Proposal

SMART CORRIDOR SYSTEM MANAGEMENT SERVICES

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
CONTRACT NUMBER TP017

jhk & associates

March, 1990

LACTC

jhk & associates

March 13, 1990

Mr. Albert V. Scala
Manager of Contracts
Los Angeles County Transportation Commission
403 West Eight Street, Suite 500
Los Angeles, CA 90014-3096

Attention: Mr. Scott Vranesh

Subject: Request for Proposal (RFP)
Contract Number TP017
Smart Corridor System Manager Services

Dear Mr. Scala:

JHK & Associates is pleased to submit this proposal in response to the subject RFP dated February 6, 1990. The proposal has been prepared in strict accordance to the requirements stated in the RFP. JHK has reviewed the RFP and the proposed scope of work in detail, and no exceptions or deviations are taken.

JHK & Associates is very excited about the Smart Corridor project and of the prospects for providing the Commission with the Systems Management services necessary to design and implement the Smart Corridor System. Many of the staff assigned to this project were also participants in the Smart Corridor Demonstration Project, and are therefore looking forward to the opportunity of turning the ideas presented in the conceptual design into an operational entity providing benefit to motorists in the Santa Monica corridor.

The scope of work for the Systems Management services parallel those developed during the concept study. JHK has developed a work plan that is presented in this proposal that will accomplish the objectives of the Commission within the target time frame set for the project. However, JHK's estimated cost to conduct the proposed work plan exceeds the budget amount indicated in the RFP, as did our original estimate for these services that was made during the conduct of the concept study.

The estimate presented in this proposal was developed independently from the original estimate. It has been carefully reviewed and is believed to accurately reflect the costs necessary to follow the scope of services without adversely affecting the quality of the work. To reduce the cost would require the elimination of items of work. Since this would reduce the effectiveness of the Smart Corridor System and since JHK has no knowledge of the work tasks the Commission would consider eliminating, we have chosen to provide a work plan and cost to perform the project in conformance to the scope specified. We anticipate that discussions will be held to determine how LACTC desires to reduce the scope such that a project can be defined that meets the objectives of the affected agencies and is within the available budget. JHK would welcome the opportunity to discuss this matter with you or your designated representative at your convenience.

In closing, I want to assure you and Los Angeles County that JHK & Associates is very interested in providing these services and would welcome the opportunity of answering any questions or providing any additional information that may be desired.

Respectfully submitted,

JHK & ASSOCIATES

Tom L. Stout
Senior Vice President

TLS/kc
Enclosure
Project No. 9806

PROPOSAL

SMART CORRIDOR SYSTEM MANAGER SERVICES
CONTRACT NUMBER TP017

Submitted to:

Los Angeles County
Transportation Commission

Submitted by:

JHK & Associates
205 S. Broadway, Suite 907
Los Angeles, CA 90012

In Association with:

Katz, Okitsu & Associates
Hughes Aircraft Co.

March 13, 1990

Copyright 1990
All rights reserved

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

PROPOSAL LETTER
CONTRACT NUMBER TP017

PROPOSER: JHK & Associates

ALBERT V. SCALA, MANAGER OF CONTRACTS
LOS ANGELES COUNTY TRANSPORTATION COMMISSION
403 WEST 8TH STREET
LOS ANGELES, CALIFORNIA 90014
ATTN: SCOTT VRANESH

In response to the Request for Proposal (RFP) No. TP017, for Smart Corridor System Manger Services, we the undersigned hereby declare that we have carefully read and examined the RFP documents including any plans and specifications, and hereby propose to perform and complete the Work as required in the Contract Documents.

The undersigned agrees to supply the services at the costs indicated in its cost proposal if its Proposal is accepted within 90 days from the date specified in the RFP for receipt of proposals.

If awarded a Contract, the undersigned agrees to execute formal Contract Documents which will be prepared by the COMMISSION for execution, within 10 calendar days following Notice to Proceed, and will deliver to the COMMISSION prior to execution of the Contract the necessary original Certificates of Insurance.

Incorporated herein and made a part of this Proposal is the Response Data and Proposal Forms required by Section 2 and Section 3 respectively of the Proposal Requirements.

The undersigned acknowledges receipt, understanding and full consideration of the following Addenda to the RFP Documents:

Addenda No. Answers To Questions and Clarification to RFP dated February 16, 1990.

Proposer represents that the following persons are authorized to negotiate on its behalf with the COMMISSION in connection with this RFP:

Jack L. Kay	President	(415) 428-2550
Tom L. Stout	Senior Vice President	(404) 447-6831
Craig C. Gardner	Vice President	(404) 447-6831

The undersigned certifies that it has examined and is fully familiar with all of the provisions of the RFP Documents and is satisfied that they are accurate; that it has carefully checked all the words and figures and all statements made in the Proposal Requirements; that it has satisfied itself with respect to other matters pertaining to the proposal which in any way affect the Work or the cost thereof. The undersigned hereby agrees that the COMMISSION will not be responsible for any errors or omissions in the RFP Documents.

BY: _____

Tom L. Stout
Senior Vice President

JHK & Associates
205 S. Broadway, Suite 907
Los Angeles, California 90012
Phone: (213) 625-1522
FAX: (213) 625-1158

TABLE OF CONTENTS

TABLE OF CONTENTS Continued

A. Standard Form 254

SECTION A

STANDARD FORM (SF) 254

JHK & Associates

Katz, Okitsu & Associates

Hughes Aircraft

STANI
FORM (SF)

254

Architect-Engineer and Related Services Questionnaire

1. Firm Name / Business Address: Federal I 4-1745398

JHK & Associates
205 S. Broadway, Suite 907
Los Angeles, CA 90012
213/625-1158

1a. Submittal is for ☐ Parent Company ☐ Branch or Subsidiary Office

2. Year Present Firm Established: 1971

3. D repared: March 13, 1990

4. Specify type of ownership *and* check below, if applicable.

Corporation

A. Small Business
B. Small Disadvantaged Business
C Woman-owned Business

5. Name of Parent Company, if any:

5a. Former Parent Company Name(s), if any, and Year(s) Established:

Traffic Research Corporation 1954-1966
Peat, Marwick, Livingston & Co. 1966-1969
Peat, Marwick, Mitchell & Co. 1969-1971

6. Names of not more than Two Principals to Contact: Title / Telephone

1) Jack L. Kay, President 415/428-2550
2) Tom L. Stout, Senior Vice President 404/447-6831

7. Present Offices: City / State / Telephone / No. Personnel Each Office

7a. Total Personnel 199

San Francisco, CA	415/428-2550	24	Orlando, FL	407/345-1471	9
Alexandria, VA	703/370-2411	29	Albuquerque, NM	505/764-9091	4
Norcross, GA	404/447-6831	39	Baltimore, MD	301/825-5414	2
Tucson, AZ	602/624-2306	27	Miami, FL	305/596-5994	1
Phoenix, AZ	602/954-0383	14	Pasadena, CA	818/564-8960	1
New York, NY	718/459-1900	31	San Diego, CA	619/295-2248	9
Hartford, CT	203/522-3915	5	Los Angeles, CA	213/625-1522	4

8. Personnel by Discipline: *(List each person only once, by primary function)*

35	Administrative	11	Electrical Engineers		Oceanographers
	Architects		Estimators	9	Planners: Urban/Regional
	Chemical Engineers		Geologists		Sanitary Engineers
25	Civil Engineers		Hydrologists		Soils Engineers
6	Construction Inspectors		Interior Designers		Specification Writers
14	Draftsmen		Landscape Architects		Structural Engineers
	Ecologists		Mechanical Engineers	44	Surveyors
	Economists		Mining Engineers		Transportation Engineers

4	Programmers
7	CAD Operators
14	Systems Engineers
19	Technicians
11	System Operators

9. Summary of Professional Services Fees Received: (Insert index number)

	Last 5 Years (most recent year first)				
	19 89	19 88	19 87	19 86	19 85
Direct Federal contract work, including overseas	4	4	4	4	4
All other domestic work	7	7	7	7	6
All other foreign work*	1	1	1	1	1

*Firms interested in foreign work, but without such experience, check here: ☐.

Ranges of Professional Services Fees

INDEX
1 Less than $100,000
2 $100,000 to $250,000
3 $250,000 to $500,000
4 $500,000 to $1 million
5 $1 million to $2 million
6 $2 million to $5 million
7 $5 million to $10 million
8 $10 million or greater

10. Prof Firm's Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
1) 078	25	1,500	11)			21)		
2) 087	10	450	12)			22)		
3) 088	3	30	13)			23)		
4) 107	200	13,500	14)			24)		
5)			15)			25)		
6)			16)			26)		
7)			17)			27)		
8)			18)			28)		
9)			19)			29)		
10)			20)			30)		

11. Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
107	P	1 East Avenue Improvements and Norwalk Distributed Traffic Signal System	Department of Public Works 297 W. Avenue Norwalk, CT 06850	125	On-going
107	P	2 New York City Signal System Expansion	NYC DOT, Bureau of Traffic Operations 28-11 Queens Plaza N., 7th Floor Long Island City, NY 11101	5,275	1987
107	P	3 Smart Corridor Demonstration Project	City of Los Angeles Dept. of Transportation City Hall, Los Angeles, CA 90012	740	1989
107	P	4 Hartford Computerized Signal System	Transportation Services Bureau 525 Main Street Hartford, CT 06103	800	1989
107	P	5 Tampa Area Traffic Control System Expansion	Florida DOT, 605 Suwannee Street Tallahassee, FL 32302	190	1989
107	P	6 Gainesville Distributed Traffic Signal System: Design and Construction Engineering	Same as above	420	1989
107	P	7 New Haven Computerized Signal System	Traffic & Parking Department 200 Orange Street New Haven, CT 06510	800	On-going

107	C	8 I-90 Seattle and Mercer Island Tunnels (Subcontract - Sverdrup Corp)	ashington State DOT ighway Admin. Bldg. Olympia, WA 98504	554	1990
107	P	9 Portland Traffic Control System	City Traffic Engineer 1120 SW 5th Avenue Portland, OR 80222	1,512	1989
107	P	10 Sioux City, Iowa Traffic Control System	Iowa DOT, 2800 Gordon Drive Sioux City, IA 51105	627	1988
107	P	11 Guidelines for Successful Traffic Control Systems	FHWA, HRS-40, 400 7th Street, SW Washington, DC 20590	230	1989
107	P	12 Evaluation of Integrated Motorist Information System, Long Island, NY	FHWA, HRS-40, 400 7th Street, SW Washington, DC 20590	714	On-going
107	P	13 Anaheim Traffic Control & Changeable Message Sign System	City of Anaheim Traffic Engineering Division Anaheim, CA 92805	676	1989
107	P	14 Chesterfield County Toll Road Analysis	R. Lockwood, VADOT Hwy & Trans., 1221 E. Broad St. Richmond, VA 23219	272	1982
107	P	15 Operations of Integrated Motorist Information System (Long Island)	NY State DOT Albany, NY 12232	2,510	1989
107	P	16 Los Angeles Area Traffic Control & Surveillance System	DOT, City of Los Angeles City Hall, Los Angeles, CA 90012	2,321	1989
107	P	17 Freeway Data Collection for Studying Vehicle Interaction	FHWA, HRS-40, 400 7th Street, SW Washington, DC 20590	392	1984
107	P	18 Outer Loop Highway Design Phoenix, AZ	Arizona DOT Phoenix, AZ	350	1986
107	P	19 Traffic Engineering Studies at Naval & Marine Corps	Dept. of Navy, Chesapeake Div. Naval Facilities Engineering Command, Washington, DC	1,000	On-going

107	P	20 San Francisco Bay Area Freeway Traffic Operations Center	alifornia DOT (Caltrans) ..O. Box 7310 San Francisco, CA 94120	60	1987
107	C	21 I-10 Signing, Striping, Lighting and Signal Design	Arizona Dept. of Transportation Phoenix, AZ	120	1984
107	P	22 Scottsdale Roadway Design	City of Scottsdale, AZ	140	1985
107	P	23 Traffic Signal Design Training Course	US Dept. of Transportation FHWA, Washington, DC	519	1985
107	P	24 Evaluation of Preferential Treatments for High Occupancy Vehicles	US Dept. of Transportation FHWA, Washington, DC	370	1980
107	C	25 Burlington Skyway Surveillance & Control System	Provence of Ontario MTC 1201 Wilson Ave. Downsview, Ontario, M3M 1J8	360	1985
107	P	26 Development of New Highway Capacity Manual	National Cooperative Highway Research Program, Washington, DC	450	1981
107	P	27 Surface Transit Alternatives Study	Metropolitan Washington Council of Governments, Washington, DC	175	1984
107	P	28 Florida Freeway Operations Study - Statewide	Florida DOT 605 Suwannee Street Tallahassee, FL 32301-8064	164	1988
107	P	29 Arterial Corridor Study Project	Maricopa Council of Governments Phoenix, AZ	174	1985
107	P	30 NCHRP 3-28(2) Travel Characteristics of Large Scale Suburban Activity Centers, Nationwide	Transportation Research Board Washington, DC 20418	340	1989

12. The foregoing is a statement of facts

Signature: _____ Typed Name and Title: Tom L. Stout, Sr. Vice President

Date: March 13, 1990

☆ USGPO 1986-491-248/40037

STA ID
FOI F)

254

Architect Engineer and Related Services Questionnaire

1. Firm Name / Business Address:

KATZ, OKITSU & ASSOCIATES
TRAFFIC ENGINEERS
1200 Corporate Center Dr., Suite 140
Monterey Park, CA 91754

