

B. Printed Circuit Boards and other Electronic Fabrication/Assembly

C. Mockup of LATHE area and Structure including Cat Walk and Ladder Assembly.

D. Monorail supports, beams and hoist assembly.

E. Cab handling dollies and Sling Assemblies

F. Photographic Services

G. Motion Picture Post Production

H. Film Location Management

I. Systems Design - Experimental Development Subsystem.

J. Systems Programming - Real Time

K. Systems Programming - Non-Real Time

L. Engineering Drafting Services

M. Raw Stock Supplies

1. Metal and Extrusions including subassemblies
2. Wood and other mockup materials
3. Fasteners

N. Manufacturing Processes including welding, plating and painting.

PART II

SMALL DISADVANTAGED BUSINESS CONCERNS
CANDIDATE COMPANIES FOR PART I TASKS

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
A&D PUBLICATIONS 18455 Burbank Blvd. Tarzana, CA 91356 214-996-0556	Established in 1974 and conducts a Tech Manual preparation business in Southern California	Rockwell International Colony Life Insurance Univ. of Southern Calif.
ARLENE'S TYPESETTING SERVICE 8031 Linda Vista Road San Diego, CA 92111 714-279-3660	Established in 1977 and conducts a typesetting service in the San Diego area.	Univ. of California General Dynamics NOSC/San Diego
DATA COMPOSITION OF AMERICA, INC. 2034 N. 3rd St., Phoenix, Arizona 95018 602-253-5990	Established in 1976 and conducts a computerized photocomposition business internationally.	NASA/Houston Lockheed Aircraft McDonnell Douglas

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
ESCA-TECH CORPORATION 3001 Reohill Ave. Costa Mesa, CA 92626 714-751-3630	Established in 1975 and provides a computerized image processing service internationally.	Honeywell, Inc. Ford Aerospace Litton Industries
ILLUSTRATIVE TECHNICAL SERVICES 4826 S. Figueroa St. Los Angeles, CA 90037 213-231-2752	Established in 1969 and conducts a graphics and typesetting service in Southern Calif.	Rockwell International University of California TRW
MICHAEL SANCHEZ & ASSOC. 672 S. LaFayette Park Place Los Angeles, CA 90057 213-386-3816	Established in 1965 and conducts graphics and design business in Southern California.	Lockheed Hughes Aircraft Hang Ten International
PACE PUBLICATIONS ARTS 3531 E. Miraloma Anaheim, CA 92806	Established in 1961 and conducts graphics and publications services business internationally.	IBM Xerox Rockwell International Alcoa

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
LARRY MONTOYA & SON 6842 Janney Ct, San Diego, CA 92111 714-278-7527	Established in 1959 as a general contractor.	City of San Diego Pacific Telephone Co. State of California License No. B-1/180858
KIRCHEVAL & ASSOC. INC. 7844 Convoy Court San Diego, CA 92111 714-571-0520	Established in 1974 as an engineering contractor.	General Atomics Rohr Industries AMETEK-Straza License No. 298694A
LUSARDI CONSTRUCTION CO. P.O. Box 35 San Marcos, CA 92069 714-744-3133	Established in 1970 as an engineering contractor.	Rockwell International Alpha-Beta Standard Oil of Calif. License No. 251151A
CHULA LUMBER CORP. 814 W. 24th St. National City, CA 92050 714-477-3101	Established in 1964 and conducts lumber and building materials supply business in San Diego area.	U.S. Navy City of San Diego NCR General Dynamics

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
LUMBER PURVEYORS CO. 690 "L" St. National City, CA 92050 714-426-6933	Established in 1970 and conducts lumber and plywood business in San Diego area.	U.S. Navy National Steel & Ship Rohr Industries
BRAZILE METALS SERVICE 2554 E. 25th St. Los Angeles, CA 90058 213-583-6922	Established in 1975 as a franchised distributor of aluminum sheet, plate, rod, bar and tubing.	Rockwell International Honeywell Rohr Industries
METAL SUPPLY INC. 2070 E. 37th St. Los Angeles, CA 90058 213-232-6133	Established in 1961 as a franchised distributor of steel bars, shapes, sheets and plate.	Lockheed McDonnell Douglas Hughes Aircraft
PB METALS & SUPPLY CO. 3409 E. Slauson Ave. Maywood, CA. 90270 213-585-2159	Established in 1976 as a franchised distributor of titanium, aluminum, steel and hi-temp. alloys.	Rockwell International Bendix Corp. Beckman Instruments

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
A-1 NUT & BOLT CO., INC. 2656 Pacific Park Dr. Whittier, CA 90601 213-685-5155	Established in 1969 and distributes threaded fasteners statewide.	State of Calif. Rockwell International McDonnell Douglas
CERTIFIED FASTENERS INC. 10105 Shoemaker Ave. Santa Fe Springs, CA 90670 213-944-9734	Established in 1960 and conducts business nationally.	Aerojet General Bendix Corp. Grumman Aerospace
ACUDATA SYSTEMS 16222 S. Maple Ave. Gardena, CA 90248 213-327-1824	Established in 1970 and conducts business nationally. Designs and manufactures circuit boards, wire and cable assemblies.	TRA U.S. Army U.S. Navy U.S. Air Force Rockwell International Hughes Aircraft
AMEX SYSTEMS, INC. 12901 Crenshaw Blvd. Hawthorne, CA 90250 213-679-8225	Established in 1971 and conducts business nationally. Designs and manufactures circuit boards, wires and cable assemblies.	TRA Rockwell International Northrop Corp. NASA/JPL.

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
CONTRACT SYSTEMS ASSOCIATES Bldg. 2067 Brown Field San Diego, CA 92173 714-426-8361	Established in 1973 and conducts business in San Diego region. Performs assembly of circuit boards and electrical harnesses.	TRA NELC/San Diego Rohr Industries Stromberg Datagraphics
EPA ELECTRONICS, INC. 220 Demeter Street East Palo Alto, CA 94303 415-323-2461	Established in 1968 and conducts business internationally. Designs and manufactures electronic instruments and components.	TRA Hewlett-Packard International Business Machines Lawrence Radiation Laboratory
SAM'S ELECTRONIC ASSEMBLY, INC. 105 W. 35th St. National City, CA 92050 714-426-3401	Established in 1973 and conducts business in San Diego region. Performs assembly of harnesses, circuit boards and electro mechanical devices.	TRA Solar Turbines International General Dynamics Electronics NOSC/San Diego
WILDER ELECTRONIC ENTERPRISES P.O. Box 254 Independence, CA 93526 714-878-2116	Established in 1976 and conducts business nationally. Performs assembly of circuit boards and cable assemblies.	TRA Stromberg Datagraphics, Boeing Aerospace Electronics Sperry Univac.

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
AVW SYSTEMS 125 N. Ash Ave. Inglewood, CA. 90301 213-671-9461	Established in 1978 and conducts technical film production, systems engineering and programming business nationally.	TRW, U. S. Army Missle Command, General Instrument
APPLIED ELECTRO TECHNOLOGY 2220 S. Anne St. Santa Ana, CA. 92704 714-556-6570	Established in 1973 and manufactures relay time delays and flasher warning lights nationally.	Lockheed Aircraft, Bell Helicopter, Naval Undersea Center
ATLAS FIRE EQUIPMENT CORP. 312 11th Ave. San Diego, CA. 92101 714-427-1987	Established in 1958 and wholesales fire extinguishers and other emergency equipment statewide.	Naval Supply Dept., San Diego State University, Burroughs Corp.
CEDILLOS TESTING COMPANY 12309 Woodruff Ave. Downey, CA. 90241 213-923-7209	Established in 1973 and conducts non-destructive testing business in Southern California.	Lockheed Aircraft, General Electric, McDonnell Douglas
DALE FUKAMAKI INC. 3860 Crenshaw Blvd. Los Angeles, CA. 90008 213-299-5006	Established in 1974 and is distributor of material handling equipment and systems in Southern California.	Beckman Instruments, Rockwell International, C. F. Braun Corp.
ELECTRO COMPONENTS DISTRIBUTION 1630 S. Sunkist St. Anaheim, CA. 92806 714-634-0222	Established in 1974 and is a distributor electrical merchandise, motor controls and switches in Southern California	Beckman Instruments, Hughes Aircraft, Atlantic-Richfield
FACTORY SUPPLY CO. INC. 8981 Rose Ave. Montclair, CA. 91763 714-624-8046	Established in 1963 and wholesales industrial tools and supplies statewide.	General Telephone, Kaiser Steel, Bechtel Corp.

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
FRANKLYN/LESLIE'S INC. 711 S. Grandview St. Los Angeles, CA. 90057 213-487-2234	Established in 1951 and is a wholesaler of drafting, engineering and audio/visual products.	General Services Administration, TRW, Lockheed Missile and Space
IND-X-RAY LABORATORIES, INC. 3490 Union Pacific Ave. Los Angeles, CA. 90023 213-261-4156	Established in 1940 and conducts radiographic inspection business statewide.	Lockheed, McDonnell-Douglas, Northrop Corp.
LA LUZ CINEMA VIDEO PRODUCTIONS INC. 5380 East Whittier Blvd. Los Angeles, CA. 90021	Established in 1977 and conducts motion picture production business internationally	Dept. of Health, Education and Welfare, McCulloch International, Raytheon
MDS ENGINEERING COMPANY 3030 Main St. San Diego, CA. 92113 714-238-1468	Established in 1976 and conducts electronic and electrical equipment installation business on national basis.	Naval Supply Center, Federal Aviation Administration, General Services Administration
META/4 PRODUCTIONS INC. 8727 W. 3rd. St. Los Angeles, CA. 90048 213-273-6075	Established in 1975 and produces motion pictures internationally.	Carnation Co., Dept. Health Education and Welfare, Dart Industries
MOBILITY SYSTEMS AND EQUIPMENT CO. 6151 W. Century Blvd. Los Angeles, CA. 90045 213-641-3606	Established in 1970 and designs and manufactures ground support equipment and rapid transit systems internationally.	Western Airlines, Air Canada, Continental Airlines
MOCTESUMA ESPARZA PRODUCTIONS 2036 Lemoyne St. Los Angeles, CA. 90026 213-660-5292	Established in 1974 and produces motion pictures internationally.	McGraw-Hill Broadcasting, New York State Dept. of Education, National Institute of Health