2. Year Present Firm Established: 1987

3. Date Prep: 3-8-90

4. Specify type of ownership and check below, if applicable.

Partnership

- A. Small Business
- [x] B. Small Disadvantaged Business
- C. Woman-owned Business

1a. Submittal is for [x] Parent Company [ ] Branch or Subsidiary Office

5. Name of Parent Company, if any:

--

5a. Former Parent Company Name(s), if any, and Year(s) Established:

--

6. Names of not more than Two Principals to Contact: Title / Telephone

1) Moses Katz Partner/ (213) 260-4703
2) Walter Okitsu Partner/ (213) 260-4703

7. Present Offices: City / State / Telephone / No. Personnel Each Office

7a. Total Personnel 25

Monterey Park/California/ (213) 260-4703/25

8. Personnel by Discipline: *(List each person only once, by primary function.)*

___ Administrative	___ Electrical Engineers	___ Oceanographers	___
___ Architects	___ Estimators	___ Planners: Urban/Regional	___
___ Chemical Engineers	___ Geologists	___ Sanitary Engineers	___
6 Civil Engineers	___ Hydrologists	___ Soils Engineers	___
___ Construction Inspectors	___ Interior Designers	___ Specification Writers	___
8 Draftsmen	___ Landscape Architects	___ Structural Engineers	___
___ Ecologists	___ Mechanical Engineers	___ Surveyors	___
___ Economists	___ Mining Engineers	3 Transportation Engineers	___

9. Summary of Professional Services Fees Received: (Insert index number)

	Last 5 Years (most recent year first)				
	19 89	19 88	19 87	19	19
Direct Federal contract work, including overseas					
All other domestic work	4	3	1		
All other foreign work*					

*Firms interested in foreign work, but without such experience, check here: [ ]

Ranges of Professional Services Fees

Index
1. Less than $100,000
2. $100,000 to $250,000
3. $250,000 to $500,000
4. $500,000 to $1 million
5. $1 million to $2 million
6. $2 million to $5 million
7. $5 million to $10 million
8. $10 million or greater

9. Profile of Firm's Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Num Proj	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total (in th	Fees ds)
1) 107	230	3,000	11)			21)			
2)			12)			22)			
3)			13)			23)			
4)			14)			24)			
5)			15)			25)			
6)			16)			26)			
7)			17)			27)			
8)			18)			28)			
9)			19)			29)			
10)			20)			30)			

11. Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
107	C	1 Baldwin Hills Regional Shopping Center Los Angeles, CA and uninc. L.A. County 10 traffic signals	Los Angeles Community Redevelopment Agency, Engineering 354 S. Spring St., L.A., CA 90013	$18,700	1987
107	C	2 Westchester Parkway Development Los Angeles, CA 9 traffic signals	Los Angeles City Dept. of Airports Los Angeles, CA	$20,000	1988
107	C	3 Centinela Avenue & Jefferson signal L. A. County (uninc.) 1 traffic signal	Psomas & Associates	$2,750	1988
107	IE	4 Long Beach-L.A. Light Rail Project L.A. County (uninc.) 5 traffic signals	Los Angeles County Transportn Commsn. Los Angeles, CA	$25,000	1988
107	C	5 Corson-Lake Office Development Pasadena, CA 4 signing & striping plans	Mollenhauer, Higashi & Moore Los Angeles, CA	$10,500	1988
107	C	6 Vermont Avenue-Washington Bl Shoppg Ctr Los Angeles, CA 1 temporary signing & striping plan	Mollenhauer, Higashi & Moore Los Angeles, CA	$1,800	1988
107	IE	7 Long Beach-L.A. Light Rail Project L. A. County (uninc.) 12 signing & striping plans	Los Angeles County Transportatn Commsn.	$40,000	1987

	C	8 SMART CORRIDOR Santa Monica Fwy corridor 312 traffic signals	Los Angeles Dept. of Trans. L.A. City Hall	$350,000	99C
107	C	9 Metro Green Line,Los Angeles 38 signal, striping plans	TransCal 403 W. 8th St. L.A.	$150,000	1990
107	C	10 Pkwy Calabasas/101 Fwy. Los Angeles County Signal, lighting meter plans	Spearhead 4722 La Presa Ave. Rosemead, CA.	$29,000	1990
107	C	11 Monarch Estates San Diego, CA.	R. B. McComic Inc. 4920 Carroll Cyn. San Diego, CA 92121	$18,000	1990
107	C	12 L.A. Reception Center Los Angeles	Kennedy/Jenks/Chilton 17310 Red Hill #220 Irvine, CA 92714	$27,300	1990
		13			
		14			
		15			
		16			
		17			
		18			
		19			

STANDARD FORM 254 (REV. 10-83)

		20			
		21			
		22			
		23			
		24			
		25			
		26			
		27			
		28			
		29			
		30			

12. The foregoing is a statement of facts

Signature: Moses Katz Typed Name and Title: Moses Katz, Partner

Date: 3-12-90

* U.S. GOVERNMENT PRINTING OFFICE : 1988 O - 421-526 (721)

STANDARD FORM 254 (REV. 10-83)

STANDARD FORM

254

Architect-Engineer and Related Services Questionnaire

1. Firm Name / Business Address:
HUGHES AIRCRAFT COMPANY
Ground Systems Group
Command & Control Systems Division
P.O. Box 3310
Fullerton, CA 92634
ATTN: D.V. Goode Bldg. FU 618/D315

1a. Submittal is for ☐ Parent Company ☐ Branch or Subsidiary Office

2. Year Present Firm Established:

3. 3/13/90

4. Specify type of ownership and check below, if applicable.
Corporation

A. Small Business
B. Small Disadvantaged Business
C. Women-owned Business

5. Name of Parent Company, if any:
General Motors Corp.

5a. Former Parent Company Name(s), if any, and Year(s) Established:
N/A

6. Names of not more than Two Principals to Contact: Title / Telephone
1) Donald V. Goode, Manager, Major Programs Contracts (714) 732-5673
2) Donald Savitt, Senior Scientist (714) 732-0610

7. Present Offices: City / State / Telephone / No. Personnel Each Office

7a. Total Personnel 70,000

Various Los Angeles and Orange County Locations (all Divisions of Hughes)

8. Personnel by Discipline: *(List each person only once, by primary function)*

150	Administrative	50	Electrical Engineers	___	Oceanographers
___	Architects	___	Estimators	___	Planners: Urban/Regional
___	Chemical Engineers	___	Geologists	___	Sanitary Engineers
___	Civil Engineers	___	Hydrologists	___	Soils Engineers
___	Construction Inspectors	___	Interior Designers	___	Specification Writers
___	Draftsmen	___	Landscape Architects	___	Structural Engineers
___	Ecologists	___	Mechanical Engineers	___	Surveyors
___	Economists	3	Mining Engineers	___	Transportation Engineers

168	Computer Science Engrs
176	Systems Engineers
146	Staff Engr/Scientist
7	Physical Scientist
34	Production
120	Miscellaneous
854	Total Personnel

9. Summary of Professional Services Fees Received: (insert index number)

IN $MILLION

Last 5 Years (most recent year first)

	19 89	19 88	19 87	19 86	19 85
Direct Federal contract work, including overseas	63	38	61	68	76
All other domestic work	9	7	26	96	65
All other foreign work*	111	144	104	76	126

*Firms interested in foreign work, but without such experience, check here: ☐

Ranges of Professional Services Fees

1. Less than $100,000
2. $100,000 to $250,000
3. $250,000 to $500,000
4. $500,000 to $1 million
5. $1 million to $2 million
6. $2 million to $5 million
7. $5 million to $10 million
8. $10 million or greater

STANDARD FORM 254 (REV. 10-83)

10. Profile [illegible]'s Project Experience, Last 5 Years

Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)	Profile Code	Number of Projects	Total Gross Fees (in thousands)
1)			11)			21)		
2)			12)			22)		
3)			13)			23)		
4)			14)			24)		
5)			15)			25)		
6)			16)			26)		
7)			17)			27)		
8)			18)			28)		
9)			19)			29)		
10)			20)			30)		

11. Project Examples, Last 5 Years

Profile Code	"P", "C", "JV", or "IE"	Project Name and Location	Owner Name and Address	Cost of Work (in thousands)	Completion Date (Actual or Estimated)
	P	1 Advanced Automation System Command and Control for Air Traffic	Federal Aviation Administration, 400 Independence Ave. Washington, DC 20591	130,000	1988
	P	2 Intelligent Vehicle Highway Systems	General Motors Warren, MI	625	1990
	C	3 TRAVTEK	Joint - General Motors Florida DOT AAA	1,000	1992
	P	4 North European Air Defense Command & Control System	AMS - Norway Government	82,000	1992
	P	5 Korean Air Traffic Control System	Korean Ministry of Defense Seoul, Korea	20,000	1986
	P	6 Forward Area Air Defense System	MICOM	25,000	1990
	P	7 German Air Defense Command & Control System	German Ministry of Defense	160,000	1985

STANDARD FORM 254 (REV. 10-83)

		8 Joint Surveillance System, Command & Control	US Air Force	12,000	1984
	P	9 Japan Air Defense Command & Control System	Japanese Ministry of Defense	833	1992
		10			
		11			
		12			
		13			
		14			
		15			
		16			
		17			
		18			
		19			

The foregoing is a statement of facts.

Signature: Donald Savitt Typed Name and Title: Donald Savitt, Senior Scientist

Date: March 13, 1990

B. Work Plan

SECTION B
WORK PLAN

JHK & Associates is pleased to submit the following work plan in response to the Los Angeles Transportation Commission's (LACTC) Request for Proposal, Contract Number TP017, Smart Corridor System Manager Services. The proposal reflects the firm's understanding of the work as described in the RFP and the insights gained while conducting the initial phase of the overall project. That work, which led to the current project, was recently completed under a contract with the City of Los Angeles, Department of Transportation. The project, entitled the Smart Corridor Demonstration Project, was coordinated through the Steering and Technical Committees identified to coordinate the proposed project. This prior contact with the project, and direct work with the committees, provides JHK with the insight and experience needed to move efficiently into the System Manager activities.

This section of the JHK Project Team's proposal contains a description of the proposed activities that will be undertaken in performing the tasks outlined in the RFP. The general relationship of the work tasks is shown in Exhibit B.1. A detailed CPM schedule of the entire project showing the relationship of subtasks is included in the proposal as a supplement. Each work task description is also provided with an exhibit that shows the task CPM schedule.

The work descriptions presented herein are intended to provide the proposal reviewer with an indication of the types of activities and how they will be performed by the JHK Project Team. Since the key issues and special project considerations are presented in Section G, Statement of Problem, of this proposal, they will not be repeated in this section. However, the work task activity descriptions are based on the approach discussed in Section G.

TASK A PRELIMINARY DESIGN

In this task the preliminary design for all features of the Smart Corridor System will be developed. The task will result in a major product -- the Smart Corridor Preliminary Design Report. This report will serve as the specification for completing the detailed design of the system in subsequent tasks.

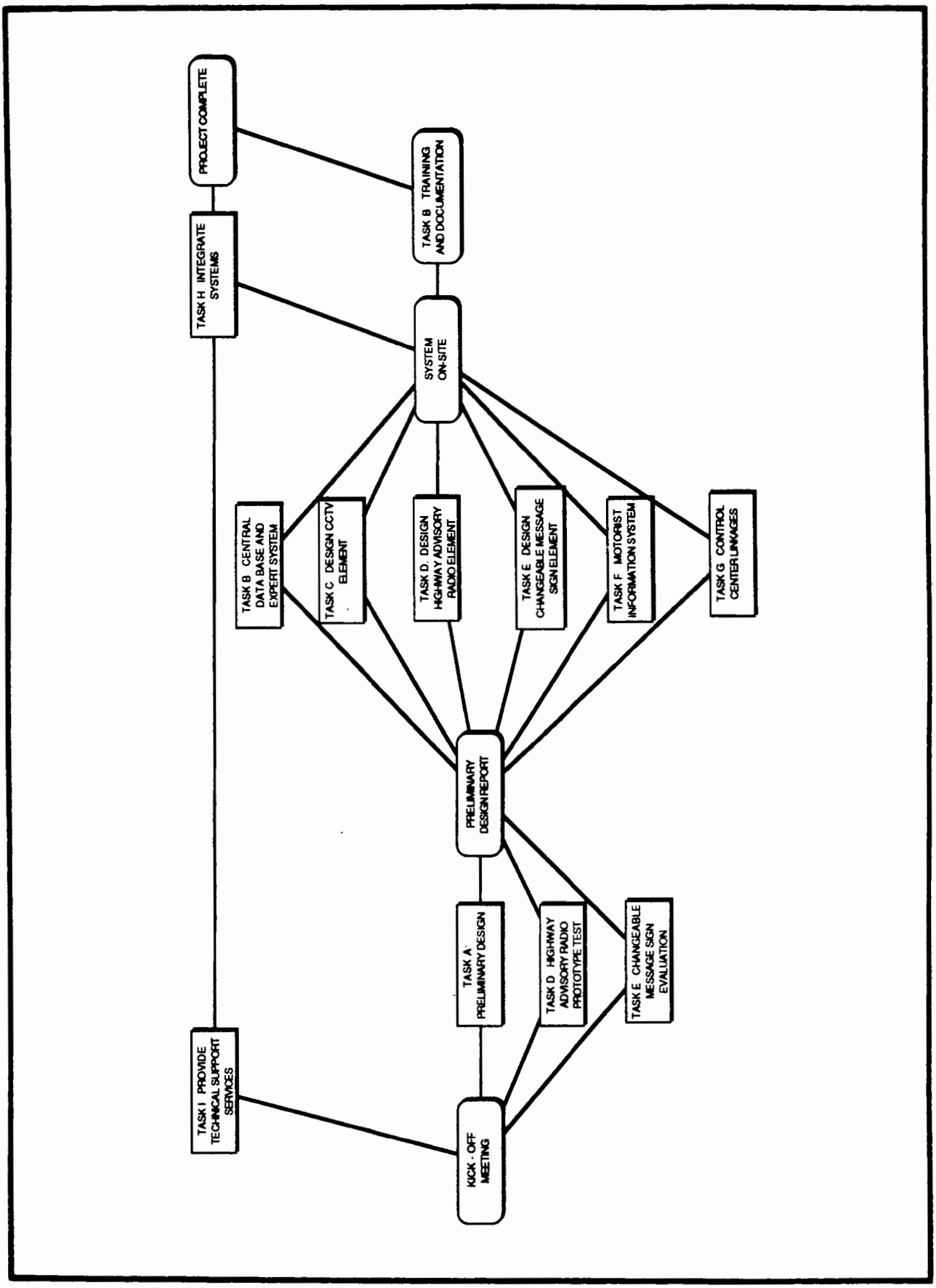


Exhibit B.1. Smart Corridor Work Plan

The conceptual system design that emerged from the Smart Corridor Demonstration Project contained general recommendations about all of the features covered by the Request for Proposal. It was not intended that the level of detail presented in the conceptual design be sufficient to permit the final design to occur. The preliminary design performed in this task is to build on the information developed by JHK for the conceptual design to produce the data required for preparation of documents from which bids can be received and from which hardware and software may be procured.

The preliminary design effort is a vital undertaking because it sets the standards for the remainder of the work. A clear definition of the system requirements and agreement to these requirements by the agencies will ensure that the project moves forward efficiently and meets the overall goals of the Smart Corridor project. Without this clear definition, it is highly likely that the design efforts will result in less than optimum conditions in the field.

Exhibit B.2 shows the relationship of sub-tasks to be completed during the preliminary design. The exhibit also indicates the critical path. The following is a brief discussion of the sub-tasks proposed by JHK to develop the Smart Corridor preliminary design.

Task A.1 - Kick-off Meeting

The project will be initiated at a kick-off meeting. Attendees will include the consulting team and representatives of all of the agencies involved in the project. The kick-off meeting will serve to bring all of the participants up to date on the current status of the project. It will also provide an opportunity for all of the persons involved to get to know one another and to establish the lines of communication which are so essential to the success of this project. The kick-off meeting will allow all of the participants to come to a common understanding of the work to be done during this Systems Management phase.

JHK will prepare the agenda for, and lead the kick-off meeting. As several activities will be initiated at the end of the kick-off meeting a product of the meeting will be a comprehensive list of contacts and a detailed schedule of activities for the near-term tasks.

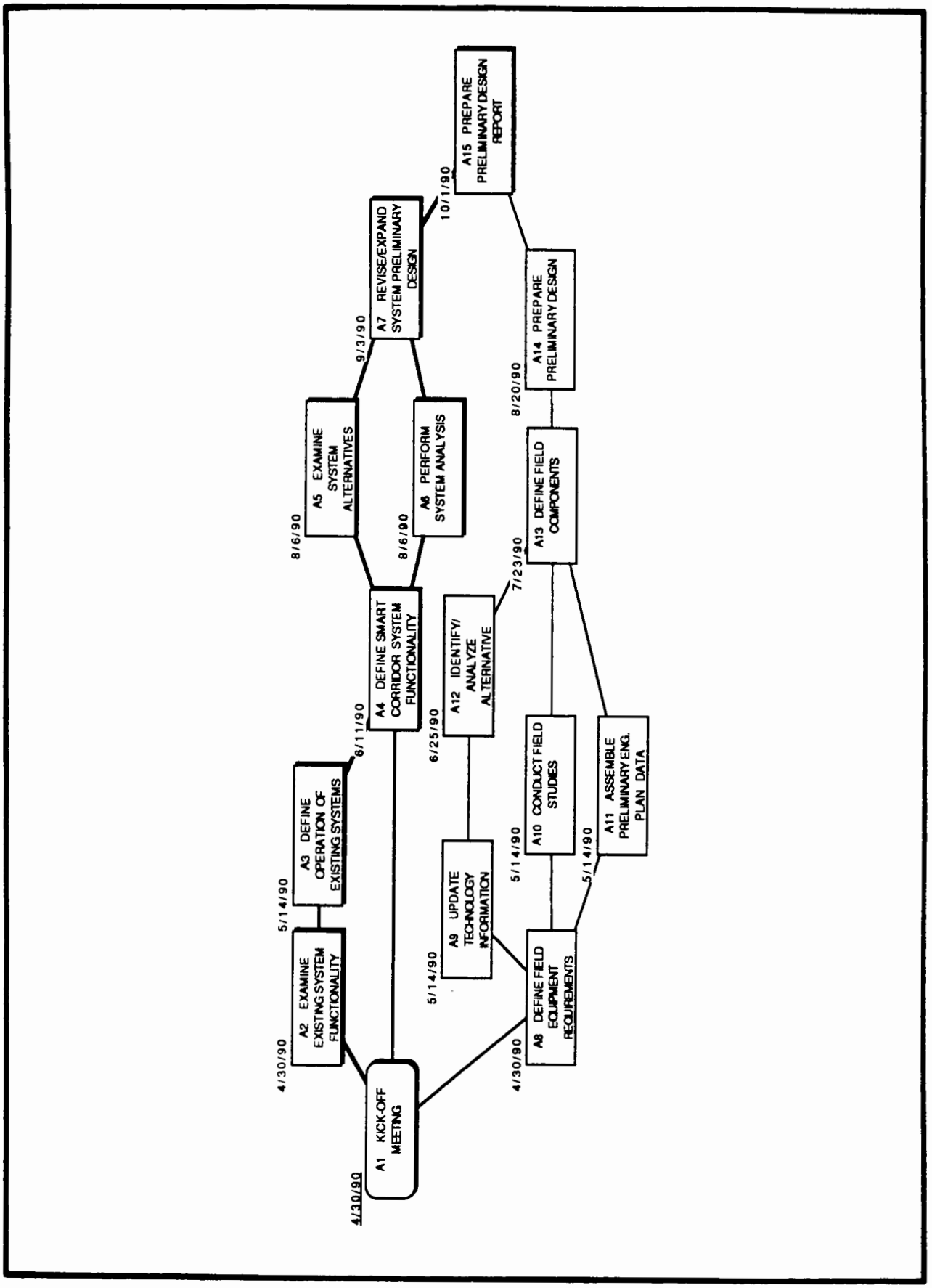


Exhibit B.2. Task A: Preliminary Design CPM

Task A.2 - Examine Existing System Functionality

In the conceptual design phase of the project, the consulting team and members of the Steering Committee reviewed the operation of several of the existing traffic surveillance and related systems, including the City of Los Angeles' Automated Traffic Surveillance and Control (ATSAC) system, Caltran's Semi Automatic Traffic Management System (SATMS), the California Highway Patrol (CHP) computer-aided dispatch (CAD) system, the Los Angeles Police Department CAD system, and the Southern California Rapid Transit District (SCRTD) dispatch system. This allowed the conceptual design development to reflect ongoing activities of these agencies. This was accomplished through the basic design of the centralized data base and through the intertie of all systems of the various agencies. It is recognized, however, that changes to the systems will have occurred, particularly those of the CHP and SCRTD, during the interim period. Also, additional subsystems such as Teletext and Pathfinder will have been added and are to be incorporated into the Smart Corridor System.

In this task JHK will examine the existing systems in detail and define all aspects of their functionality as related to the Smart Corridor System. The work involves reviewing the documentation for the various systems, meeting with the persons responsible for operating the systems and reviewing proposals being considered by the agencies to modify the existing systems.

Task A.3 - Define Operation of Existing Systems

This task will build on the detailed review of existing systems performed in Task A.2. JHK will develop a narrative and block diagram summary of the operations of the existing systems. The summary will be reviewed with each operating agency and the Steering Committee to ensure common understanding of the operations and functionality provided by the systems. Of more importance, the work in this task will focus on how the systems fit into the overall operations of the agencies. It is necessary to clearly understand how each of the control systems functions. However, to define the uses of this functionality and how it complements the overall mission of the agencies is the essence of the Smart Corridor concept. Since the Smart Corridor system is expected to enhance the operation of the agencies, it is critical that it be designed to complement

and strengthen existing operations.

Task A.4 - Define Smart Corridor System Functionality

JHK will begin this task immediately after the kick-off meeting, and its completion is dependent upon the definition of operations of existing systems performed in the previous task. The basic functionality of the Smart Corridor system was defined in the conceptual design phase working papers. It is imperative, however, that the concepts presented in the initial working papers be expanded and described in detail so that all operating agencies have a clear definition as to how the Smart Corridor central data base systems and expert systems will work.

During this task, JHK will prepare documentation that describes the operation of the Smart Corridor System as it affects each of the agencies, and in turn, how the agencies operation affects the overall Smart Corridor goals. As part of this task, JHK will develop a series of traffic condition scenarios (e.g. various types of recurring and non-recurring incidents, disasters, etc.) and the use of the Smart Corridor system to respond to these conditions. This will provide concrete guidelines as to the operational support that needs to be provided by the Smart Corridor central system.

Near the completion of this task, a workshop will be held to review the overall Smart Corridor system functionality. This will be followed by one-on-one meetings with the affected agencies. A working paper will be developed by JHK and provided to the agencies so that they may review in detail the effects of the Smart Corridor system functionality on to their ongoing operations.

Task A.5 - Examine System Alternatives

A common thread running through the JHK team approach to this project is that system requirements drive the overall system design: that is, the form of the system follows the function that it is expected to perform. Using the system functionality defined in Task A.4, a comprehensive review of the hardware and software requirements will be made. System alternatives will be defined including the nature and number of workstations to be provided for each agency and the requirements for the central system.

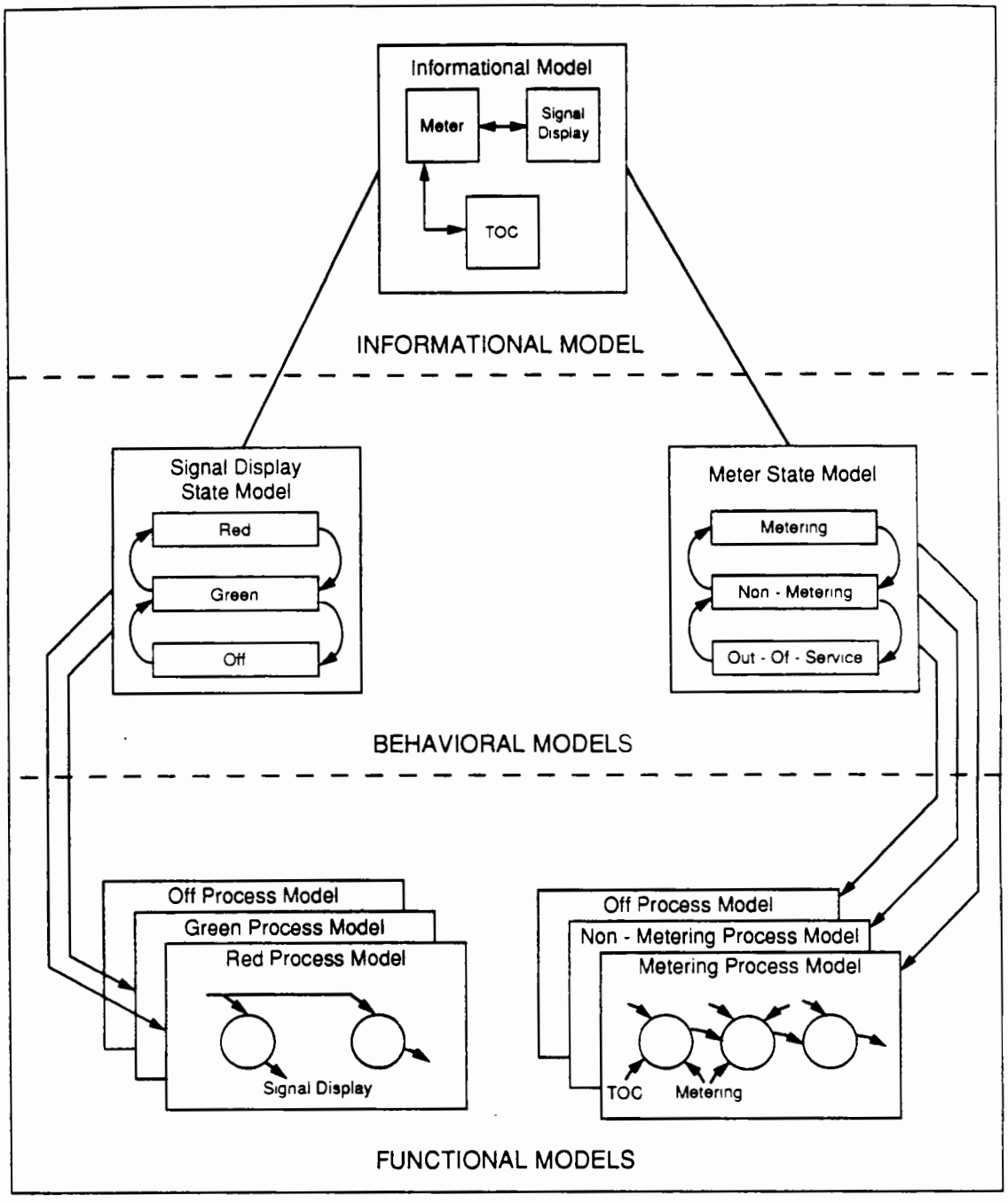
Significant work was performed to develop system alternatives during the conceptual design phase. This was essential to develop cost estimates for the program. However, changes in hardware and software have occurred since the conceptual design phase was completed and these changes must be considered during the final design. Also, new software development tools are available and improved man/machine interfaces, such as graphical user interfaces and geo-coded information systems are being developed and can be incorporated into the design. JHK proposes that the Smart Corridor development activity take advantage of the most efficient development tools possible. The result of Task A.5 will be a definition of the system alternatives, including hardware and software, to be recommended for the project.