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
OLYMPIC CAMERA 828 W. Olympic Blvd. Los Angeles, CA. 90015 213-746-0575	Established in 1969 and sells cameras and photographic supplies to wholesale trade nationally.	Los Angeles Unified School District, Southern California Edison Co., McCellan AFB
PAGOS CORPORATION 10889 Wilshire Blvd. Los Angeles, CA. 90024 213-477-4591	Established in 1971 and provides services in the areas of optical physics and engineering.	Hughes Aircraft, Rockwell International, Naval Underseas Weapon Command
PECK SALES COMPANY 7326 Laurel Canyon Blvd. North Hollywood, CA. 91605 213-875-0172	Established in 1974 and manufactures and distributes photographic and graphic arts supplies nationally.	USC Medical Center, Bunker Ramo, Kaiser Permanente
RCI MICROFILM, INC. 111 Main St. El Segundo, CA. 90245 213-322-8220	Established in 1970 and performs planetary and rotary filming internationally.	ITT Gilfillan, Naval Supply Center, Rockwell International
RIBCO SHIELDING PRODUCTS 1697 Cordova St. Los Angeles, CA. 90007 213-731-0819	Established in 1970 and designs and manufactures EMI shielding materials nationally.	Aerospace Corp., Honeywell Inc., Litton Industries
ROYAL COLOR LAB 2112 S. Atlantic Blvd. City of Commerce, CA. 90040 213-266-6596	Established in 1970 and conducts a color film processing service in Southern California.	Rockwell International, Los Angeles City School District, Los Angeles Economic Development Corp.
SCALE MODEL COMPANY 401 W. Florence Inglewood, CA. 90301 213-674-1534	Established in 1974 and constructs scale model and special effects upon client request.	TRW, Hughes Aircraft, Litton Industries

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
STANDARD ENGINEERING INC. 44800 Industrial Dr. Fremont, CA. 94538 415-657-7555	Established in 1972 and designs and manufactures real time computer interface systems.	NASA/Goddard, NASA/Houston, Lawrence Radiation Laboratory
SUBIA INC. 5419 McConnell Ave. Los Angeles, CA. 90066 213-390-6219	Established in 1971 and provides technical copy writing and illustration nationally.	Lockheed Aircraft, TRW, Hughes Aircraft
SYNTRONIX INC. 15010 Ventura Blvd. Sherman Oaks, CA. 91403	Established in 1967 and provide data processing and microfilm services in Southern California.	Litton Industries, Blue Cross, Todd Shipyard
THERMAL DEVICES INC. 8645 Yolanda Ave. Northridge, CA. 91324 213-343-4114	Established in 1971 and designs and manufactures temperature detectors, thermocouples, and digital readout devices.	Rockwell International, Northrop Corp., Aerospace Corp.
THOMPSON PAPER CO. 3029 N. Alameda St. Compton, CA. 90222 213-636-2506	Established in 1973 and wholesales industrial paper products, tapes and packaging materials statewide.	Shell Oil, Hughes Aircraft, Crocker Bank
UTILITY INDUSTRIAL SUPPLY INC. 5166 W. Jefferson Blvd. Los Angeles, CA. 90016 213-933-9172	Established in 1956 and wholesales lighting fixtures, cables and industrial supplies statewide.	Continental Airlines, Western Airlines, MGM Studios
VER SALES INC. 810 N. Lake St. Burbank, CA. 91502 213-849-6531	Established in 1972 and is a distributor of wire rope, cables and slings statewide.	State of California, Atlantic Richfield, Chrysler Corp.
WESTERN TECHNICAL ASSOCIATES 5730 Arbor Vitae St. Los Angeles, CA. 90045 213-641-6260	Established in 1968 and provides systems management technical support and manufacturing services nationally.	Naval Air Systems Command, Hughes Helicopters, Federal Aviation Administration

COMPANY	CAPABILITY	PRINCIPAL CLIENTS
ZAMUDIO CORPORATION 7319 Clairemont Mesa Blvd. San Diego, CA. 92111 714-565-6145	Established in 1975 and wholesales industrial paper and packaging products in San Diego area.	Ronr Industries, General Atomics, Wickes Corp.

ATTACHMENT 8

SMALL DISADVANTAGED BUSINESS CONCERNS

SUBCONTRACTING PLAN

BUY LIST

ATTACHMENT 8

BUY LIST

35mm Motion Picture Projectors, similar or equal to "Simplex" models produced by:

E. Leitz, Inc.
Industrial Park
Rockleigh, N. J. 07647
FSCM No. 35643

8 Ch. Audio Tape Recorders, similar or equal to "NAGRA", models produced by:

Kudelski, S. A.
Route-De-Geneve, 1033
Cheseaux-Sur-Lausanne, Switzerland

Master Intercom Unit, similar or equal to "EXTACOM GM-1204", as produced by:

Fisher Berkeley Corporation
5800 Chirstie Ave.
Emeryville, CA 94608
FSCM No. 29915

Video Switcher and Emote Operator Panel, similar or equal to "System 21" as produced by:

Dynair Electronics, Inc.
5275 Market St.
San Diego, CA 92114
FSCM No. 11650

1. X-Y Plotters, 3 Color, P/N 4662
2. Wave Form Monitors, P/N 525 or 528
3. Wave Form Monitors, P/N 525 or 528
4. Wave Form Monitors, P/N 1480 NTSC
5. Anser Video Analyzers
6. Vector Scopes, P/N 1420 NTSC

All the above to be similar or equal to noted items as produced by:

Textronix, Inc.
14150, S. W. Karl Braun Drive
Beaverton, Or. 97077
FSCM No. 80009

Digital Effects Generators, similar or equal to P/N DPE 5000 as produced by:

Micro Consultants, Ltd.
Interface House
Croydon Road
Caterman, Surrey
CR36QB, England

Video Cassette Recorders, similar or equal to P/N CR-6060U as produced by:

Japan Victor Corp.
1011 W. Artesia Blvd.
Compton, CA 90220

Biological Telemetry System, similar or equal to items produced by:

Konigsberg Instruments, Inc.
2000 E. Foothill Blvd.
Pasadena, CA 91107
FSCM No. 15709

NTSC/RGB Code Converters, similar or equal to P/N TCE-3000 as produced by:

Telemation, Inc.
2195 South 3600 West
Salt Lake City, Utah 84115
FSCM No. 32791

Occulometer Subsystem and TV Camera, similar or equal to item produced by:

Honeywell, Inc.
Defense Electronics Div.,
Radiation Center,
2 Forbes Road
Lexington, MA 02173
FSCM No. 81395

Graphics Light Pen Controllers, similar or equal to P/N GMR-27 as produced by:

Grinnell, Inc.
2986 Scott Blvd.
Santa Clara, CA 95050

Color CRT Monitors, similar or equal to P/N 5322RS19 as produced by:

Conrac Corporation
600 W. Rimsdale Ave.
Covina, CA 91722
FSCM No. 08904

Electronic Equipment Consoles, Multiple-Bay, similar or equal to "Custom-Line 33", as produced by:

AMCO Engineering Company
7333 W. Ainslie St.
Chicago, Ill. 60656
FSCM No. 98587

Strip Chart Recorders similar or equal to P/N 260 as produced by:

Gould Inc.
Instrument Systems Div.
3631 Perkins Ave.
Cleveland, OH 4414
FSCM No. 29328

Teleprinters similar or equal to Model No. LA180 as produced by:

Digital Equipment Corp.
147 Main St.
Maynard, MA 01754
FSCM No. 15476

Synchronous Generators similar or equal to Model No. 212 as produced by:

Minnesota Mining & Mfg. Co.
Electronic Products Division
3M Center
St. Paul, MN 55101
FSCM-No. 76381

Color Analyzers similar or equal to products made by:

Hazeltine Corp.
Pulaski Road
Greenlawn, N.Y. 11740
FSCM No. 80249

Black and white Video Monitors similar or equal to model VE-909 as sold by:

Hitachi Sales Corp. of America
401 W. Artesia Blvd.
Compton, CA 90220

High Resolution Monitors similar or equal to Model WV-5400R produced by:

Electrohome Ltd.
809 Wellington St., N.
Kitchener, Ontario, Canada
FSCM No. 02324

1. Editor, similar or equal to Model ECS-103
2. Time Code Reader System, similar or equal to Model ICR-100
3. Audio/Video Switcher, similar or equal to Model AVS-100
4. VTR Interface, similar or equal to Model IFP-2860
5. Status Display Generator, similar or equal to Model SDG-100

All above produced by:

Convergence Corporation
17935 Sky Park Circle
Irvine, CA 92714

1. TV Cameras with Screen Splitter, similar or equal to Model 2850
2. Synchronous Generator, similar or equal to Model 2710

The above produced by:

COHU, Inc.
5725 Kearney Ville Road
San Diego, CA 92112
FSCM No. 05159

1. Editing VTR similar or equal to Model VO-2860
2. Color Monitor, similar or equal to Model PVM-1211

Sold by:

Sony Corporation of America
Video Products Division
700 W. Artesia Blvd.
Compton, CA 90220
FSCM No. 56472

APPENDIX E

LATHE PROGRAM

DRAWING SYSTEM DESCRIPTION

The project systems engineering organization assigned to the LATHE program has the responsibility of producing drawings to fulfill the requirements of the contract. Attachment 1 to the contract is the Statement of Work (S.O.W.) and in paragraph 2.9.6, generally defines the drawing requirements.

In order to meet the realistic needs of the program, amplification and clarification of the contractual requirement is necessary. This document is intended to provide the necessary guidelines to fulfill these needs. The intent of these guidelines is: (1) to achieve drawing consistency, (2) provide adequate planning/manufacturing information, (3) to provide release and distribution procedures and (4) to produce the required drawings within the confines of a limited budget.

The subject areas covered in this drawing system description are:

1. Drawing Numbering System
2. Preparation of drawings
3. Preparation of Parts/Materials Lists
4. Drawing Release Procedure
5. Drawing distribution
6. Change Control
7. Drawing Status for Final Submittal

1. LATHE DRAWING NUMBERING SYSTEM

The drawing numbering system to be implemented for the LATHE program will provide identifying digits for the model number, the subject subsystem and the functional area ("group") responsible for producing the drawing. Each drawing number will consist of 8 digits (which may be expanded, if the need arises, to 9 digits).

The model number assigned to the LATHE is "404" and will constitute the first three digits of the drawing number.

The fourth digit of the drawing number will signify the applicable subsystem in accordance with assigned numerical designators as shown in TABLE 1A. These designators are the same as the second digit of the subsystem WBS and also of the C.E.S. number (Cost Estimating System).

The functional area designator will be the fifth digit in the number sequence. This digit will be in accordance with assigned designators in TABLE 1B.

The last three digits will be referred to as drawing number sequence digits and may be used as a purely chronological sequence or, at the option of the responsible principal engineer, may be used to categorize the type of drawing within the subsystem; such as schematics, Engineering Test Requirements, etc. [REFER to Table 1C for example of the use of the last digit (of the 3 digit sequence) to designate the type of drawing represented.]

DRAWING NUMBERING SYSTEM

DRAWING NUMBER SEQUENCE: (ZZZ)

Sequence Nos. 001 thru 499 will be reserved for TRA in each subsystem series.

Sequence Nos. 500 thru 999 will be reserved for DSI in each subsystem series.