Task A.6 - Perform System Analysis

System analysis is the process of translating Smart Corridor goals into an initial system design specification. The JHK Team's formal system analysis and design methodology has been described in Section G, Statement of Problem, of this proposal. The system analysis task builds on the initial requirements and system architecture definitions developed in Task A.4 and A.5 and is the first step in formal software specification.

The purpose of the system analysis performed in this Task A.6 is to describe in a moderate level of detail the required operation of the Smart Corridor system and its interfaces. The data produced under this task will provide a global view of system requirements which can be examined for coherence, completeness and consistency. A more detailed view of system requirements is also provided so that they may be examined and confirmed by the Smart Corridor Technical Committee prior to moving into the final design phases of the project.

At a global level, a system-wide object oriented communications model will be produced. This model will depict the major information and control flows of the system. At the detailed level, the JHK system analysis and design methodology will be applied to define three formal requirements models: the informational model, the behavioral model, and the functional model. These models are depicted in Exhibit B.3.



THE OBJECT ORIENTED ANALYSIS PROCESS

The object oriented analysis process constructs three types of formal models: informational models, behavioral models, and functional models. The information model identifies the conceptual entities (objects) of the world. Behavioral (state) models represent the behavior of each object or relationship in the information model. Functional data flow diagrams graphically depict the action processes associated with each state in the behavioral model.

Exhibit B.3. Systems Analysis Formal Requirements Model

Models of these types have been used in system engineering analysis for some time. The principal advantage of a model-based approach over other methods of system analysis is that the requirements specifications produced are more exacting and provide a natural first step to software design.

JHK will perform a technical analysis of the system which will translate and quantify the results of the system modeling efforts in terms of physical system requirements and constraints. The results of this task will be documented by a Technical Memorandum titled "Smart Corridor System Analysis Report".

Task A.7 - Revise/Expand System Preliminary Design

JHK will perform the work necessary to develop and refine the preliminary design for the Smart Corridor central data base and expert systems. The design includes the interties with the various operating systems of the participating agencies. The work builds on the activities of the previous tasks, where the overall functionality of the system has been developed by JHK. From this functional design, the translations into hardware and software requirements are developed.

Included in the preliminary design will be a comprehensive layout of the Smart Corridor software, a listing of the software products to be used in developing the system software, and the hardware operating platforms which are expected. The design will also reference the local area and extended area network requirements for the transfer of the information between the existing systems and the central data base system.

Task A.8 - Define Field Equipment Requirements

JHK will also initiate this task immediately after the kick-off meeting. During this task JHK will perform the preliminary design of the field components, including the physical interties between systems, the changeable message sign subsystem, the closed circuit television subsystem, and the highway advisory radio subsystem. At this time JHK will also undertake prototype activities to address unique questions associated with the highway advisory radio technology and the design of the trailblazer changeable message signs. The prototype activities are described

separately in Tasks D-1 through D-4 and E-1 through E-3.

During the conceptual design study, JHK identified the basic requirements of the field equipment. The concept design report also indicated the relationship of these elements to the ongoing design in the Smart Corridor area for the expansion of ATSAC and its associated communications network. In this task, JHK will thoroughly define the specific field equipment requirements for inclusion in the preliminary design phase. The approach will be to build on the information developed during the conceptual design study and update the requirements based on conditions which have changed since the time of the conceptual design study.

JHK will develop a listing of specific operational requirements for the field components. Operational requirements will include items such as the field of vision for the CCTV cameras, the distance from sign for message recognition and message requirements for the changeable message signs, the functional requirements and data to be shared via the system interties, etc. The definition of operational requirements and field equipment requirements will shape the direction subsequent activities will take.

Task A.9 - Update Technology Information

During the conceptual design study a significant effort was made to evaluate the technologies that are available for use in Smart Corridor type projects. This included a review of color and black and white closed circuit television, the use of various sign technologies and lighting techniques for changeable message signs, and the use of synchronized, low-power highway advisory radio, a new technology. Also investigated were other aspects of motorist information including the Teletext project, FM side carrier allocation digital broadcast, highway advisory telephone, and media interface requirements.

JHK will build upon the conceptual design study technology review to reflect changes which have occurred in the dynamic marketplace of traffic control and motorist information devices. Questionnaires will be developed for each system element and sent to potential manufacturers of the equipment. The questionnaire will also solicit information on the status of new product development and confirmation of the understanding of the functionality of the current products offered. Telephone contacts and face-to-face interviews will be conducted by JHK, as required, to solicit information on technology applicable to the Smart Corridor project. The

information will be summarized by type of device and presented to the Steering Committee in technology workshops. Where appropriate, JHK will also schedule demonstrations of the technologies, to ensure that all members of the Steering Committee understand the implications of the design decisions being made.

The activities in this task are directed at two specific goals. The first goal is to ensure that the appropriate technology is being considered for the final design phases. The second goal is to continue the information transfer to the Steering Committee and the staff of the operating agencies so that the end system users and maintainers are fully apprised of the capabilities and level of technology to be associated with the various devices.

JHK will also perform a review of parallel studies being conducted by other agencies. For example, the Ministry of Transport in the province of Ontario, Canada, has been especially aggressive in research and development activities related to new technologies; especially in the CMS arena. The information obtained from other agencies will be incorporated into the technology review performed directly by JHK.[1]

Task A.10 - Conduct Field Studies

Concurrent with the review of applicable technologies, field studies will be conducted. The goal of these studies will be to identify specific locations for the recommended field devices. This is especially important for the CMS and HAR subsystems. The field studies will include a site-specific review of all of the proposed locations to identify any obstructions or obstacles to the implementation process. The JHK Project Team is intimately familiar with the design conditions and constraints in the Smart Corridor area due to their earlier activities on the Smart Corridor Demonstration project. This will facilitate the review of field conditions as they apply to preliminary design decisions.

[1] Note: The JHK Responsible Officer for this project is on the NCHRP distribution list for all freeway operations research material and was a member of a committee that made a comprehensive review of the research program in freeway and surface street operations being proposed by the Federal Highway Administration.

Task A.11 - Assemble Preliminary Engineering Plan Data

In this task, the JHK Project Team will develop the base plans required for preliminary engineering plan preparation. The base plans will be developed by using existing drawings from Caltrans and those being prepared for the Los Angeles Department of Transportation for the expansion of the ATSAC System.

Task A.12 - Identify/Analyze Alternatives

In this task, trade-off studies will be conducted to determine the applicable technologies and devices to be used as part of the alternatives analysis. As shown previously on Exhibit B.2, input includes information from the Tasks A.7 and A.8 and information from pilot tests on HAR technology and a prototype design for the trailblazer element of the CMS.

These analyses will be based on: complete understanding of the requirements; careful selection and agreement on evaluation criteria; precise definition of candidate solutions or designs; and appropriate consideration of pertinent technical, cost, schedule, and risk factors.

As an important part of engineering and integration, the tradeoff analysis process may be applied to design decisions, implementation approaches, test alternatives, support tools, etc. The analysis may also cover a board range of decisions from major decisions (e.g., design of a subsystem to incorporate newly proven technology) to the very simple.

Exhibit B.4 is an illustration of the tradeoff analysis approach, with hypothetical criteria and values. Experienced specialists associated with the project will define and weigh the evaluation criteria. The alternative candidates will be established and a table of characteristics, such as shown in (A) of the exhibit, will be prepared. Characteristics may be qualitative as well as quantitative. In all cases, engineering judgement will be applied to all criteria. A rating is established for each alternative against each criteria, then a composite measure of effectiveness (MOE) is determined for each candidate by establishing a weight for each of the criteria, a weighted rating of each candidate against each criteria (WR = Wt x R) and then summing the weighted columns for each of the candidates, as shown in (B) of the figure.

Cost and schedule estimates are made for each candidate as illustrated in (C) of the figure. The cost analysis is aided by the use of a life cycle cost model to show the difference in life

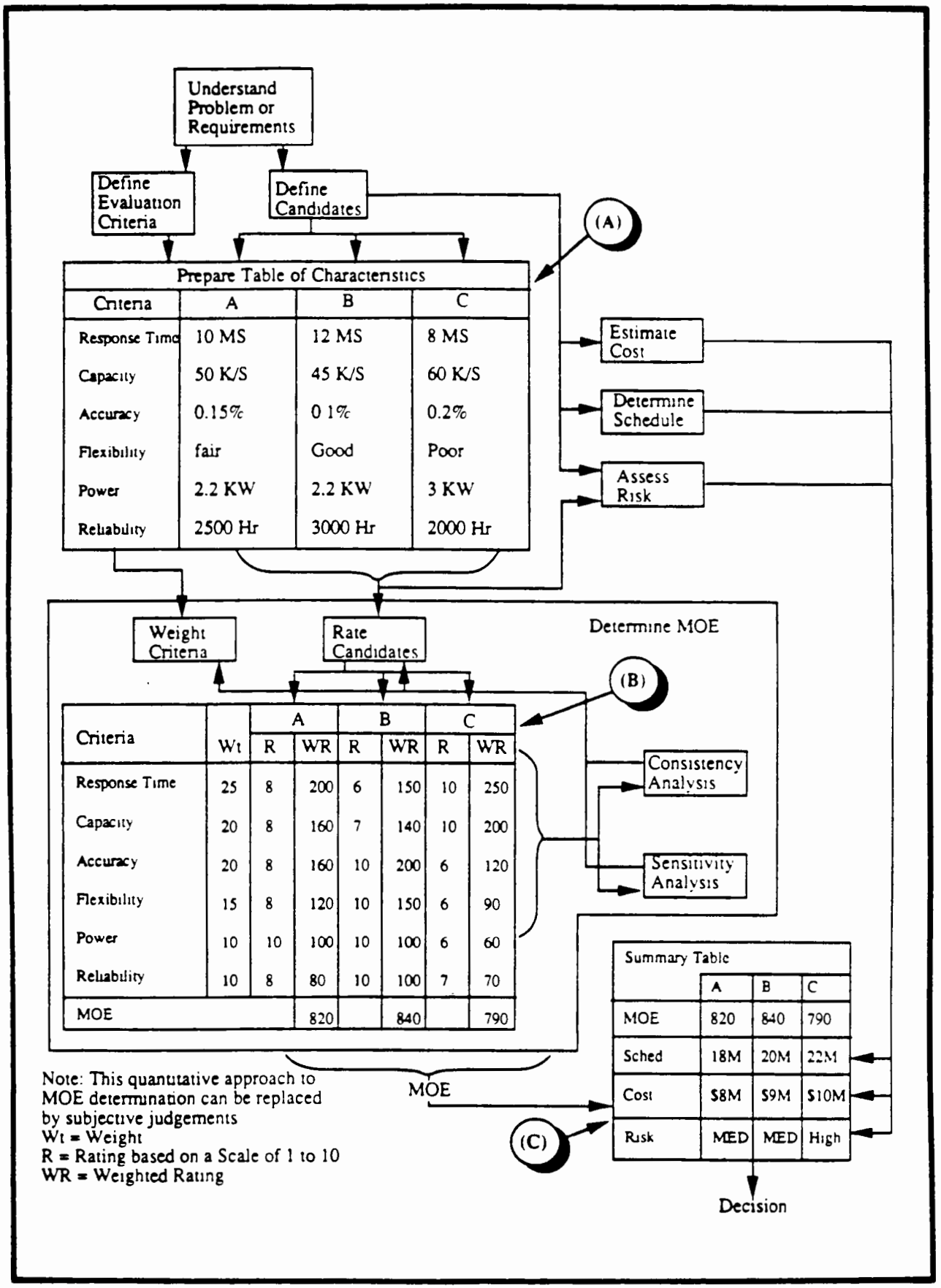


Exhibit B.4. Example of a Tradeoff Analysis Process

-cycle costs among the candidates. Where costs are approximate, estimates include an assessment of the uncertainties involved.

The risk of each candidate is assessed in terms of the uncertainties in achieving the MOE, cost, or schedule requirements and the projected penalties for failure to achieve the MOE, cost or schedule. The results of the MOE, cost, schedule, and risk assessments of each candidate are tabulated to provide the basis for a decision. The results are then documented to record the rationale for decisions and to support re-evaluations later as conditions change. In cases where there are no significant differences in a factor such as cost, schedule, or risk, that factor can be deleted from the analysis and so documented. The formal documentation of tradeoffs aids the traceability of design decisions back to fundamental requirements and helps justify design decisions.

Task A.13 - Define Field Components

In this task, the results of the field studies and the alternative analysis will be brought together to define the final field elements that are to be included in the Smart Corridor project activities.

Task A.14 - Prepare Preliminary Design

In this task, the JHK Project Team will complete the preliminary design activities for all field elements of the Smart Corridor project. This will include the preparation of preliminary plans showing the locations of the devices and a description of the functional requirements of all of the elements to be included. The definition of system elements will be in sufficient detail to allow comprehensive review by the Steering Committee and affected agencies and to serve as input to the final design process.

Task A.15 - Prepare Preliminary Design Report

This task represents the culmination of the efforts in the preliminary design stage of the project. It is the work required to pull together the preliminary design of the field elements and

the comprehensive preliminary design of the central system and system interties.

The preliminary design report will provide an overview of the project and the project elements. An element-by-element description of the features and functions to be provided will be included in the report. A summary of features will be provided for each of the elements to facilitate review by decision-makers. Each of the summary features will then be expanded and described in detail for the more complete technical review by staff.

The preliminary design report and all activities associated with Task A will be completed within the six month time frame indicated in the Request for Proposal.

TASK B CENTRAL DATA BASE AND EXPERT SYSTEMS

In this task the JHK Project Team will develop the Smart Corridor system. This will consist of the detailed software design and development for the expert systems, the central data base, the interfaces to existing systems, the node servers, and other applications software required to use the operations plans and decisions matrix developed by Caltrans, LADOT, and CHP. In addition, JHK will procure the necessary computer equipment and systems software through JHK's competitive procurement process.

JHK will oversee the installation of the hardware and software and conduct acceptance tests. Applications software will be developed and tested at JHK's facilities in Norcross before being relocated to Los Angeles. This is a standard procedure that has been used successfully by JHK for over ten years.

Exhibit B.5 presents the CPM schedule for this task. JHK proposes to conduct this work by means of 36 activities, or subtasks. These activities are structured based on the systems engineering approach presented in Section G.

Task B.1 - Develop Overall Software Design

The work elements in this task include developing formal specifications for component software modules, software tasks, and software environments. These elements are described below:

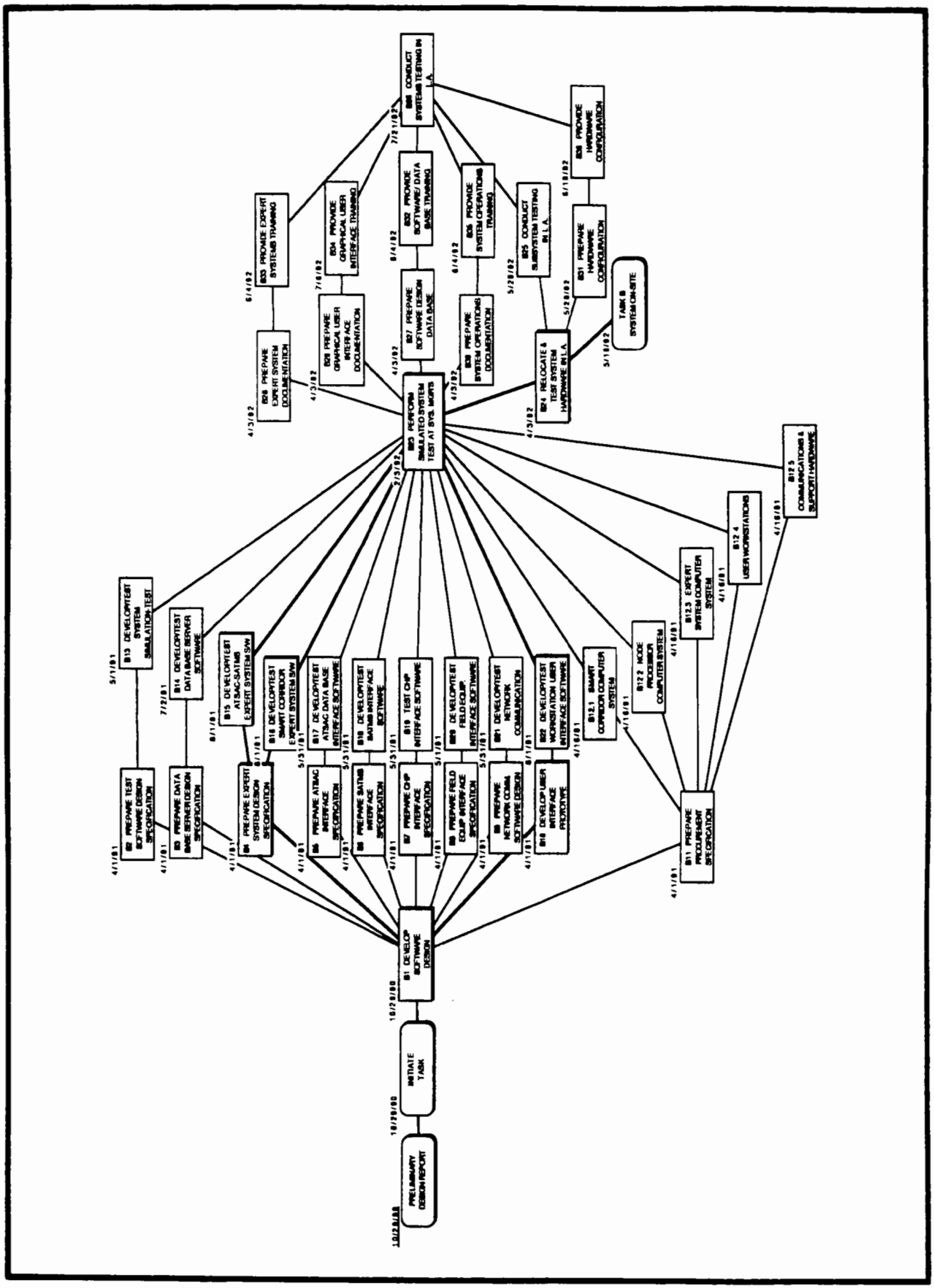


Exhibit B.5. Task B: Central Data Base and Expert System CPM Schedule

- Software Module Specifications - The specification of software modules actually starts with the development of the informational, behavioral and functional models in Task A.6. The transformation of these models into software specifications is no more than a formalization of previous work. The formal software specifications first define each object module type (e.g. class), its attributes, and the services or methods that it supports. These diagrams with accompanying method descriptions constitute what are known as "object specifications". Next, a more global picture is provided by diagrams showing object class and assembly structures. An object communications diagram is produced which defines messaging connections between objects.

- Software Task Specifications - In a real-time system, software modules are combined or structured into higher level modules called "tasks" or "processes". The need to group modules into larger tasks is primarily a matter of practicality. Tasks with like processing needs or which have to be executed in sequence minimize operating system overhead.

  As with lower level software modules, software task modules will be formally specified with an object specification. Each higher level task object can be thought of as an object module that handles the administrative needs of its subordinate objects. Its methods will normally take care of the execution sequencing, start-up and shut-down of subordinate modules.

- Software Environment Specifications - The functionality, user flexibility, and ease-of-use of the Smart Corridor software system will be determined, to a large extent, by which commercial software tools, data base, expert system shell, and operating environment software are purchased to support the Smart Corridor system. Two emerging trends in systems development today are greater software interoperability and standardized operating environments. The net result is that if applications software is designed in light of these trends, then a wealth of compatible support software will be available commercially at a very reasonable cost.

  The JHK Team will also define the software development environment required for completion of the project. This shall, as a minimum, include the target computer, user interface standards and support tools, data base requirements, expert system shell, application program interface standards, specifications for other hardware, and operating system software.

The results of this task will be documented as a technical memorandum titled "Smart Corridor Software Design Report".

Task B.2 - Prepare Simulation and Test Software Design Specification

The JHK Team will design a simulation environment that will allow component system software modules to be tested and verified prior to final system integration. This environment will be based on graphical user interface (GUI) technology. The following features are envisioned:

- The user of this simulation environment will be able to set up models for the operation of all system communication streams associated with a given software component module under test.
- Field device responses will be programmable based on models that the user can specify interactively.
- Simulation results will be available for display in graphical or text formats.
- During algorithm and expert system testing, an automated log will be kept of all system and device responses.

The product of this task will be a Technical Memorandum titled "Simulation and Test Software Specification".

Task B.3 - Prepare Data Base Server Design Specification

The Data Base Server will be the central repository for all data used by the high level functions of the Smart Corridor system. As such, it is the basis for these functions and a formal specification is required to assure that it will properly support this functionality.

The server will actually be a data base management system in that it will consist of both data and the software necessary to maintain the data. Much of the data base functionality will be provided or facilitated by the commercial data base package around which the central server will be constructed.

A large part of the central data server's operation will be concerned with "normal" data maintenance activities, such as efficient data access, data acquisition, report generation, user interfaces, data archiving, etc. However, a greater concern is the fact that the data will originate from a variety of sources in diverse formats with differing degrees of timeliness.

In general, the Smart Corridor data will consist of historic and current traffic flow information, current and future capacity information, lists of actions which must be performed to execute a given response plan, and geographical data describing the arterial/highway network within the corridor. Further, the data will include (near) real-time detector data, incident reports and operator inputs.

To provide the proper support for the more visible high level functions, a composite data model will be devised to present the data as a consistent and unified entity. Special data base software will be designed to assure that this unified model can be maintained and efficiently accessed.

The data server specification will provide a detailed description of all aspects of this sub-system. The specification components are presented below:

- Data Dictionary: extensive description of all data to be maintained by the Smart Corridor system. The dictionary will include a description of each record type as well as information about each element of that record (name, type, range of values, origin, etc.)

- Data Relationship Diagrams: diagrammatical presentation of the inter-relationships of the various record types, presented at the level of Bachman diagrams.

- Data Flow Diagrams: Description of those procedures which are solely or primarily responsible for data access, reporting maintenance, acquisition, etc. This section will also indicate the major interface points for both high level Smart Corridor functionality and data exchanged with the various member agencies.

- Policy Procedures: List of data policies that will affect the structure and operation of the data base. Examples of such procedures include aging events out of the system, response plan maintenance, etc.

- Hardware Requirements: Specification of the special hardware requirements to perform the data base operations, including storage requirements, processor power, etc. These requirements will become part of the overall hardware specifications.

- Data Base Management Software Selection: Selection recommendation for the commercial software which will form the basis for the Smart Corridor data base. The selection will be based on performance, functionality, and connectivity to other software within the system (i.e. expert system software, data networking software).

Task B.4 - Prepare Expert System Design Specification

Three expert system workstations are currently envisioned for the Smart Corridor project. The first will be located at the Smart Corridor Central site, and will provide decision support services for incidents of corridor-wide significance. Units two and three will be located at the Caltrans TOC and at the LA DOT ATSAC center respectively. These latter two units will provide decision support for local agency incident and detection, and response functions.

The JHK Team will develop expert system application specifications for each expert system unit. These specifications will include:

- A description of external and internal expert system interfaces, including formats, rates, protocols, etc.
- Performance requirements, including decision response times, and event response requirements.
- A complete description of each knowledge base, including a rule base listing.
- Specification of minimum ES-shell and development environment requirements.

The JHK Team will also investigate the application of neural network technology to the Smart Corridor project. As a minimum, this investigation will include an assessment of applicability, likely performance, and system costs.

Results of Task B.4 will be documented by a technical memorandum titled "Smart Corridor Expert Systems Design Specification".

Task B.5 - Prepare ATSAC Interface Specification

The operation of the local agency-based components will be critical to the success of the Smart Corridor system. The local agency is the source of the majority of data processed by the Smart Corridor high level functions and the party responsible for ensuring that response plans are

executed properly.

The ATSAC interface must collect data efficiently, but with as little impact as possible upon normal system operation. The interface must also provide assistance in carrying out the response plans issued by Smart Corridor Central. The ATSAC interface consists of three major components: local incident detector, data extractor, and plan implementor. Each component is described below.

- Local Incident Detector: Responsible for providing Smart Corridor Central with a list of possible incidents. The Smart Corridor System Description document described two components of the local incident detector: the incident preprocessor and the expert incident processor. (The latter is described elsewhere in this document.) The incident preprocessor is a filter that uses user-supplied threshold values to identify possible arterial incidents for further processing. Requirements will be developed that address each of the following system aspects:
  - Algorithms to provide candidate incident identification
  - Data requirements
  - Local expert system interface
  - Software design to implement above algorithms, with special attention to a data-driven implementation.
- Data Extractor: Responsible for acquiring detector data from the ATSAC UTCS-Enhanced traffic control system on-line data base and providing it to Smart Corridor Central. The extractor also provides raw data to the local incident detector. Design of the data extractor will be driven primarily by the specification of the Smart Corridor Central data base and the requirements of the local incident detector. Once these components have been established, the following aspects will be addressed:
  - Data required by all interfaces
  - Data timing requirements (how often the data will be updated)
  - System timing units (second, minute, signal cycle, etc.)
  - Data exchange formats
  - Data extraction procedures
  - Data format for all interfaces

- Software design.

- Plan Implementor: Will aid the local system in performing the agreed upon operations and inform Smart Corridor Central as to ATSAC's progress in implementing this plan. Design of the local plan implementor will be based on the format of plan response messages (from the Smart Corridor data base server) and the requirements of the local traffic control software. The following aspects will be addressed:
  - Local operations required to implement any given system change
  - Interface to UTCS-Enhanced software command processor
  - Software design to implement response plan activation
  - User interface required to maintain response plans.

A specification incorporating each of the above components will be developed using the methodologies described in Section G of the proposal. In particular, due to the nature of the activities involved, the specification will make extensive use of data flow diagrams.

Task B.6 - Prepare SATMS Interface Specification

For the purposes of this work plan definition, the JHK Team assumes that Caltrans' existing Modcomp-based system will be the interface point for freeway-based system input data. It is recognized, however, that Caltrans District 7 is in the process of formulating an upgrade project for the SATMS which may change its configuration significantly.