1 NOTE: If DSI chooses not to use the functional subsystem sequencing, as illustrated, they will use functional s/s "9" as their designator, followed by Drawing Number Sequence (3 digits which may be expanded to 4 digits if required) i.e.

404 x 9ZZZ

In house (TRA) drawing number assignment will be controlled by the release group. The release group will keep the drawing number assignment record book and will maintain this record in a manner similar to other programs. Where individual functional areas opt to use the last three digits to categorize drawing types, this shall be coordinated with the release group.

Drawing sequence numbers assigned to DSI will be provided as a block of numbers. TRA drawing records will be completed as required information is received from DSI.

The following shows the digital breakdown of the drawing numbering system:

MODEL NO.	END ITEM OR WBS	FUNCTIONAL CODE	DWG. NO. SEQUENCE
404	X	Y	ZZZ

	SUBSYSTEM W.B.S. OR END ITEM DESIGNATOR — FOURTH DIGIT (X)
1	CAB SUBSYSTEM
2	MOTION S/S
3	VISUAL S/S
4	EXPERIMENTER/OPERATOR S/S
5	LOGIC CONTROLLER S/S
6	DATA CONTROLLER S/S
7	EXPERIMENT DEVELOPMENT
8	EXPER. TERRITORY DEV. S/S
9	EVALUATOR SYSTEM (OVERALL)
0	RESERVED

TABLE 1A

	FUNCTIONAL DESIGNATOR — FIFTH DIGIT (Y)
1	INSTALLATIONS
2	MECHANICAL
3	STRUCTURAL
4	HYDRAULIC
5	PNEUMATIC
6	ELECTRICAL/ELECTRONIC
7	RESERVED FOR FUTURE USE
8	RESERVED FOR FUTURE USE
9	RESERVED 1
0	RESERVED FOR FUTURE USE

TABLE 1B

TYPE OF DRAWING USING LAST DIGIT OF 3 DIGIT SEQUENCE	
LAST DIGIT	TYPE OF DRAWING
0	ASSY. OR MAJOR SUB-ASSY.
1	ENGINEERING TEST REQUIREMENTS
2	SCHEMATIC, WIRING DIAG. OR WIRE LIST
3 thru 9	OPEN FOR ALL OTHER TYPES OF DRAWINGS

TABLE 1C

2. PREPARATION OF DRAWINGS

Drawings produced for the LATHE program will be prepared in accordance with good commercial practices. This means that standard drawing forms and general format in use by Teledyne Ryan will be used on this program.

The drawings produced must be interpretable by low-skill level technicians and shop personnel and without the assistance of detailed planning paper or engineering personnel. It also means that references to "standard" Ryan procedures (EPFS' or similar documents) will not be permissable. This will dictate the deletion of EPFS-100 Block from the standard TRA format. Where reference to procedures is required on drawing, they will either be explained in the general notes of the drawing or called out to be in accordance with commercially accepted standards such as the National Electrical Code, etc. Reference designators shall be assigned using ANSI Y32.16 1975 as deemed necessary and appropriate to satisfy the design concept. The unit number assigned shall be the appropriate end item number.

Other specific details relative to information to be included on LATHE drawings will be covered by issuance of Program Directives as required.

3. PREPARATION OF MATERIALS LISTS

Separate parts lists will be provided on the LATHE program. They will be prepared and handled in general conformance with the normal engineering procedures. Since this program is projectized and handled in accordance with special procedures generated within the project, certain documents will be treated by specific handling. Ordering of materials and parts will fall into this special handling category. No parts will be requisitioned by procurement in the normal manner from parts lists or Advanced List of Materials (ALM's). All requisitions will be generated within the project by the Fabrication, Test & Installation principle Engineer. He will be the recipient of all ALM's for advance ordering and all parts lists for normal procurement.

ALM's will be prepared for all long-lead items. Long-lead determination is to be made by the principal engineer responsible for the sub-system. ALM's will fall into two categories. The first will be for those items which will fall into a bulk materials or multiple use category (See Sample 1A). This category will cover materials to be used on more than one assy/sub assy or end item and will be issued against a fictitious drawing for each functional area. The reason for this type handling will be to take advantage of quantity purchase price breaks to be realized by such handling.

The second category ALM will be for those long lead items which are peculiar to a specific assy, sub assy, detail part, etc. and will be written against the drawing on which it will eventually be used. This category will be similar to normal ALM preparation.

All ALM's will be issued (internally released within the project) to the Fabrication, Test & Installation Principle Engineer who shall have responsibility for preparation of Purchase Requisitions.

For purposes of accountability, when the separate drawing Parts List are prepared, they shall make reference to those items which have been ALM's. This reference will be by an entry in the "MAT'L CODE" column of the parts list by indicating the ALM number which ordered the specific items or bulk material. All other items on the list of material will be ordered at this time in the same manner as the ALM's.

4. DRAWING RELEASE PROCEDURE

All drawings for the LATHE program will be prepared by personnel assigned to the program. When drawings have been completed and are ready for release, they will be "in-group" checked and the check block signed off by the person checking the drawing. Drawings will then be signed by the principal engineer. He will sign the group engineers block, determine other (minimum) signatures required and initials for those not required, obtain Fabrication, Test & Installation Principal Engineer's signatures and Senior Project Engineers signature (or designee), before transmittal to the release group. In summary, the signatures required prior to submittal for release will be: (see example)

Other data required on drawings, which the release group will check for are NEXT ASSY/USEAGE, and CONTRACT NUMBER.

Release group will prepare (minimum information) release record card and submit vellums to reproduction for limited copy repro and distribution.

Vellums will be returned to release where they will be filed in a separate LATHE file.

5. DRAWING DISTRIBUTION

LATHE drawing distribution will be limited to essential users. This distribution will be as follows:

RELEASE RECORDS FILES	1 copy
PRINCIPAL ENGINEER	1 copy
PROGRAM FILES	1 copy
FABRICATION, TEST & INSTALLATION PRINCIPAL ENGINEER	2 copies
ENGINEERING BLUEPRINT FILE	2 copies

6. CHANGE CONTROL

Because of the nature of the LATHE program, wherein manufacturing will fall into one of three general categories (PROJECT MFG., TRA SHOP BUILD OR OUT-OF-PLANT PROCUREMENT), fast response change implementation will be imperative. The contract (S.O.W., para. 2.3) does not require any formal configuration management control, and therefore, allows the program to institute change controls which will allow an expedient method of implementation. Even though, formal change control is not required, it is extremely important that the system instituted does afford a realistic method of control and that the current released documentation does represent the current design. This philosophy rules out the use of red-lined prints and other miscellaneous uncontrollable expediency methods.

Because the release procedure discussed in paragraph 4 above provides a fast response release, it follows that change control using the Engineering Order (E.O) system with minor deviation from normal engineering procedure and released in the same manner as described for drawing release in para. 4, will provide an adequate change method. The exception will be in allowing the use of E.O. supplements on a limited basis for changes of a magnitude which are not realistic to document on the 8 1/2 x 11 E.O. format.

7. DRAWING STATUS FOR FINAL SUBMITTAL

Drawings will be updated for final submittal by incorporation of all outstanding E.O.'s (and E.O. supplements). Those updated drawings will reflect, in exact detail, the hardware configuration being delivered.

R-2291
Rev 5-69

ADVANCE LIST OF MATERIAL (ALM) (BULK MAT'L & OTHER MULTIPLE USE ITEMS)

TYPE OF RELEASE: ☒ R & D ☐ PRODUCTION

MODEL	WORK ORDER	CONTRACT OR SALES ORDER	EFFECTIVITY	ALM NO.	REV
404	△1		1	404X6000 △1	

PREPARED BY / DATE	STDS/REL / DATE	DATE	DATE	DWG NO.
Designer	—	—	—	△1

CHECKED BY / DATE	PROJECT DESIGN / DATE	FAB, TEST & MFG / DATE	RELEASE / DATE	
Principal Engr	SR. PROJECT ENGR.	PRINCIPAL ENGR	L. SMITH DESIGNEE	☐ EM ☐ ELECTR ☒ AERO

ITEM	PART NO. OR SIZE	DESCRIPTION	SPECIFICATION OR MFGR	USED ON △1	DATE DUE	QUANTITY PER UNIT	QUANTITY THIS RELEASE	PURCHASE REQ'N
1	#20 AWG	7 STRAND INSULATED WIRE	BELDEN MFG. CO.	40416000	6/27/8X	—	2K FT.	
2				40426000		—	5K FT.	
3				40436000		—	1K FT.	
4	#20 AWG	7 STRAND INSULATED WIRE	BELDEN MFG. CO.	40456000	6/27/8X	—	3K FT.	

SAMPLE
1-A

VOLUME II – QUALITY ASSURANCE PLAN

VOLUME II

TRA QUALITY ASSURANCE PLAN
RESEARCH LOCOMOTIVE AND TRAIN HANDLING EVALUATOR
(LATHE)

1.0 SCOPE

This plan represents the overall philosophy of how Quality Assurance will be implemented and managed to verify delivery of the ~~LATHE~~ RALES system with minimum defects in accordance with contract requirements and applicable documents.

It is the intent of this plan to provide a meaningful and effective method for assuring Quality workmanship, proper configuration, and satisfactory performance of design objectives.

2.0 QUALITY PROGRAM MANAGEMENT

This program is under the direction of a Program Manager. Quality Assurance will maintain a Program Quality Engineer in constant liaison to assure compliance with Quality requirements. Program direction will be given by the TRA Program Manager and policy direction and administrative support by the Director of Quality Control.

2.1 ORGANIZATION

Quality Assurance is under the direction of Executive Management and is implemented through the Director of Quality Assurance. (See Figure 1 - Quality Organization.)

Quality Assurance activities will be coordinated by the LATHE Program Quality Engineer. The organizational pattern assures effective and economical control of the various Quality Assurance disciplines. The cooperation and efforts of the Manufacturing, Engineering, Purchasing, Production Control, etc. departments, is such that they support and complement the total Quality System.

2.2 GUIDELINES

When it is necessary to deviate from the routine type contract Quality requirements, Teledyne Ryan Aeronautical has developed a series of "Quick-Response" Quality procedures that apply to prototype, limited production applications. Quality Assurance has elected to use the operating procedure for Quick Response Development Type Programs, Number 1004 as a guideline for assuring the requirements of the contract have been met.

2.2 GUIDELINES (CONTINUED)

The Quality Control Department will continue to use the existing Quality Operations Manual as a working guide but the intent and instructions contained in Operating Procedure #1004 (attached) will take precedence and may also be subject to variations due to published Program Directives from the Program Quality Engineer. In addition, the following procedures may be utilized for reference and used as a guide:

a. Aerospace System Procedure #2001
"Expedited Release of Drawings"

b. Aerospace System Procedure #2013
"Engineering Procedure for Quick Response and Prototyping Programs"

c. Aerospace System Procedure #3014
"Test and Systems Support Procedure for Quick Response and Prototyping Programs"

As a minimum, "Best Commercial Practices" shall be utilized in all aspects of Engineering and Manufacturing operations.

2.3 DOCUMENTATION

Engineering drawings and blueprints will be controlled under a discrete and separate system from that in routine usage at Teledyne Ryan Aeronautical. A limited number of drawings and blueprints will be released by Design Engineering for manufacturing usage. Any required changes to these drawings will be immediately implemented by a coordinated effort between Engineering and Manufacturing representatives. Quality Assurance will verify proper documentation control. This system will ensure that the end item conforms to the desired engineering configuration and is documented for future reference.

Detail parts may be fabricated from Engineering Support Work Requests (ESWR) which will contain sufficient detail to fabricate and provide record of inspection for the item being built. "Make Per Print" instructions are acceptable and may be supplemented by detail planning if complexity so requires.

"Assemble Per Print" work instruction will be of sufficient detail to insure assembly to the engineering configuration. In-process inspections shall be performed and recorded at appropriate points defined by the assembly work instructions. Operation sequence will be established as necessary to insure product integrity.

2.3 DOCUMENTATION (CONTINUED)

Work instructions will be reviewed by Quality Control to assure inspection at appropriate points during fabrication and assembly.

All inspections, tests, and non-conformances will be recorded on appropriate record forms. All records, including material and process certifications, x-rays, and other non-destructive testing results will be filed in an accessible coordinated file system and retained as objective evidence of Quality. These records will be made available, for on-site review by the Contracting Officer's Technical Representative (COTR) or his designee

2.4 CUSTOMER COORDINATION

Customer witness or observance for all inspections, tests, or demonstrations conducted during the development of the LATHE system will be accomplished when so specified. The COTR will be notified at least (7) seven working days in advance of specified test/inspection operations. Reasonable facilities will be provided for the convenience of the COTR during the performance of his duties. Quality Assurance will provide the COTR with access to Quality Assurance records, documents, inspection equipment, etc. as required by contract and provide assistance in coordinating COTR inspection activities.

3.0 QUALITY CONTROL

The Program Quality Engineer as an integral member of the LATHE program team will be responsible for all aspects of the Quality Control system as is appropriate to this contract and shall include but not necessarily be limited to the following areas:

A. Pre-Release and Design Effort

   1. Quality Plan
   2. Contract Review
   3. Specification Review
   4. Prepare Special Inspection Instructions

B. Procurement

   1. Vendor Survey and Selections
   2. Purchase Documentation Review
   3. Prepare Material Acceptance Data Sheets

C. Fabrication and Assembly

   1. Work Instruction Review
   2. Process Control Surveillance

3.0 QUALITY CONTROL (CONTINUED)

3. Tooling Surveillance
4. Detail and Assembly Inspections

D. Functional Acceptance Testing

1. Acceptance Test Procedure Coordination
2. Test Procedure/Test Equipment Compatibility Coordination
3. Test Equipment Calibration and Certification Surveillance
4. Acceptance Test Witnessing

E. Product Delivery

1. Final Inspections and Test Acceptance

3.1 PRE-RELEASE AND DESIGN EFFORT

Engineering drawings, to be released to manufacture the product, shall be prepared in a fashion to minimize costs and time. Sufficient configuration definition shall be included to describe all dimensions, materials, and special manufacturing processes necessary for the part and/or assembly to perform safely and adequately its intended use. Special Inspection Instructions and Inspection Check Lists may be written to support and verify that the above complies to contract requirements.

3.2 PROCUREMENT

Suppliers furnishing material or services for use in contract end items shall be required to maintain an adequate Quality Control system. Quality Engineering evaluates all suppliers using Inspection Procedure IP-2-001 (Supplier Control) as a guide. Purchase Requisitions are reviewed for appropriate process and quality requirements. These requirements as applicable to the type of product, shall be imposed as outlined in Inspection Procedure IP-2-002 (Procurement Documents).

Material Acceptance Data Sheets are used as a controlling document to assure that complete and accurate instructions are available for purchased parts requiring inspection or test upon receipt. Due to the complexity of some items, acceptance may be at source and/or in next higher assembly.

3.3 FABRICATION AND ASSEMBLY

Work instructions or shop planning will, at a minimum, state "Make Per Blueprint" with inspection and test points specified on the planning form. These points will be of a sufficient quantity to assure a functional and physical quality product. ESWR's may be utilized for shop release of fabricated items.

Inspection and test of details and sub-assemblies will be limited to those items which cannot be readily examined at the next higher level. While performing inspection operations, the inspector shall use the following, as applicable, to determine the acceptance of parts:

Design Engineering Drawings
Manufacturing Planning
Production/Inspection Tools

The inspector shall make all checks necessary to insure conformance to the applicable drawing and related specifications. Drawing changes shall be checked to determine that the parts actually conform to the latest engineering revisions. Production tools and inspection check fixtures will be utilized as required.

When production parts are identified per engineering drawings but the manufacturing configuration deviates from the drawing, to facilitate production, the nature of such deviation shall be detailed in the planning. Inspection shall inspect to the drawing as further modified by the planning. Parts such as these are considered "in-process" and will attain Engineering configuration upon installation and acceptance at next assembly operations.

When parts are acceptable, the planning and parts shall be identified with the appropriate inspection stamps (reference Inspection Procedure IP-10-001, Inspection Stamps).

"Best Commercial Practice" will be minimum criteria for all manufacturing/inspection operations.

All details which deviate from Engineering design requirements will be segregated, documented and dispositioned through a two (2) man MRB Board consisting of specified Quality and Engineering personnel. Corrective Action as a result of material review activities will not be provided unless required to preclude recurrence of repetitive discrepancies.

3.3 FABRICATION AND ASSEMBLY (CONTINUED)

Non-conformance on assemblies will be recorded on the Inspection Squawk Sheet. Problems encountered during assembly which require engineering, tooling and/or test procedure changes, will be included on the Squawk Sheet. Disposition and corrections will be made by responsible program personnel in coordination with the Program Quality Engineer.

Personnel performing operations directly relating to product quality and requiring specific skills, such as weldors, non-destruct testers, radiographic and penetrant inspectors, etc., maintain certification status on a prescribed basis. Records on personnel certifications are on file. Processes requiring certification is under the control of the Materials and Process Laboratory. (Reference Inspection Procedure IP-4-002, (Control of Processes.)

Articles subject to handling damage during fabrication and processing will utilize special carts, boxes, containers, packaging, and transportation vehicles as necessary to prevent damage due to handling.

Quality Control through routine floor inspection activity and audits, maintains surveillance of adequacy of material handling procedures and practices. The basis of this control is Inspection Procedure IP-16-002, Inspection Surveillance.

3.4 FUNCTIONAL ACCEPTANCE TESTING

Because of the unique characteristics of equipments used to make up the total LATHE system, acceptance testing of the components, subsystems and the total system will be performed by TRA/DSI Test Engineering, with the Program Quality Engineer providing surveillance. Acceptance test plans as contractually required will be developed and submitted for COTR approval and will include, as a minimum, a description of the tests to be conducted to demonstrate compliance with performance and design requirements of the Evaluator system.

Under Quality Assurance surveillance compatibility between the Acceptance Test Procedure, test equipment set-up and test jigs and fixtures and the unit, subsystem or system under test, will be verified.

Although specific test areas at the subsystem level will be addressed in the acceptance test plan, examples of test areas are provided here as a tentative listing by subsystem:

a. Cab Subsystem

- Structural integrity of cab components
- Environment control subsystem operation

3.4 FUNCTIONAL ACCEPTANCE TESTING (CONTINUED)

- Cab control console operation
- Cab sound and lighting distribution
- Cab TV monitoring capability
- Equipment accessibility demonstrations
- Man pack system operating interface
- Eye movement tracker interface

b. Visual Subsystem

- Structural integrity of screens and installations
- Screen optical characteristics such as gain, reflectivity, resolution
- Projector system operating characteristics

c. Motion Subystem

- Hydraulic subsystem pressure drop and oil temperature control
- Frequency response characteristics
- Service access
- Hydraulic fill and bleed procedures

d. Experimenter/Operator Control Console Subsystem

- Functional characteristics, input and control
- Databus interface testing through use of universal test set

e. Logic Controller Subsystem

- Functional characteristics, hardware
- Functional characteristics, software
- Peripheral equipment interface verification

f. Data Controller Subsystem

- Functional characteristics, hardware
- Functional characteristics, software
- Peripheral equipment interface verification

g. Experiment Development Subsystem

- Functional verification, sound and video equipment
- Controller interface verification

- Console functional operation

h. Experiment Territory Development Subsystem

- Camera equipment interface
- Data logging equipment interface

The subsystem testing described above will logically develop into system level testing as the individual subsystem performance is verified and accepted. This (system) category of testing will include, but not be limited to, the following areas:

- Cab subsystem/motion base interface
- Cab subsystem/visual subsystem interface
- Experiment-operator/logic controller/data controller interface
- Experiment-operator/development/territory development subsystem interface
- Electromagnetic compatibility verification
- Overall system operation and preparation for final factory inspection

Detailed test plan shall be developed and submitted for approval 24 months from the effective date of contract.

Measuring and test equipment shall be inspected, calibrated, and identified prior to issuance to the using department. Measuring equipment shall be calibrated at periodic intervals established on the basis of stability, purpose and degree of usage. A schedule indicating calibration due dates for measuring and test equipment is maintained and controlled by the Metrology Laboratory.

The Precision Gage Laboratory shall be responsible for calibration and maintenance of all linear and optical measuring equipment used for product acceptance, including the inspector's personal tools. Quality Assurance personnel shall perform constant surveillance of measuring equipment to determine the following:

a. That equipment bears current certification identification.

b. That equipment is performing satisfactorily.

c. That equipment is not mistreated.

d. That equipment failure tag is used when operation is faulty, questionable, or out of calibration.

3.4 FUNCTIONAL ACCEPTANCE TESTING (CONTINUED)

Inspection Procedure IP-5-003, Standards Laboratory Test/ Measuring Equipment is used as guidance for this inspection surveillance.

3.5 PRODUCT DELIVERY

On completion of the initial integration acceptance testing, the total LATHE system will undergo a final factory inspection prior to tear-down, packaging and shipment to the operating site. This inspection/ test operation will be conducted with procedures having been previously submitted and approved by the COTR.

The purpose of this inspection is to verify that the total LATHE system is assembled and performs in accordance with specified requirements. The COTR shall be informed of any discrepancies noted during this inspection and the contractor shall correct these discrepancies.

Upon satisfactory completion of this inspection/test operation and verification of correction of any discrepancies, the Evaluator system will be disassembled, packaged, and shipped to the customer designated site.

The approved factory inspection procedure(s) used during this test series will also be used at the operating site to conduct the preliminary acceptance test in preparation for the final system acceptance test.