The JHK Team proposes to extract data from the Modcomp-based SATMS, utilizing the same approach as currently being implemented for the Caltrans/Anaheim Intertie project, for which JHK & Associates is the systems manager. This approach uses a VME-based single board processor to extract real-time detector data from the system.

For the Smart Corridor project, SATMS data would be extracted by the VME single board computer and passed to a Smart Corridor node processor which would be responsible for data reformatting and local storage.

Under this task, complete specification of the SATMS-to-Smart Corridor interface would be accomplished. The product of this effort will be a technical memorandum titled "Smart Corridor SATMS Interface Specification". This document will include complete details of the interface and will provide acceptance test procedures for verifying the proper operation of SATMS interface software and hardware.

Task B.7 - Prepare CHP Interface Specification

Under this task, the JHK Project Team will develop a specification to be used by CHP and/or its systems consultant to provide a Smart Corridor interface to the CHP's computer-aided dispatch system for the purposes of sending and receiving incident status information. The JHK Team will work with CHP staff to ensure that critical security issues are properly addressed and that CHP's needs are met.

The product of this task will be a technical memorandum titled "Smart Corridor California Highway Patrol Interface Specification". This document shall include complete details of the interface between CHP computers and the Smart Corridor system, and shall address interface acceptance test requirements.

Task B.8 - Prepare Field Equipment Interface Specification

The Smart Corridor concept study recommended a system configuration that would tie together Highway Advisory Radio and changeable message signs through interface software operating on existing ATSAC and SATMS computer hardware. Under this task, interface specifications will be developed by the JHK Team to define the nature of these interfaces and the methods for communicating message and status information to and from the Smart Corridor system. The work will include:

- Communications protocols, data formats, and response timings
- Field controller functional requirements and firmware specifications
- Local agency to Smart Corridor intersystem communications protocols formats and performance requirements.

The results of this test work will be documented in a technical memorandum titled "Field Equipment Interface Specification".

Task B.9 - Prepare Network Communication Software Design Specification

The Smart Corridor system will be a distributed system with system components located at each cooperating agency. Communications, therefore, are key to the system's success. Some system components will be connected using point-to-point connections, while others may be part of the peer-to-peer network. Regardless of the techniques used for connection, consistent system procedures are needed to facilitate the flow of information from one system component to another.

Under this task, the JHK Project Team will detail the complete network topology of the system and will specify the software drivers and communications support modules necessary for providing the required system functionality.

The client/server concept will be applied across the board for intertask communications, whether tasks are on the same machine or separated by some distance. Regardless of the distance of the data transfer or the particular transport mechanism, communications software will be designed to make these factors transparent to applications software modules.

The final output of this task will be a technical memorandum titled "Network Communications Software Specification". This document shall form the basis of the work to later be accomplished under Task B.21.

Task B.10 - Develop User Interface Prototype

Rapid prototyping methods will be utilized to specify user interface control dialogue displays and reports. Rapid prototype is a systems engineering design methodology that uses available hardware and software tools to evolve system functionality in an incremental, easy to verify way.

As part of developing the software specifications for the Smart Corridor project, the JHK Team will develop prototypes of all user interface controls, displays, and reports. These prototypes will be used to obtain feedback from the Smart Corridor technical staff regarding user

requirements and major functionality issues during the prototype implementations.

System analysis results from Task A.6 will be used to define the principal user interface requirements for the system. These basic requirements will then be further analyzed, resulting in dialogue definitions, screen display layouts, and report formats. Finally, user interface prototypes will be implemented using Graphical User Interface (GUI) technology and screen writer prototype development tools.

Prototypes will address all aspects of user interface including (but not limited to):

- Screen display presentation
- Menus and controls
- Connections to function keys
- Complex human-machine task performance.

To ensure that prototype screens and report formats are somewhat realistic, they will be refreshed with data updates from a limited data base. The final output of this task will be a coordinated agency-approved user interface prototype.

Task B.11 - Prepare Hardware and Support Software Procurement Specifications

The JHK Project Team will develop technical specification packages for system equipment that address functional requirements, material standards, and environmental considerations. All specification packages will define high-quality equipment. However, care will be taken to ensure that equipment items can be obtained from more than one source. The JHK Project Team recommends that several procurement specification packages be prepared, as follows:

- Smart Corridor Central computer system specifications
- Node processor computer systems specifications
- Expert system computer systems specifications
- User workstations systems specifications

- Communications and support hardware specifications

The distinct advantage offered by breaking up the equipment procurement into multiple subsystems is that component items can be organized into the subsystems having compatable components and which make the most economic sense.

For the Smart Corridor project, JHK will take full responsibility for system design, software development, equipment procurement, and system integration. This approach provides continuity throughout these processes, as well as a single source of accountability. All equipment procurement will be provided as direct costs to the System Manager's contract.

Task B.12 - Procure and Test Hardware and Support Software

As indicated under Task B.11, JHK will take full responsibility for system hardware and support software procurement. JHK will handle the purchasing, testing, and related support activities in order to ensure that all products and support services procured are in accordance with project requirements and applicable local, state and federal regulations.

The work under Task B.12 has been divided into five sub-tasks, each pertaining to a separate procurement package as follows:

- Task B.12.1: Procure and test Smart Corridor Central computer system and support software
- Task B.12.2: Procure and test node processor computer systems and support software
- Task B.12.3: Procure and test expert system computer systems and support software
- Task B.12.4: Procure and test user workstations and support software
- Task B.12.5: Procure and test network communications and support hardware

The final product of each of the above sub-tasks will be a letter from the JHK Project Manager to the LACTC Project Coordinator indicating the successful completion of component

system acceptance tests, with a recommendation to accept the subject procurement. The letter shall include documentation of the results of the tests performed.

Task B.13 - Develop and Test System Simulation and Test Software

The JHK Project Team will build an interactive simulation environment for testing system software components. The environment will use graphical displays and controls which will allow simulated inputs and assumptions to be easily and interactively modified, with the results of systems testing efforts being displayed in real-time. It is only with such tools that the limiting cases and combinations which might only be found as a rarity under real world situations can be determined and addressed before the system is actually brought on line.

The development and testing of the system simulation and test software produced under this task will follow the specifications previously developed under Task B.2. Software acceptance will follow the successful completion of an approved software test plan.

Task B.14 - Develop and Test Data Base Server Software

The Smart Corridor data server and its interface support modules are the basis for all high level Smart Corridor system functions. It must, therefore, be both reliable and manageable. The development of the data server will proceed in three major phases.

The first phase will provide the basic physical data base implementation and the minimal software utilities to support it. Creating the data base early in the development process allows other aspects of the overall system design to proceed sooner. Operations performed during this phase will include:

- Installation of the data base management system software
- Creation of the physical data base
- Creation of utilities to perform simple data reporting, retrieval, updates, loading, etc.

The second phase of this work is envisioned to include the development and testing of the following Smart Corridor Central (SCC) system processes:

- Central data management
- User data server
- User access manager
- Textual user interface
- Motorist user interface

Task B.15 - Develop and Test ATSAC-SATMS Expert System Software

At the ATSAC and SATMS local agency levels, process data indicating possible incidents are passed to a knowledge-based expert system (KBES). This system will make use of expert system rules, link data, historic traffic data, existing incident reports, and operator input to identify actual system incidents. In addition, an incident response function will be included which will use locally stored response plans, expert system rules, traffic data, and operator input to recommend response actions. Both local expert systems will also include a response plan executor which will interface with the operating and Smart Corridor Central logic to issue the local commands to enact a particular incident response plan.

For the most part, the functionality provided by the expert systems at both agencies will be similar. However, in the case of the ATSAC system, the KBES will be used to make the initial determination as to a possible incident. It is envisioned that the work here will build upon previous research work on urban surface street incident detection conducted at the ATSAC control center.

Task B.16 - Develop and Test Smart Corridor Expert System Software

The Smart Corridor Central subsystem handling incident management will be responsible for tracking each incident report. This incident management subsystem will be provided as an expert system-based module which will make use of various data (links status data, expert rules,

etc.) to determine which incidents will require Smart Corridor Central action. Once the expert system has determined that an action is warranted, a response plan selection function will select which of the available response plans will be used. This function, as well, will be expert system-based.

The work under this task will develop and test the Smart Corridor Central expert system modules required to accomplish these tasks. The effort will follow the specifications previously developed for this system component under Task B.4. Smart Corridor expert system testing will be accomplished based on an approved software test plan.

Task B.17 - Develop and Test ATSAC Data Base Interface Software

Proper operation of the local agency interface software is essential for the operation of the Smart Corridor system. The operation of each of the three major local interface components is tightly tied to that of other components within the system.

As the first element of this task, a data extractor module will be developed and tested. The data extractor will access UTCS-Enhanced software data and supply it to the Smart Corridor central data server, as well as to the local incident detector. Next, the incident detector module will be built. The incident detector will actually be composed of an algorithmic component and an expert system component that must be integrated properly. The incident detector must supply incident reports to the central data server and the local response plan implementor. The local response plan implementation is the final module to be built. It helps the local traffic control software implement locally or centrally directed plans.

The ATSAC interface specification will allow each component to be developed incrementally. For example, the basic data extractor functionality can be developed when needed by the Smart Corridor central data server. These various components will then later be integrated into a consistent package as more components become available.

Of major concern is that installation of Smart Corridor hardware and software at the ATSAC control center proceed in a manner so as to not disrupt the normal local operation of the center. Great care will be taken to minimize this disruption in terms of both traffic control operations (day-to-day) and computer system performance.

An acceptance test document will be developed based on the ATSAC interface specification developed under Task B.5. Provisions will be made for acceptance testing each of the major system components. Once approved, testing will take place in accordance with this plan.

Task B.18 - Develop and Test SATMS Interface Software

As with ATSAC-based software, the SATMS local component software is essential for the proper operation of the Smart Corridor system. In the case of the SATMS local interface, the data extractor task will access freeway surveillance data and supply it to the Smart Corridor Central data server and to the local incident detection and management logic operating on the closely attached expert system workstation. The incident detector function must coordinate with the Central data server and the local implementor software, in order to implement Smart Corridor response plans.

All local interface software and hardware connections will be developed as specified by the SATMS interface specification under Task B.6. As with the ATSAC connection, a major concern is that the installation of the Smart Corridor hardware and software proceed in a manner so as to not disrupt normal SATMS operation during critical periods at the Caltrans TOC.

The SATMS software will be tested in accordance with an acceptance test document produced for this purpose. Implementation and testing will proceed incrementally, to ensure that SATMS operation is not disrupted.

Task B.19 - Test CHP Interface Software

A workstation processor has been recommended for location at the CHP district offices. An Ethernet network will likely provide all data access between Smart Corridor Central and the CHP systems. The CHP workstation will have the responsibility for receiving incident reports from the CHP's computer-aided dispatch system and sending them to Smart Corridor Central. As with workstations located at other dispatch agencies, a response executor will process response messages received from SCC and expand them into meaningful information which CHP can act upon. The response executor would also be responsible for querying the local agency operator as to whether a response plan will be complied with and then relaying this information to Smart

Corridor Central.

Actual CHP system resident interface software will be developed in accordance with the interface specification developed under Task B.7. This software will be developed by CHP or its representative, in accordance with system manager-developed specifications.

Task B.20 - Develop and Test Field Equipment Interface Software

The JHK Project Team will develop and test highway advisory radio, changeable message signs, and other field equipment interface software and/or firmware required to meet project requirements as defined in the preliminary system design. This work shall follow the specifications set forth under Task B.8.

Task B.21 - Develop and Test Network Communications Software

Network communications software will be developed and tested in conformance with specifications developed under Task B.9. Communications interface modules will be developed to transport information between Smart Corridor system tasks operating on the same and different processors.

Testing of transport mechanisms will be performed based on an approved software test plan. As part of this tasks effort, special test software will be developed to prove that communication interfaces are working properly.

Task B.22 - Develop and Test Workstation User Interface Software

Workstation-based user interface software will be developed utilizing graphical user interface (GUI) and geographic information system (GIS) foundations. Smart Corridor user interfaces will follow from the approved user interface prototypes previously developed under Task B.10. All user interface applications will be built on a consistent foundation of GUI and GIS software tools and utilities.

The work to create Smart Corridor interfaces will be split between the development and refinement of these utilities and the actual coding of each software application screen complement. In addition, a limited amount of graphics screen development will be required from

the system manager to establish the basic default graphics for Smart Corridor interface displays.

Task B.23 - Perform Simulated System Testing at System Manager's Facility

Following the completion of software development procedures, the JHK Team will integrate system components and conduct system-level testing at JHK's Norcross, Georgia offices. The software testing team will utilize simulation and test software to conduct these system tests. Event logging software will be developed as a diagnostic mechanism. Other tools that will be used in this effort include:

- On-line performance monitoring software
- On-line software debuggers
- Hardware logic analyzers
- Communications protocol analyzers
- Communications loop-back devices.

Simulated system testing will be performed in accordance with an approved test plan. Successful completion of this testing effort will release the system for shipment from the system manager's facility to Los Angeles for final integration and testing.

Task B.24 - Relocate and Test System Hardware in Los Angeles

This task includes the work necessary to relocate system hardware from JHK's Norcross, Georgia office to its final location in Los Angeles. The effort also includes the execution of system hardware tests in Los Angeles, to verify that the equipment arrived without damage and is ready for system software integration. The relocation work will involve packing, insuring, shipping, unpacking, locating, testing and the other activities necessary to accomplish the task.