Material shipped shall be packaged in accordance with packaging instructions and must have shipping inspection prior to boxing or crating.

4.0 ACCEPTANCE AT SITE

A member of the TRA/DSI LATHE on-site support team shall be designated as a Quality Control representative. This representative will be responsible for all contractor Quality Assurance-related activities through final acceptance by the government. Quality Control documentation required for receipt of equipments, inspections for shipping damage, installation inspections, or failure and repair inspections and testing, shall be coordinated by this designee.

Upon receipt of LATHE equipment from the factory, the Quality Control designee will determine the extent, if any, of shipment damage and initiate corrective action. The equipment will be installed in accordance with approved LATHE drawings and individual equipment operation will be verified. When fully assembled, the LATHE system shall undergo a preliminary system acceptance test in accordance with the COTR approved system acceptance test plan.

4.0 ACCEPTANCE AT SITE (CONTINUED)

A preliminary system acceptance test report shall be prepared to include test descriptions, data analysis, and resulting system performance.

After review by the COTR and on COTR direction, the TRA/DSI LATHE team will conduct a system test verifying the operations and maintenance manual, by direct application of procedures contained therein. The Quality Control designee will be responsible for records of failures, repairs, maintenance, inspections, and other system anomalies in preparation for final system acceptance.

Revisions to the system acceptance test plan resulting from the preliminary system acceptance testing shall be incorporated and submitted to the COTR for approval. At the completion of the system testing and with concurrence of the COTR, the TRA/DSI team shall conduct the final system acceptance test and prepare the final system acceptance test report for approval by the COTR.

5.0 LOGS AND REPORTS

Utilizing Quality Assurance factory inspection records and acceptance test reports, a chronological, historical test log will be maintained throughout the duration of the entire sub-assembly/assembly test program. Information from this log will be used to correct problems in design, record progress, and to be a source of information for program status reports. Several logs and reports are deliverable items and are discussed below.

a. Quality Assurance Report: This report is to be prepared and delivered 30 months from date of contract award and will be a summary of subsystem testing, engineering evaluation, and system integration testing.

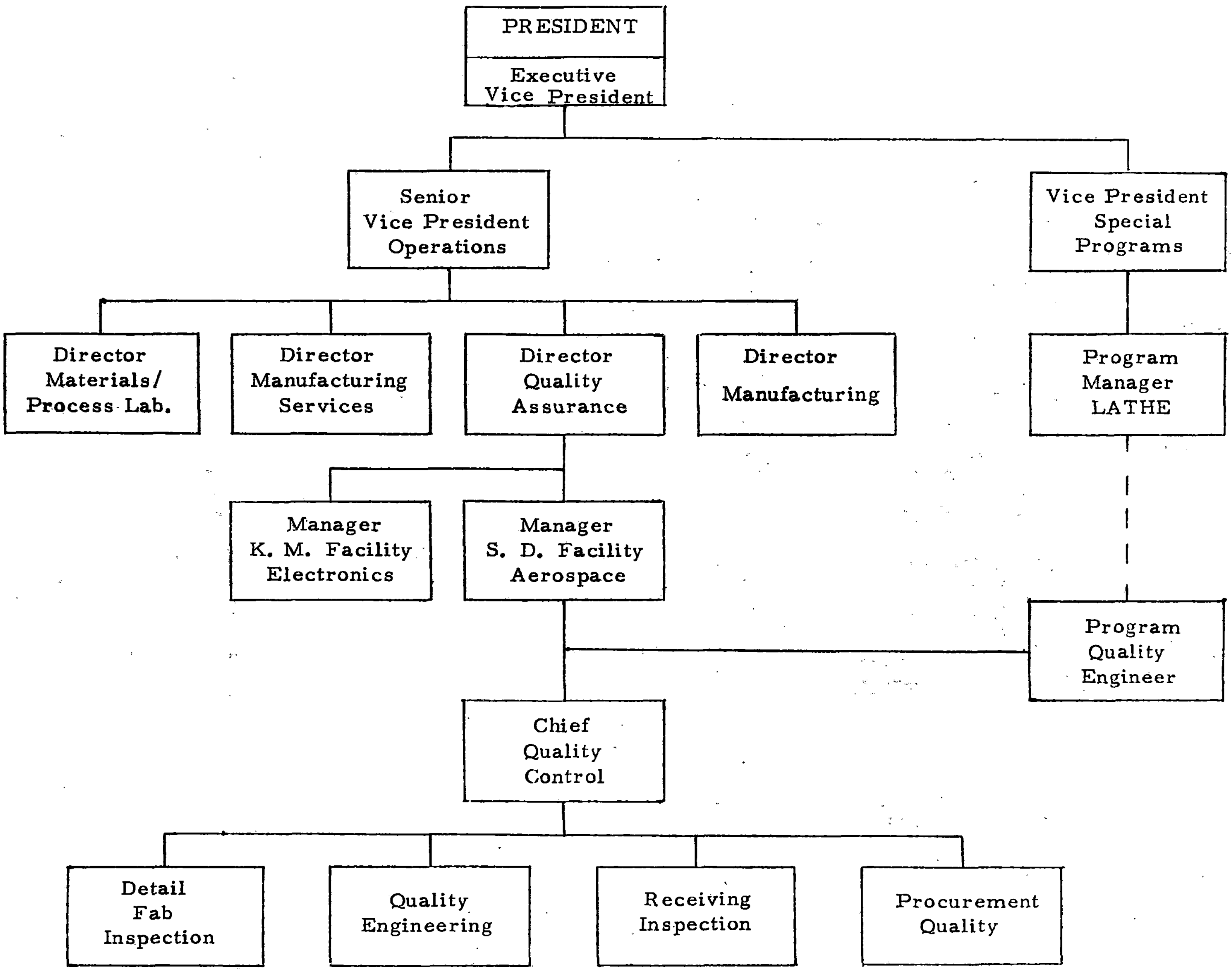
b. Factory Inspection Report: This report is to be prepared and delivered 30 months from date of contract award and will be a summary of factory (acceptance) testing.

c. System Acceptance Daily Log: This log is to be prepared during preliminary system acceptance testing at the government site and delivered 32 months from date of contract award. It will be a log of significant daily events.

5.0 LOGS AND REPORTS (CONTINUED)

d. Preliminary Acceptance Test Report: This report is to be prepared and delivered 32 months from the date of contract award and will incorporate the data and results obtained in the preliminary system acceptance testing.

e. Final Acceptance Test Report: This report is to be prepared and delivered 34 months from the date of contract award and will incorporate the data and results obtained in the final system acceptance testing.



QUALITY ORGANIZATION
FIGURE 1

10 June 1974

TELEDYNE RYAN AERONAUTICAL
OPERATING PROCEDURE
FOR
QUICK RESPONSE
DEVELOPMENTAL TYPE PROGRAMS
NO. 1004

I. PURPOSE

This document is intended to provide for overall Program Quality Control in accordance with contract requirements and applicable documents as noted in the following paragraphs.

II. PROCEDURE

A. QUALITY PROGRAM MANAGEMENT

In accordance with Aerospace Systems Procedure 1051, "Program Management and Control for Quick Response and Prototyping Programs," and Electronic and Space Systems Procedure 20-72, "Program Management and Control for Aerospace Quick Response Programs."

B. ENGINEERING DRAWINGS, DOCUMENTATION AND CHANGES

In accordance with following procedures: Effective as of the date of this document attached hereto.

Aerospace Systems Procedures

2013 "Engineering Procedure for Quick Response and Prototyping Programs."

3014 "Test and Systems Support Procedure for Quick Response and Prototyping Programs."

2001 "Expedited Release of Drawings."

Electronic and Space Systems Procedure

19-72 "Engineering Procedure for Aerospace Quick Response Programs."

NOTE: Where the term "customer" is used in this or other referenced procedures, it is understood that "customer" refers to the agency acting as "contract sponsor" for the program.

ATTACHMENT 1

C. WORK INSTRUCTIONS

(a) New detail part planning will generally reflect a "make per print" statement. Material, processing and inspection points will be specified on standard planning form.

(b) Assembly planning may reflect "assemble per print" and will consist of parts lists, processing and inspection steps. Operational sequence will be established only if necessary to insure product integrity. Inspection Control Log, ICL (R-2965) may be used in lieu of Assembly Inspection Record, AIR (R-4683).

D. CORRECTIVE ACTION

(a) Corrective Action in material review activities, relative to Tooling, Engineering and Planning deficiencies, will not be provided unless required to preclude recurrence of repetitive discrepancies on subsequent units in process.

(b) The Quality Trend Reporting System and Data Reporting will not be implemented.

E. CONTROL OF PURCHASES

Single source procurements will be authorized in cases where competitive purchasing would adversely affect delivery schedule.

F. COMPLETED ITEM INSPECTION AND TEST

(a) A First Article Inspection will not be performed; requirements will be considered to have been met when the details and subassemblies meet the end-item requirements.

(b) Detail Tooling Inspection will not be performed. Tooling will be considered acceptable upon the successful assembly of the details in accordance with assembly design requirements.

(c) Acceptance Test Procedures may not follow established format, however, will contain all information required to adequately describe test functions. Test results will be recorded on Data Sheets. Test Procedures will not be submitted for Customer approval.

(d) Testing of component and subsystems will not require production type test stations, however, testing will be conducted under the cognizance of Quality Assurance and may be accomplished through the media of existing laboratory test equipment which has been calibrated in accordance with existing procedures.

F. COMPLETED ITEM INSPECTION AND TEST (Continued)

(e) Contract sponsor in-process inspections will not be required; however, all Quality records related to the product end-item will be made available to the contract sponsor upon his request at the time and place of final acceptance.

(f) Inspection status will be evidenced by means of existing Quality Assurance stamp system.

(g) Measuring and test equipment will be calibrated under conditions adequate to assure the measurement accuracy established by the National Bureau of Standards. The re-calibration of inspection and test equipment will be accomplished on a pre-scheduled basis. All calibrated equipment will be identified to indicate when the next calibration is due per established schedule.

G. HANDLING, STORAGE AND DELIVERY

(a) Articles subject to handling damage during fabrication and processing will utilize special carts, boxes, containers, packaging, and transportation vehicles as necessary to prevent damage due to handling.

(b) Articles which are required to be stored will be adequately protected during the storage period against deterioration and damage.

(c) Articles packaged for shipment will be preserved as required to protect against expected handling and transit damage.

(d) All end items will be properly identified and will have shipping inspection acceptance prior to packaging or shipping.

(e) Contract sponsor final acceptance of completed articles shall be evidenced by DD250.

H. NON-CONFORMING MATERIAL

1. Material review will be conducted in accordance with existing procedures except as noted in Paragraph II (D).

I. GOVERNMENT PROPERTY

GFP will be visually inspected upon receipt by Quality Assurance to the extent necessary to verify identification, completeness and damage. Functional testing will not necessarily be performed at the time of receipt, but may be performed at an optimum point in time during contractor operations. Audits will be performed on stored GFP to assure that adequate preservation and packaging is provided.

Non-conforming GFP will be handled on an Inspection Test Report and the cognizant contract sponsor representative will be notified.

VOLUME II

DSI
QUALITY ASSURANCE PLAN

RESEARCH LOCOMOTIVE AND TRAIN HANDLING EVALUATOR
(LATHE)

1.0 SCOPE

This plan represents the overall philosophy of how Quality Assurance will be implemented and managed to verify delivery of the LATHE system with minimum defects in accordance with contract requirements and applicable documents.

It is the intent of this plan to provide a meaningful and effective method for assuring Quality workmanship, proper configuration and satisfactory performance of design objectives.

2.0 QUALITY PROGRAM MANAGEMENT

This program is under the direction of the Program Manager.

2.1 Organization

The Quality Assurance organization is under the direction of Executive Management.

The organizational pattern assures effective and economical control of the various Quality Assurance disciplines. The cooperation and efforts of the

Manufacturing, Engineering, Purchasing, Production Control, etc., departments, is such that they support and complement the total Quality System.

2.2 Guidelines

Dynamic Sciences, Inc. (DSI) will use Teledyne Ryan Aeronautical (TRA) developed "Quick Response" Quality procedures that apply to prototype, limited production applicators. DSI has elected to use the operating procedure for Quick Response Development Type Programs, Number 1004 as a guideline for assuring the requirements of the contract have been met.

Quality Control will use the existing TRA Quality Operations Manual as a working guide but the intent and instructions contained in Operating Procedure Number 1004 (attached) will take precedence and may also be subject to variations due to published Program Directives from the Program Office. In addition, the following procedures may be utilized for references and used as a guide:

a. Aerospace System Procedure #2001
"Expedited Release of Drawings"

b. Aerospace System Procedure #2013
"Engineering Procedure for Quick Response and Prototyping Programs"

c. Aerospace System Procedure #3014
"Test and Systems Support Procedure for Quick Response and Prototyping Programs"

As a minimum, "Best Commercial Practices" shall be utilized in all aspects of Engineering and Manufacturing operations.

2.3 Documentation

DSI Engineering drawings and blueprints will be controlled under the TRA project system in use at Teledyne Ryan Aeronautical. A limited number of drawings and blueprints will be released by Design Engineering for manufacturing usage. Any required changes to these drawings will be immediately implemented by a coordinated effort between Engineering and Manufacturing representatives. Quality Assurance will verify proper documentation control. This system will insure that the end item conforms to the desired engineering configuration and is documented for future reference.

"Assemble Per Print" work instruction will be of sufficient detail to insure assembly to the engineering configuration. In-process inspections shall be performed and recorded at appropriate points defined by the assembly work instructions. Operation sequence will be established as necessary to insure product integrity.

Work instructions will be reviewed by Quality Control to assure inspection at appropriate points during fabrication and assembly.

All inspections, tests, and non-conformances will be recorded on appropriate record forms. All records, including material and process certifications, x-rays, and other non-destructive testing results will be filed in an accessible coordinated file system and retained as objective evidence of Quality. These records will be made available for on-site review by the Contracting Officer's Technical Representative (COTR).

2.4 Customer Coordination

Customer witness or observance for all inspections, tests or demonstrations conducted during the development of the LATHE system will be accomplished when so specified. The COTR will be notified at least (7) working days in advance of specified test/inspection operations. Reasonable facilities will be provided for the convenience of the COTR during the performance of his duties. Quality Assurance will provide the COTR with access to Quality Assurance records, documents, inspection equipment, etc., as required by contract and provide assistance in coordinating COTR inspection activities.

3.0 QUALITY CONTROL

The LATHE program team will be responsible for notification of members of the Quality Control organization as is appropriate to this contract and shall include the applicable functions of but not necessarily be limited to the following areas:

A. Pre-Release and Design Effort

1. Quality Plan
2. Contract Review
3. Specification Review
4. Prepare Special Inspection Instructions

B. Procurement

1. Vendor Survey and Selections
2. Purchase Documentation Review
3. Prepare Material Acceptance Data Sheets

C. Fabrication and Assembly

1. Work Instruction Review
2. Process Control Surveillance

3. Tooling Surveillance

4. Detail and Assembly Inspections

D. Functional Acceptance Testing

1. Acceptance Test Procedure Coordination

2. Test Procedure/Test Equipment Compatibility Coordination

3. Test Equipment Calibration and Certification Surveillance

4. Acceptance Test Witnessing

E. Product Delivery

1. Final Inspections and Test Acceptance

3.1 Pre-Release and Design Effort

Engineering drawings, to be released to manufacture the product shall be prepared in a fashion to minimize costs and time. Sufficient configuration definition shall be included to describe all dimensions, materials, and special manufacturing processes necessary for the part and/or assembly to perform safely and adequately its intended use. Special Inspection Instructions and Inspection Checklists may be written to support and verify that the above complies to contract requirements.

3.2 Procurement

Suppliers furnishing material or services for use in contract end items shall be required to maintain an adequate Quality Control system. Purchase Requisitions are reviewed for appropriate process and quality requirements. These requirements as applicable to the type of product shall be imposed.

Data Sheets are used as a controlling document to assure that complete and accurate instructions are available for purchased parts requiring inspection or test upon receipt. Due to the complexity of some items, acceptance may be at source and/or in next higher assembly.

3.3 Fabrication and Assembly

Inspection and test of details and sub-assemblies will be limited to those items which cannot be readily examined at the next higher level. While performing inspection operations, the inspector shall use the following, as applicable, to determine the acceptance of parts:

Design Engineering Drawings
Manufacturing Planning
Production/Inspection Tools

The inspector shall make all checks necessary to insure conformance to the applicable drawing and related specifications. Drawing changes shall be checked to determine that the parts actually conform to the latest engineering revisions. Production tools and inspection check fixtures will be utilized as required.

When production parts are identified per engineering drawings but the manufacturing configuration deviates from the drawing, to facilitate production, the nature of such deviation shall be detailed in the planning. Inspection shall inspect to the drawing as further modified by the planning. Parts such as these are considered "in-process" and will attain Engineering configuration upon installation and acceptance at next assembly operations.

When parts are acceptable, the planning and parts shall be identified with the appropriate inspection stamps.

"Best Commercial Practice" will be minimum criteria for all manufacturing/inspection operations.

All details which deviate from Engineering design requirements will be segregated, documented and dispositioned through a two (2) man MRB Board consisting of specified Quality and Engineering personnel. Corrective Action as a result of material review activities will not be provided unless required to preclude recurrence of repetitive discrepancies.

Non-conformance on assemblies will be recorded on the Inspection Squawk Sheet. Problems encountered during assembly which require engineering, tooling and/or test procedure changes, will be included on the Squawk Sheet. Disposition and corrections will be made by responsible program personnel in coordination with the Quality Inspector.

Articles subject to handling damage during fabrication and processing will utilize special carts, boxes, containers, packaging, and transportation vehicles as necessary to prevent damage due to handling.

Quality Control through routine floor inspection activity and audits, maintains surveillance of adequacy of material handling procedures and practices.

3.4 Functional Acceptance Testing

Because of the unique characteristics of equipments used to make up the total LATHE system, acceptance testing of the components, subsystems and the total system will be performed by TRA/DSI Test Engineering. Acceptance test plans as contractually required will be developed and submitted for COTR approval and will include, as a minimum, a description of the tests to be conducted to demonstrate compliance with performance and design requirements of the Evaluator system.

Although specific test areas at the subsystem level will be addressed in the acceptance test plan, examples of test areas are provided here as a tentative listing by subsystem:

a. Visual Subsystem

   - Projector system operating characteristics

b. Logic Controller Subsystem

   - Functional characteristics, hardware
   - Functional characteristics, software
   - Peripheral equipment interface verification

c. Data Controller Subsystem

   - Functional characteristics, hardware
   - Functional characteristics, software
   - Peripheral equipment interface verification

d. Experiment Development Subsystem

   - Functional verification
   - Controller interface verification
   - Console functional operation

e. Experiment Territory Development Subsystem

   - Camera equipment
   - Data logging equipment

The subsystem testing described above will logically develop into system level testing as the individual subsystem performance is verified and accepted.

Measuring and test equipment shall be inspected, calibrated and identified prior to issuance to the using department. Measuring equipment shall be calibrated at periodic intervals established on the basis of stability, purpose and degree of usage.

3.5 Product Delivery

On completion of the initial integration acceptance testing, the total LATHE system will undergo a final factory inspection at TRA prior to teardown, packaging and shipment to the operating site. This inspection/test operation will be conducted with procedures having been previously submitted and approved by the COTR.

The purpose of this inspection is to verify that the total LATHE system is assembled and performs in accordance with specified requirements. The COTR shall be informed of any discrepancies noted during this inspection and the contractor shall correct these discrepancies.

Upon satisfactory completion of this inspection/test operation and verification of correction of any discrepancies, the Evaluator system will be disassembled, packaged and shipped to the customer designated site.

The approved factory inspection procedure(s) used during this test series will also be used at the operating site to conduct the preliminary acceptance test in preparation for the final system acceptance test.

Material shipped shall be packaged in accordance with packaging instructions and must have shipping inspection prior to boxing or crating.

TELEDYNE RYAN AERONAUTICAL

OPERATING PROCEDURE

FOR

QUICK RESPONSE

DEVELOPMENTAL TYPE PROGRAMS

NO. 1004

I. PURPOSE

This document is intended to provide for overall Program Quality Control in accordance with contract requirements and applicable documents as noted in the following paragraphs.

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A. QUALITY PROGRAM MANAGEMENT

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B. ENGINEERING DRAWINGS, DOCUMENTATION AND CHANGES

In accordance with following procedures: Effective as of the date of this document attached hereto.

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Electronic and Space Systems Procedure

19-72 "Engineering Procedure for Aerospace Quick Response Programs."

NOTE: Where the term "customer" is used in this or other referenced procedures, it is understood that "customer" refers to the agency acting as "contract sponsor" for the program.

ATTACHMENT 1

C. WORK INSTRUCTIONS

(a) New detail part planning will generally reflect a "make per print" statement. Material, processing and inspection points will be specified on standard planning form.

(b) Assembly planning may reflect "assemble per print" and will consist of parts lists, processing and inspection steps. Operational sequence will be established only if necessary to insure product integrity. Inspection Control Log, ICL (R-2965) may be used in lieu of Assembly Inspection Record, AIR (R-4683).

D. CORRECTIVE ACTION

(a) Corrective Action in material review activities, relative to Tooling, Engineering and Planning deficiencies, will not be provided unless required to preclude recurrence of repetitive discrepancies on subsequent units in process.