The final output of this task will be a letter from JHK & Associates' project manager stating that all system hardware has arrived without damage at Smart Corridor agency offices and has been tested and found to be ready for final system integration.

Task B.25 - Conduct Simulated Subsystem Testing in Los Angeles

The JHK Project Team will test the individual components of the Smart Corridor system as they are assembled in Los Angeles. This task represents the first opportunity for testing system components in their final configuration. Although software will be exercised in these tests, the system will not necessarily be fully operational or completely configured.

Where actual devices are not yet available for a complete test, simulators will be used to verify proper component operation under loaded conditions. The simulation and test environment developed under Task B.13 will be used to support these tests. System component parts must pass the same software component test procedures previously performed at JHK's System Division office in Norcross, Georgia.

The final output of this task will be a compiled notebook of successfully executed subsystem test results.

Task B.26 - Integrate System and Conduct Initial System Testing in Los Angeles

Work under this task includes the final software systems integration effort for the Smart Corridor project. System integration is the merging of the various hardware and software subsystems into an operational control system. In addition, the process includes completion and updating of basic data needed to operate the system, and any modifications or corrections needed to improve system performance.

An important element of this task will be the development and initial execution of a software system acceptance test plan. The attributes of such a plan are as follows:

- All specified software features and functions will be tested to verify proper operation, including benchmark tests of the ultimate sized system.
- Tests will be organized into a set of functional categories. If an incorrect software operation is identified, the necessary modification will be made as soon as possible. The entire series of tests within that category will then be repeated to ensure the modification did not cause a new malfunction elsewhere.

- o Test procedures will identify necessary test equipment and personnel needed to conduct the tests.
- o Each test description will include the following:
  - Functional description and objectives
  - Specification and operator's manual reference
  - Step-by-step testing instruction and procedures
  - Data reduction procedures
  - Criteria for passing the test
  - Space for Smart Corridor staff representatives to sign off that the test plan has been passed
  - All required test forms and report outputs.

When this task has been carried out, the system hardware/software configuration will be complete, ready for final integration with Smart Corridor field components.

Task B.27 - Prepare Software Design/Data Base Documentation

Under this task, the JHK Team will prepare system software documentation and system data base documentation as described below:

System Software Documentation

System software documentation will be developed which will include the following information:

- An overview of the Smart Corridor system, explaining the purpose of each major software component and the interaction of components

- A description of the computer system resources and hardware environment required by each major software module of the Smart Corridor system

- An overview of all Smart Corridor communications protocols, as implemented by Smart Corridor software and hardware

- A description of Smart Corridor system data bases, explaining the data structures and organization, architecture, and configuration

- Documentation of operating system library calls, functions, utility routines, and all other system support resources used by the Smart Corridor software modules.

  In addition to the above, the JHK Team will provide complete as-built specifications for all software modules. These specifications shall be a natural by-product of the formal system analysis and design process previously described. As appropriate, these software specifications shall include: state transition diagrams; timing diagrams; data flow diagrams; structure charts; and logic diagrams.

- Data dictionaries for each software module

- Pseudo-code or textural descriptions of protocols and algorithms

- The use of formal object oriented software design diagrams to specify the system and component level design.

System Data Base Documentation

The JHK Team will prepare a system data base manual to provide comprehensive instructions for building and maintaining any system data bases required for the Smart Corridor system. All input formats, specification procedures, and output formats will be described. Instructions for loading, saving and backing up all information necessary for system operation will be provided. In addition, data base editing procedures will be carefully explained, with appropriate examples. The manual will be used as training material during training sessions provided for under Task B.32.

Task B.28 - Prepare Expert System Documentation

The JHK Team will produce both a user's manual and operator's manual for each expert system applications (SCC, ATSAC, and SATMS). These documents are described below.

- User's Manual - The expert system user's manual will provide engineering staff with a comprehensive description of the expert system knowledge base and system operating theory. In addition, the user's manual will document the interconnection between expert system workstations and other components of the Smart Corridor system. Details of system goals and functionality will be explained. The manual will also provide a discussion concerning the use of expert system shell tools to modify the knowledge bases.

- Operator's Manual - An expert system operator's manual will be developed to describe step-by-step operating procedures for each expert system application. The user's and operator's manuals will be used as training material for the expert systems training courses provided for under Task B.33.

Task B.29 - Prepare Graphical User Interface Documentation

A separate documentation package will be produced to describe the graphical user interface features and functionality provided by Smart Corridor system workstations. This documentation will concentrate on the explanation of graphics editing and enhancement features, including (but not necessarily limited to) the following areas:

- Interactive graphics editing
- Dynamic icon placement and data base tie-in
- New screen generation
- Advanced user interface topics

Task B.30 - Prepare System Operations Documentation

The JHK Project Team will prepare documentation and manuals covering Smart Corridor system operation for all system users and operators. Two types of manuals (System User's Manuals and Operator's Manuals) will be produced as described below. Separate versions of the operator's manual will be developed for Caltrans, LA DOT, and supporting agencies' staffs.

- System User's Manuals - A system user's manual will be prepared by the JHK Project Team to provide comprehensive instructions to Smart Corridor system managerial staff, the traffic engineering staffs of Caltrans and LA DOT, and other Smart Corridor agencies' staff members. This manual will provide a complete description of system operating theory and the manner in which all of the system features interact. Details of how the system was designed and the goals of each system function will be explained. This manual will also provide a description of how hardware and software devices are interfaced and how they operate together to serve the needs of the cooperating Smart Corridor system agencies.

- Operator's Manuals - Operator's manuals will be prepared by the JHK Project Team to provide comprehensive instructions to system operating personnel. The manuals will explain all input command procedures, including when and how they are to be used. Output screen data and report formats will be described in detail. The manuals will include the step-by-step system and component start-up and shut-down sequences. Procedures will be defined for dealing with equipment failures. The manuals will describe all operator functions, using simple English supported by examples. The operator's manuals will be used as training material for the system operations training sessions provided for under Task B.35.

Task B.31 - Prepare Hardware Configuration Documentation

Hardware configuration and maintenance documentation for all Smart Corridor control equipment will be provided for the technicians responsible for system maintenance functions. This documentation will provide overall system hardware interconnection diagrams and supplemental material to the manufacturer's documentation for individual components of the system. It will also include system-level troubleshooting and testing procedures. The documentation is expected to consist primarily of brief supplements to manufacturer-supplied materials and overall coordinating

information. Hardware configuration documentation will generally cover equipment layout and interconnection.

As a minimum, the following items will be addressed:

- Equipment power requirements and outlet specification
- Description of normal equipment operating environment, including temperature and humidity specifications
- Description of troubleshooting and diagnostic features
- Descriptions of any preventive maintenance activities (including procedures and frequency with which these procedures are to be done)
- A recommended set of spares and test equipment to be kept on hand by the operating agencies
- Diagnostic support documentation (including identification of what capabilities are incorporated in the hardware and software to aid in problem diagnosis, error logging, etc.)

Task B.32 - Provide Software/Data Base Training

The JHK Team will provide training to LACTC, Caltrans, and LA DOT personnel to impart an understanding of the Smart Corridor software and hardware design and procedures necessary to maintain and expand the Smart Corridor system. The training will include class problems, hands-on experiments with the equipment and software, and discussion of the theory of system design and operation. The training provided under this task shall follow the outline of software design and data base documentation described under Task B.27 above.

Task B.33 - Provide Expert Systems Training

Special training sessions will be provided by the JHK Project Team to address expert system design and operations. Due to the expected differences in the three proposed expert system applications, separate training sessions will be given for each expert system unit (SCC, ATSAC, and SATMS). The training will include both informal on-the-job training and formal classroom

training.

Expert system operation training will be geared to system operators and staff responsible for day-to-day operation and interface to these expert systems. An expert system theory of operation class will be presented, geared to system engineering staffs responsible for rule-based definition and maintenance. Expert system training activities will make use of the expert systems documentation produced under Task B.28 as course material.

Task B.34 - Provide Graphical User Interface Training

The JHK Project Team will provide advanced graphical user interface training for system operations and support staff. This training is intended for those interested in customizing graphics reports and graphic map displays. It will include both structured and hands-on sessions and will use the GUI documentation produced under Task B.29 as course material.

Task B.35 - Provide System Operations Training

The JHK Project Team will provide necessary training to Caltrans, LA DOT, CHP and other Smart Corridor cooperating agencies to operate the Smart Corridor system. The training will include both formal and informal classroom training in systems operation and maintenance diagnosis to appropriate operating, maintenance and supervisory personnel.

The training will include class problems, hands-on experience with the equipment, and discussion of the theory of operation. It will also include system component start-up and shut-down, as well as discussion of specialized procedures developed by the JHK Project Team.

As formal training is completed, the Smart Corridor system will be ready for staffing by system operators, dispatch/enforcement agency officers, and maintenance personnel. The system will be fully operational at this time.

Task B.36 - Provide Hardware Configuration Training

The JHK Project Team will instruct system maintenance personnel on the maintenance of system hardware and system problem diagnosis. Instruction will utilize the documentation and

manuals prepared during earlier tasks and will include discussions on how the software reacts with the hardware, proper system responses, classroom problems, and simulated system malfunctions. Special emphasis will be placed on problem isolation and determination. Facilities and procedures will be described for isolating problems as to source and resolving them in a prompt and efficient manner (such as component level replacements and/or transfer of critical system functions to an alternate device).

TASK C DESIGN CCTV ELEMENT

This task follows the preliminary design activities of Task A and will result in a design for the CCTV sub-system, formulated as a complete set of bid documents. This sub-system will comprise 29 CCTV locations on surface streets and control facilities at the ATSAC, Caltrans and CHP control centers. In addition, 14 cameras will be located on freeways by others, not as part of this project. Exhibit B.6 presents the CPM schedule for this task.

Task C.1 - Assemble Base Plans

Adequate base plans are essential for the efficient execution of the design task and full advantage will be taken of material from other relevant contracts. Plans will be required in the following areas:

1. Field Plans:

   Surface street

2. Control Centers:

   ATSAC control center
   Caltrans control center
   CHP control center

DKS is performing design work for the City of Los Angeles to expand ATSAC into the Smart Corridor area and to install the communications trunk facilities. It is expected that this will provide a set of field base plans which can be used by the JHK Project Team in successive tasks

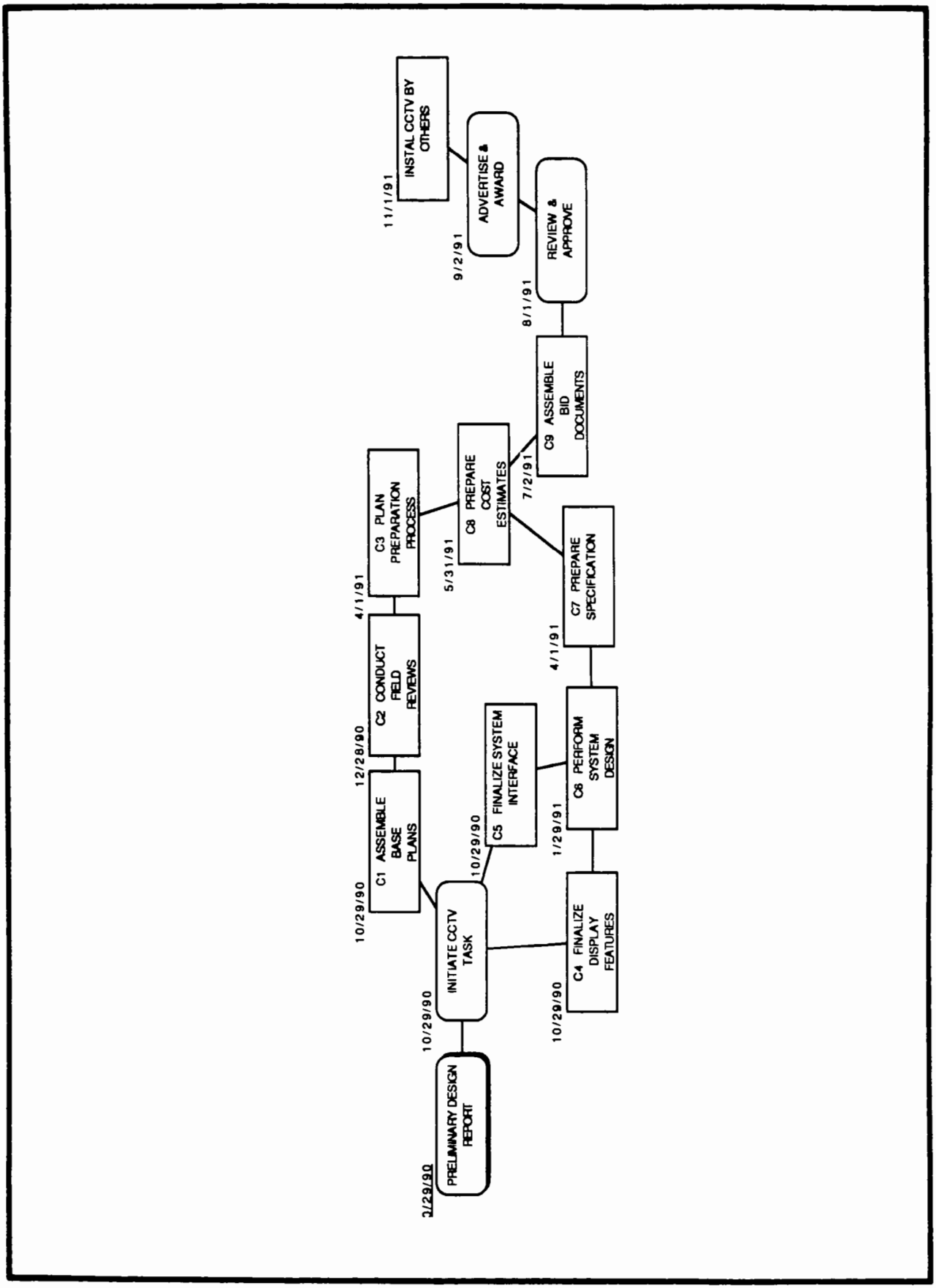


Exhibit B.6. Task C: Design CCTV Element CPM Schedule

and form the basis for the field plans in the bid package. It is anticipated that these plans will be made available in the City's AutoCAD format for ease of use and compatibility with the City's plan requirements.