(b) The Quality Trend Reporting System and Data Reporting will not be implemented.

E. CONTROL OF PURCHASES

Single source procurements will be authorized in cases where competitive purchasing would adversely affect delivery schedule.

F. COMPLETED ITEM INSPECTION AND TEST

(a) A First Article Inspection will not be performed; requirements will be considered to have been met when the details and subassemblies meet the end-item requirements.

(b) Detail Tooling Inspection will not be performed. Tooling will be considered acceptable upon the successful assembly of the details in accordance with assembly design requirements.

(c) Acceptance Test Procedures may not follow established format, however, will contain all information required to adequately describe test functions. Test results will be recorded on Data Sheets. Test Procedures will not be submitted for Customer approval.

(d) Testing of component and subsystems will not require production type test stations, however, testing will be conducted under the cognizance of Quality Assurance and may be accomplished through the media of existing laboratory test equipment which has been calibrated in accordance with existing procedures.

F. COMPLETED ITEM INSPECTION AND TEST (Continued)

(e) Contract sponsor in-process inspections will not be required; however, all Quality records related to the product end-item will be made available to the contract sponsor upon his request at the time and place of final acceptance.

(f) Inspection status will be evidenced by means of existing Quality Assurance stamp system.

(g) Measuring and test equipment will be calibrated under conditions adequate to assure the measurement accuracy established by the National Bureau of Standards. The re-calibration of inspection and test equipment will be accomplished on a pre-scheduled basis. All calibrated equipment will be identified to indicate when the next calibration is due per established schedule.

G. HANDLING, STORAGE AND DELIVERY

(a) Articles subject to handling damage during fabrication and processing will utilize special carts, boxes, containers, packaging, and transportation vehicles as necessary to prevent damage due to handling.

(b) Articles which are required to be stored will be adequately protected during the storage period against deterioration and damage.

(c) Articles packaged for shipment will be preserved as required to protect against expected handling and transit damage.

(d) All end items will be properly identified and will have shipping inspection acceptance prior to packaging or shipping.

(e) Contract sponsor final acceptance of completed articles shall be evidenced by DD250.

H. NON-CONFORMING MATERIAL

1. Material review will be conducted in accordance with existing procedures except as noted in Paragraph II (D).

I. GOVERNMENT PROPERTY

GFP will be visually inspected upon receipt by Quality Assurance to the extent necessary to verify identification, completeness and damage. Functional testing will not necessarily be performed at the time of receipt, but may be performed at an optimum point in time during contractor operations. Audits will be performed on stored GFP to assure that adequate preservation and packaging is provided.

Non-conforming GFP will be handled on an Inspection Test Report and the cognizant contract sponsor representative will be notified.

LATHE PROGRAM

PROJECT PLAN

VOLUME III

DOCUMENTATION PLAN

CONTENTS

CONTENTS (Cont'd)

1.0 INTRODUCTION

Volume III of the Research Locomotive and Train Handling Evaluator Program Plan presents the Documentation Plan. The Documentation Plan specifies the hardware and software manuals, documentation and reports that are to be submitted to the Government, the preparation format and delivery schedule, receiving agency and number of copies. Further, the Documentation Plan identifies those items which require Contracting Officer's Technical Representative (COTR) approval.

2.0 SCOPE

The Documentation Plan applies to all LATHE Program deliverable documents scheduled for delivery after November 30, 1979. The plan does not include Design Review Package deliverables which are presented in Volume I of the Research Locomotive and Train Handling Evaluator Program Plan.

3.0 DOCUMENTATION

This section specifies the manuals, hardware documentation (drawings, etc.), and reports to be submitted to the Government. The manuals are intended for installing, operating, and maintaining the Evaluator and its subsystems. All final manuals will reflect hardware and software as accepted by the Government. All manuals included with manufacturers' items will also be provided. Requirements for software documentation are presented in Section 4.0

The following manuals are included in the Documentation Plan:

- Operation and Maintenance Manuals;
- Vendor manuals for purchased equipment;
- Engineering drawings required for installation and maintenance;
- Replaceable parts lists;
- Recommended spare parts lists; and
- Recommended tools and test equipment lists.

3.1 Operation and Maintenance Manual

The Operation and Maintenance Manual will consist of the below six listed volumes:

3.1.1 Volume I - Theory of Operation. This volume will explain the purpose of the Evaluator and describe the overall Evaluator System and operation and uses. It will contain a physical description of each Subsystem supported by illustrations as necessary to locate and identify all Subsystems, cards, etc.

3.1.2 Volume II - Operation. This volume will illustrate operation panels and describe the functions of all indicators and controls. Procedures will be provided for operating the Evaluator in its various modes. A pre-test calibration procedure will also be included.

3.1.3 Volume III - Systems-Diagrams/Logic. This volume will explain the overall System functional operation, supported by a simplified block/logic diagram.

A functional description of the operation of the following will be included:

a. Cab;
b. Visual;
c. Motion;
d. Sound;
e. Logic Control;
f. Power;
g. Intercommunication; and
h. Experiment Development.

Each explanation will be supported by funcational schematic/logic diagrams as necessary. The schematic/logic diagrams will identify test points and the voltage and/or waveforms at these points. Maximum use of the applicable engineering drawings and vendor manuals, containing the detailed technical information, will be referenced.

3.1.4 Volume IV - System Level Maintenance. This volume will contain:

a. Performance Tests-Procedures for completely testing the evaluator;

b. System Calibration;

c. Fault Isolation Procedures for isolating troubles to subassemblies, circuit cards or modules;

d. Removal and replacement of complex subassemblies;

e. Hydraulic System Purging; and

f. A listing of all systems engineering drawings.

3.1.5 Volume V - Maintenance Schedule. This volume will contain a detailed schedule and all required periodic maintenance in easy to follow tabular form.

3.1.6 Volume VI - Bench Level Maintenance. This volume will contain:

a. Schematic diagrams of the printed circuit boards to be used for troubleshooting/repair;

b. Cleaning procedures, including removal, cleaning and replacement of hydraulic and air filters; and

c. Lubrication procedures.

3.2 Vendor Manuals

TRA/DSI supplier manuals will be furnished at the completion of Acceptance at site to support the major Evaluator components not manufactured by TRA and DSI.

3.3 Systems Manuals

The system manuals will be organized into several volumes to cover the major hardware subsystems of the Evaluator. The manuals will contain complete information describing the operational logic program. The manuals will identify and document logic programs supplied with the Evaluator to describe how they are used, explain software/hardware interrelationships and describe program loading. The outline of the Systems Manuals is presented in Appendix C of Volume I.

3.4 Interface Drawing

An interface drawing will be prepared by TRA/DSI. It will list the mechanical and electrical interfaces which must be provided at the site intended to house the Evaluator equipment.

3.5 Engineering Drawings

Reproducible vellum copies of all drawings required for Evaluator manufacture, installation, and maintenance will be supplied. These drawings will include schematics, logic diagrams, mechanical assemblies, and printed circuit card assemblies.

3.6 Replaceable Parts Lists

A list of replaceable parts will be supplied for each Subsystem in the Evaluator. The lists will provide information required to acquire any replaceable parts in the device including identification of critical, unique, or long lead-time components. The lists will contain part number, manufacturer's code, item name, quantity used and such pertinent information as is required to procure a replacement item. Non-functional components such as structural items. Sheet metal cabinetry, panels and common hardware will not be included. In the case of vendor components, this data will be included in the applicable maintenance manuals.

3.7 Spare Components List

TRA/DSI will supply a list of spare parts recommended for use in Evaluator maintenance. The list will contain the manufacturer's code, item name, quantity used in the Evaluator, and a recommended spares quantity. A separate list cross referencing from manufacturer's code to manufacturer's name and address will also be included. The list will be provided in sections for each major Subsystem of the Evaluator.

3.8 Tools and Test Equipment

TRA/DSI will supply a complete list of tools and special test equipment required for maintenance of the Evaluator. The list need not include common hand tools such as screwdrivers, pliers, wrenches, etc.

3.9 Format

Particular attention will be paid to clarity, typography, fidelity of photos and drawings, neatness and accuracy. Dimensions will not exceed 8 1/2 x 11, with foldouts where necessary. Bindings will be loose-leaf or similar types that will permit removal and insertion of pages, and that will lie flat when opened to any page. Each volume will not contain more than approximately two hundred (200) pages or exceed two inches in thickness. One copy will be reproducible.

4.0 SOFTWARE DOCUMENTATION

The documentation of computer programs will include: (1) software description plan, (2) functional description, (3) design descriptions, (4) computer code listings, and (5) user manuals.

4.1 Software Description Plan

A Software Description Plan will be submitted for approval. Its purpose is to delineate the overall plan of program layout, program interaction, data flow, language(s), and programming schedule. The Software Description Plan will include the following:

- Operating system to be used,
- Names and functions of main program modules,
- Data flow chart,
- Language to be used for each routine,
- Source of each routine (hardware manufacturer, AAR, to be newly written, etc.),
- Month-by-month plan of software completion.

4.2 Functional Descriptions

For each new software item, a Functional Description will be prepared giving a discussion of the purpose of the items and covering the following:

- General functional requirements and concepts of the program or item to be developed,
- Definition of purposes, capabilities, options, and design constraints,
- Language (Fortran, etc.)
- Restrictions/limitations, including the reasons therefore,
- Relationship to other programs covering the anticipated interfaces, requirements for, and use of input data, files, and generation and subsequent use of input data, files, and generation and subsequent use of output data,
- Expected input/output volumes and file sizes.

4.3 Design Descriptions

The Design Description for each software item will include:

- name and purpose of routine
- format of all inputs and outputs
- organization of file(s) written by the routine
- options and/or parameters (i.e., operator input or default values, etc.) to be handled,
- edit checks warning of faulty operator input or faulty input from sensors or control consoles,
- error message description and conditions under which such messages will be produced,
- reports to be produced (if any), including report descriptions and layouts
- expected number of source statements to be coded
- checkout/integration procedure proposed for subsequent use in component and system testing
- restrictions/limitations imposed on the operation, capability or capacity of each routine.

4.4 Computer Program Listings and Source Statements

Program documentation to be delivered will consist of:

a. Printed compilation/assembly listings

b. Printed listings of source statments

c. Magnetic tape containing the source statements of b.

The source statement listings will include sequence numbers. The printed compilation/assembly listings will include the first and the tenth items listed under the Design Descritpions above.

4.5 User Manuals

User Manuals will explain the overall purpose of various programs, how to load new/revised programs into the applicable computer, what action to take in case of apparent computer or software malfunction, and any other items necessary to normal operation.

5.0 REPORTS

TRA/DSI will provide pertinent data upon request. Regular Monthly Progress Reports and a final technical report will be submitted.

5.1 Monthly Progress Reports

The Monthly Progress Reports will summarize highlights of monthly technical effort on the overall work being performed under the Contract, comparing the actual schedule, cost performance, and manhours of each Subsystem with the Project Plan, Master Work Schedule, the Cost Plan, and the Manhours Plan. The Progress Report will contain a brief narrative describing:

a) current versus planned status, as well as projections for meeting major objectives and milestones

b) significant accomplishments for the reporting period

c) technical, cost or schedule problems and a recommended corrective action plan (including dates)

d) detailed description of the work planned for the next three months.

5.2 Final Technical Report

TRA/DSI will submit a Final Technical Report which will include:

- overview of technical problems and requirements

- description of completed System

- description of engineering innovations or newly designed methods/materials

- description of substantive differences in each Subsystem between the final critical design review and the final Evaluator System

- overview of acceptance test results.

6.0 SPECIFICATIONS

Any specifications prepared by TRA or DSI will be prepared in accordance with paragraph 3.1.3.3 of MIL-STD-490, dated 30 October 1968.

7.0 ACCEPTANCE TEST PLANS

Acceptance Test Plans are those documents which specify the tests to be conducted for demonstrating compliance of the total Evaluator System or individual Evaluator Subsystems with the performance and design requirements of this Statement of Work. These tests shall also include demonstration of maintainability and analysis of tests and experiences relating to potential life cycle events, including costs and effects. TRA and DSI shall develop the Acceptance Test Plans and submit them to the COTR for his written approval. Following receipt of the COTR's written approval, the TRA and DSI shall conduct the testing as per the approved Acceptance Test Plans.

7.1 Factory Inspection Procedures

Factory inspections will be performed at TRA's assembly plant in accordance with approved Factory Inspection Procedures, which may be a subject of the overall Acceptance Test Plan or may be a separate set of tests altogether. The Factory Inspection Procedures will be submitted for the COTR's written approval. Following receipt of the COTR's written approval of the Factory Inspection Procedures, TRA/DSI will conduct the factory inspection. Any discrepancies encountered during the Inspection will be noted, reported to the COTR and subsequently corrected by the Contractor. Upon successful completion of the Factory Inspection Procedures, TRA/DSI will deliver the Evaluator to the site provided by the Government.

7.2 Acceptance At Site

Acceptance test will be conducted in two phases. A report will be prepared to document the results of the two phases.

7.2.1 Preliminary System Acceptance Test Report. Upon receipt of written approval from the COTR of the System Acceptance Test Plan, TRA/DSI will conduct preliminary tests on the Evaluator as installed. TRA/DSI will formally notify the COTR in advance of the start of each test and provide a daily log.

Upon completion of the preliminary System Acceptance Testing, the TRA/DSI will incorporate all of the data and results obtained into a Preliminary System Acceptance Test Report. This test report will include as a minimum the following:

- description of tests
- data analyses
- test results
- discussion of any system rework as a consequence of the Preliminary System Acceptance Testing.

7.2.2 Final System Acceptance Test Report. TRA/DSI will conduct a Final System Acceptance Test in accordance with the System Acceptance Test Plan as revised. TRA/DSI will formally notify the COTR in advance of the start of each test, and provide a daily schedule update to the COTR.

Upon completion of the Final System Acceptance Testing, TRA/DSI will incorporate all data and results obtained into a Final System Acceptance Test Report. This report is subject to the written approval of the COTR. This test report will include as a minimum the following:

- description of tests
- data analyses
- test results

The COTR will give initial approval to the test results based upon a comparison of these results with the criteria established in the approved test plan. Discrepancies or test failures will be cause of corrective action and test returns by TRA/DSI. Final approval and Contracting Officer acceptance of the installed Evaluator will be deferred until the Final System Acceptance Test Report has been reviewed and approved by the COTR.

7.2.3 Format of Factory Inspection and Acceptance Test Reports. TRA/DSI will prepare reports on all analyses, demonstrations, and tests performed. Each report will be a complete description of the activity performed, and will in addition to results contain the information specified in the LATHE Quality Assurance Plan (Volume II of the Project Plan).

8.0 DELIVERY

All deliverable documentation required by this Documentation Plan will be delivered, prepaid, FOB destination, as follows:

Deliverable Item	Documentation Plan Reference	Number of Copies CO	RPB	COTR	Delivery (Months fr/EDOC)**
1. Plans and Procedures:					
a. *Acceptance Test Plan	7.0	1	-	2	24
b. *Factory Inspection Procedures	7.1	1	-	2	24
c. *Software Description Plan	4.1	1	-	2	24
2. Reports and Logs:					
a. Monthly Progress Reports	5.1	1	1	2	15th of each month
b. Factory Inspection Report	7.2.3	1	-	1	30
c. System Acceptance Daily Log	7.2.1	1	-	1	32
d. Preliminary Acceptance Test Report	7.2.1	1	-	1	32
e. *Final Acceptance Test Report	7.2.2	1	-	1	34
f. #*Final Technical Report	5.2	1	1	4	34
3. Documentation:					
a. *Interface Drawing	3.4	1	-	6	16
b. *System Support Lists	3.6,3.7, 3.8	1	-	6	25
c. #*Operations & Maintenance Manuals	3.1	1	-	6	28
d. *Engineering Drawings	3.5	1	-	6	28
e. #*Systems Manual	3.3	1	-	6	32
f. #*Software Documentation	4.0	1	-	6	32
g. *Vendor Manuals	3.2	1	-	6	34

NOTES: * COTR Approval required.
** "EDOC" means "effective date of contract."
# Deliverable Item annotated with an "#" under 2. and 3. of this Article shall be prepared in accordance with DOT-TST-75-97, "Standards for the Preparation and Publication in DOT Scientific and Technical Reports".

8.0 DELIVERY (Continued)

4. Distribution Addresses Are as Follows:

- Federal Railroad Administration
  Office of Procurement
  Contracting Officer, RAD-32
  400 Seventh Street, S.W., Room 8210
  Washington, D.C. 20590

- Federal Railroad Administration
  Program Review Division, RPB-30
  400 Seventh Street, S.W., Room 5407
  Washington, D.C. 20590

- Federal Railroad Administration
  OR&D/ORSR/Rail Vehicle Safety Research Division
  Contracting Officer's Technical Representative, RRD-33
  400 Seventh Street, S.W., Room 8311
  Washington, D.C. 20590

9.0 FINAL DOCUMENT ACCEPTANCE

9.1 Acceptance Forms

All items specified in this Documentation Plan will be accepted by the Contracting Officer using a standard Federal Government Form DD-250, after the Final Review.

9.2 Final Review

After completion of the Acceptance Testing, TRA/DSI will present and discuss evidence that all items in the Documentation Plan have been successfully accomplished.

It will also be demonstrated at the Final Review that all documents, manuals, and reports have been delivered.

The Final Review will be held at the FRA headquarters (or at another location, if agreed to by the Contracting Officer) and will extend over one or more days as required. At the end of this review the Contracting Officer will indicate whether all items are acceptable or whether any other action is required before final acceptance.

10.0 APPLICABLE DOCUMENTS

The following publications form a part of the contract and will be used as deemed necessary and appropriate by TRA/DSI in order to satisfy the requirements herein and in the "Evaluator Specification" during the design, fabrication, assembly and testing of the Evaluator. The issues in effect on the effective date of this Contract shall apply. Publications listed may be obtained from the publishers or from information dissemination centers.

Specifications:

Military

1)	MIL-D-1000	Drawings, Engineering and Associated Lists (Form 3 shall be used)
2)	Fed-STD-595	Federal Paint Standards
3)	MIL-S-457430	Soldering
4)	MIL-P-55110	Printed Circuit Boards
5)	MIL-P-22629	Printed Circuit Boards

Standards

Industry and Associations:

1)	ANSI Standard - USAS B46.1	Surface Texture, Surface Roughness, Waviness and Lay
2)	ANSI Standard - USAS B93.1	Fluid Power Cylinders, Dimensions Identification Code for
3)	ANSI Standard - USAS B93.2	Fluid Power, Glossar of Terms for
4)	ANSI Standard - USAS B93.2 & Y10.2	Hydraulics, Letter Symbols for
5)	ANSI Standard - USAS Y14.17	Fluid Power Diagrams
6)	ANSI Standard - USAS Y32.2	Electrical and Electronic Diagrams Graphic Symbols for
7)	ANSI Standard - USAS Y32.10	Fluid Power Diagrams, Graphic Symbols for
8)	ANSI Standard - USAS Y32.16	Electrical and Electronic Pre-ference Designations
9)	ANSI Standard - USAS Y14.5	Dimensions and Tolerancing for Electrical Drawings
10)	ANSI Standard - USAS Y14.15	Electrical and Electronics Diagrams

11) American Society for Testing and Materials

Specification for Materials

12) American Institute of Steel Construction

Steel Construction Manual

13) American Gear Manufacture

AGMA Recommended Practice

14) American Society of Mechanical Engineers

a. Boiler Code: Material Specifications
   Welding Qualifications
b. Code of Pressure Piping
c. Terminology for Automatic Controls (ASA C85)

15) American Welding Society

a. AWS A2.0 - Welding Symbols
b. AWS A2.2 - Non-Destructive Testing
c. AWS A2.3 - System Fabrication

16) Joint Industrial Council

Standard for Hydraulic Components and Enclosures

17) Institute of Electrical and Electronic Engineers

IEEE Standards

18) National Fire Protection Association

National Fire Codes

19) National Electrical Manufacturers Association & National Electrical Safety Code

NEMA Standards

20) American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc.

ASHRAE Guide and Data Book

21) Marshall Space Flight Center Cleaning Standard

MSFC-PROC-166C, Amendment 1 - Hydraulic System Detail Parts, Components Assemblies, and Hydraulic Fluids for Space Vehicles, Cleaning, Testing, and Handling

22) American Concrete Institute (Stds. and Codes)

23) Safety Codes - The safety codes which are applicable to this Statement of Work are:

a. American National Standards Institute (ANSI)
b. American Society for Testing and Materials
c. American Society of Mechanical Engineers

24) Occupational Safety and Health Requirements

41 CFR 50-204	Safety and Health Standards for Federal Supply Contracts
29 CFR 1926	Safety and Health Regulations for Construction

25) Computer Standards

a. ASCII - 2
b. Federal Information Processing Standards (FIPS)

26) Publications

a. SD-45 Operator's Manual	Electro-movtive Division General Motors Corporation La Grange, IL.
b. F RA/ORD - 76/275. I, II,	Locomotive Cab Design Development Technical, Volumes 1, 2, & 3
c. Southern Railway System TIES Magazine. May-June 1977	Train Dynamics Analyzer
d. Human Factors Research Simulator for Train Operations	Railway Labor Science Research Institute JNR

RESEARCH LOCOMOTIVE AND TRAIN HANDLING EVALUATOR

PROJECT PLAN

TELEDYNE

Dynamic Sciences