JHK is sensitive to the proposed modifications to the ATSAC control room and will therefore work with the City staff to secure base plans for the current and the future ATSAC facilities such that the monitors and controls are integrated with the revised center.

Similarly, base plans will be secured from Caltrans and CHP (and/or contractors) in the relevant CAD format where possible. Caltrans is in the process of upgrading the TOC. This will mean effectively replacing the existing facility. JHK will liaise with the relevant contractor/consultant to ensure the future TOC requirements are accommodated.

Task C.2 - Conduct Field Review

The preliminary placement of the CCTV cameras on the surface streets will be refined during the field review. This will include such factors as identification of the electrolier to be used as the support, and verification of the physical path to the on-street cabinet in which the CCTV dedicated communications and control equipment will be housed. This review is essential in establishing the information upon which both the cost estimates and CCTV installation plans and contract will be based.

In the case of the on-street CCTV element, the equipment cabinets will have been supplied and installed as part of the ATSAC traffic signal installation contract. The CCTV installation contract will have to provide the link in terms of the trenching, conduit and cable between the cabinet and the pole according to the design emerging from this task. Accuracy in the on-street conditions is thus necessary to ensure accurate plans and costing.

One of the camera locations is proposed as being mounted on a building. This necessitates the detailing of the exact location and method of mounting the camera as well as the identification of the cable routing through the building.

Included in the field review is the verification of the control room facilities for use in the equipment, location, and design of the operator control and viewing capabilities.

Tasks C.3 - Plan Preparation Process

In this activity the JHK Project Team will prepare the plans package for the construction of the CCTV element. The plans will be prepared in a format suitable for a normal bid letting. The plans will be prepared in accordance to LADOT and Caltrans standards as applicable. The JHK Project Team will provide all engineering and drafting services necessary to prepare the plans. As a minimum, the plans are expected to consist of the following:

- Title sheet
- Key sheet
- Tabulation of quantities
- General notes
- Typical details
- Construction details
- Intersection/roadway details
- Maintenance of traffic

The plans package will be reviewed and approved in accordance with the following stages and levels of development:

- 30% - 60% Review Stage

  As a minimum, all sheets in the plans are identified, base drawings are complete, right of way is located, all major equipment items are located, and utilities and drop points are established.

- 90% Review Stage

  As a minimum, conduit runs, cable runs, pull boxes are shown; wiring schematics provided; equipment mounting and special details are shown; quantities are provided; and all work items are identified.

- 100% Review Stage

  Final review will concentrare on the completness of notes, correct quantities, etc.

JHK employs a rigorous quality assurance program that will be implemented in the entire final design process. Details of JHK's Quality Assurance Program which has been successfully used on several projects is presented in the Appendix.

Inherent in the program is the identification of checkers and designers who provide for a strict review process independent of the original design methodology but yet still keeps the originator of the design in the review loop. All plans, specifications, and estimates will be completely checked at each submittal stage. Checking will be performed by a checker assigned by the Project Manager. The checker shall have equal or higher qualifications than the designer/originator of the design. The checker shall pay special attention to the design conformance with such standards as Caltrans policies and standards, project design guides, as well as codes, such as National Electrical Code and industrial practices. The backchecker (usually the originator) will incorporate or resolve all checker's comments. Other changes or modifications made shall be brought to the attention of the checker for re-checks. The check prints initialed by the checker and backchecker will be retained in the project file until the issuance of the next revision of the document.

The project documents will also be reviewed by a peer review team. The peer review team will consist of equally qualified engineers and designers who have not been intimately involved with the design effort, but are well informed relative to Caltrans and LADOT policies, standards and project design requirements. It is conceivable that the two teams will perform a design of various sections simultaneously while one team performs peer review for the other team.

At each design stage project documents will be submitted for review and comments. The Project Team will set aside conference time to present the design as well as to receive comments from agency reviewers. The Project Team will prepare conference notes to serve as a project record as well as to serve as reminders to the designers. All comments will be incorporated or resolved to the Agency's satisfaction prior to the next submittal.

The final plans, specifications, and estimates shall be reviewed by the Project Manager. All comments will be incorporated or resolved. All agreed-to changes shall be accurately made.

The project documents will be signed, sealed, and submitted to the prime consultant or to the Agency. Each sheet of plans will bear the professional seal, certificate number, registration classification, expiration date, and signature of the professional engineer responsible for its preparation.

Task C.4 - Finalize Display Features

In parallel with the need to develop the Functional Specifications from Task B.8 into a detailed design in the area of machine-machine (system) interfaces is the need to finalize the design for operator-machine interfaces. There are two main areas to be addressed, those of control and display.

In terms of the control interface, the design may capitalize on the multi-tasking nature of the system's workstations to provide an integrated control interface integrated into Smart Corridor system workstations rather than rely on a separate system with its own specific means of operation.

Similarly, the capabilities of equipment currently available for integrating video into graphical displays opens up additional possibilities for CCTV images other than the traditional monitors. Therefore, based upon both the CCTV preliminary design and the field equipment interface specification, this task will finalize those elements of the display functions which will impact the CCTV system final design significantly.

Task C.5 - Finalize System Interface

With respect to the design of the field elements, there are factors which impact the overall system design significantly as they represent the interaction of a particular element with other parts of the total Smart Corridor system. In the case of the CCTV sub-system these are the system interfaces (machine-machine) and the display features (man-machine).

Task B.8 will have produced Functional Specifications for the interfaces of the various field equipments to the Smart Corridor central data base and expert systems. Task C.9 will build upon the functional specifications and detail the precise characteristics of the system interfaces. This is especially important for the CCTV sub-system which will exhibit certain innovative features

with respect to its use with the Central Data Base and Expert Systems (e.g. automatic positioning of the camera and choice of field of view). Furthermore, the accurate specification of the interfaces is essential to avoid the problems associated with integrating equipment supplied from two different sources (i.e. the System Manager and the CCTV supplier).

Task C.6 - Perform System Design

The objective of this task is to bring together those elements of the CCTV sub-system which have been expanded upon since the preliminary design to ensure consistency prior to the formulation of the specifications. On the basis of the preliminary design, the finalized system interfaces and display features, the CCTV system design will be completed in this task. The design will be consistent with the results of the field review and will be of sufficient detail to permit the formulation of specifications to complement the plans.

Operational procedures and requirements will influence the system design significantly, for example, the CCTV system will be operable from three control rooms. Such factors will be clearly addressed and their accommodation identified, if necessary, by giving examples of operational procedures. Furthermore, the system design will address areas which are known to be subject to change such as the communications link between the CHP, ATSAC, and Caltrans control centers.

A System Design document will be prepared at the completion of this task and submitted for review and approval.

Task C.7 - Prepare Specifications

The specification preparation will run parallel with the plans preparation. The specifications will be written in such a way as to secure the functionality of the CCTV element, yet enable a cost-effective solution through competitive bidding.

The Specifications also form part of the Quality Assurance Process described in the Appendix. Draft specifications will be submitted for review at the 60%, 90% and final stages of the review process.

Task C.8 - Prepare Cost Estimates

The third constituent of the design package is the cost estimates. These will be prepared to reflect the specifications and plans in such a way as to clearly expose unit and equipment costs. This will identify sensitive cost areas and enable the comparison of competitive bids.

Cost estimates will be made in parallel with the final design and the preparation of the specifications. This is done to ensure that the cost effectiveness of any particular design element is taken into account. Such value engineering is an essential component of the total design process and can have a significant effect on directions taken during the system design. This is especially true with respect to those elements of the Smart Corridor system which represent the application of new or recent technologies. In the case of the CCTV sub-system, this would apply to such areas as the integration of video into the graphics workstations.

Task C.9 - Assemble Bid Documents

This consists of JHK's compilation of the plans, specifications and cost estimates in a format which will allow the relevant agency to produce a bid package by appending the agency's terms and conditions. The cost estimates will be kept separate from the plans and specifications, but the items will be presented in the bid package as a bid list.

There will follow a formal review and approval stage before the supply and installation contract will be advertised. However, given that the plans and specifications will have already been through a 30%, 60%, 90% and final review and approval process as a part of the plan preparation process, then this review and approval stage should be minimal.

The advertising and award of the supply and installation contract will be undertaken by the relevant agency. In this case, CCTV sub-system, will be the City of Los Angeles.

TASK D DESIGN OF HIGHWAY ADVISORY RADIO ELEMENT

As can be seen from Exhibit B.7, the design of the highway advisory radio sub-system of the Smart Corridor system will be subdivided into two parts. The first part comprises the execution of a pilot test; the results of which will provide an input into the preliminary design

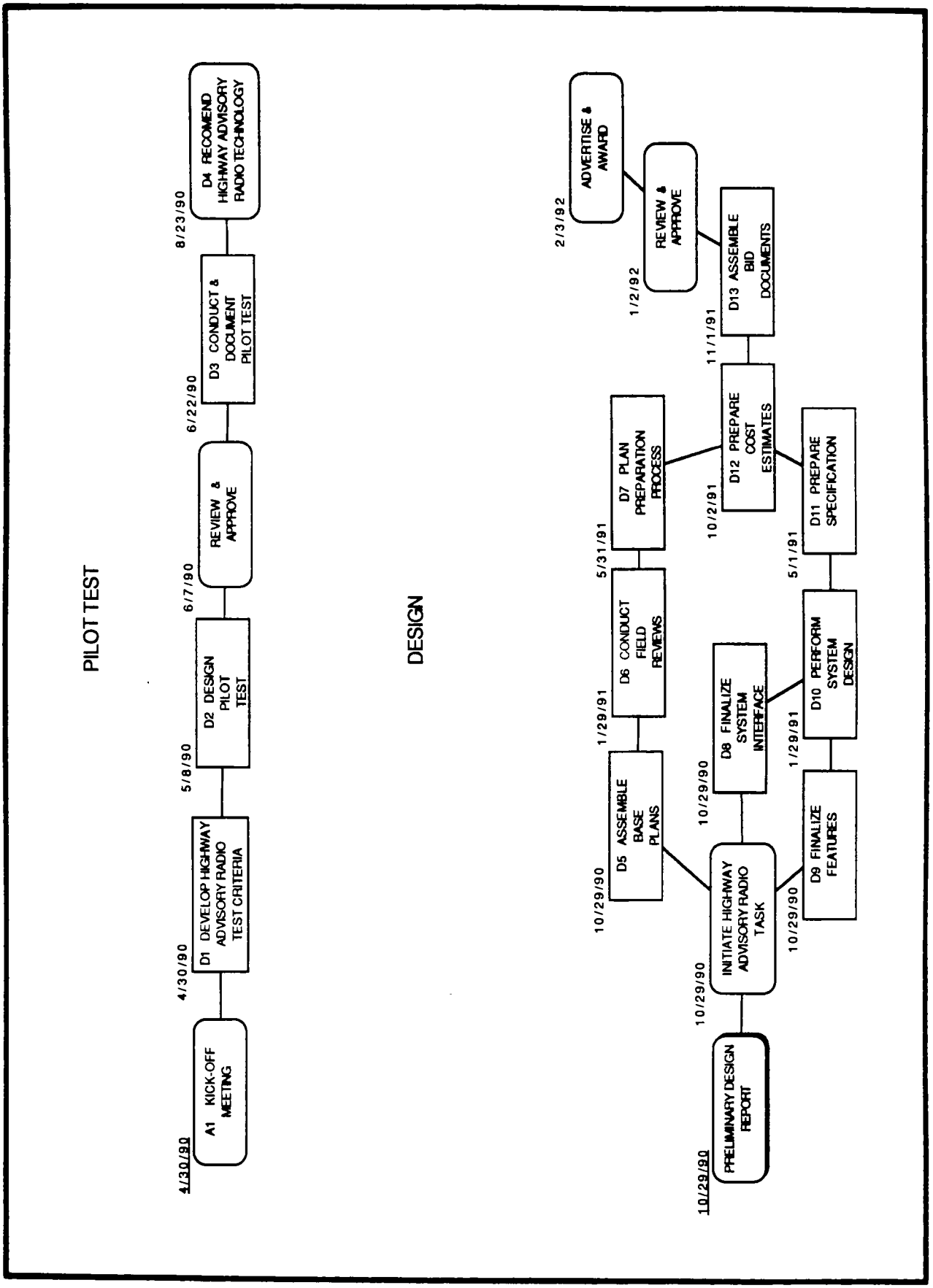


Exhibit B.7. Task D: Design of Highway Advisory Radio CPM Schedule

task (Task A). Following the completion of the preliminary design, the highway advisory radio design will continue, resulting in the bid documents for the advertising of the supply and installation contract.

Task D.1 - Develop Test Criteria

As stated in the RFP, the conceptual design of the highway advisory radio is tentatively based upon the use of low power (0.1 watt) radio transmission. The doubts about the practicality of this approach lie in the on-street performance of the commercially available system.

In January of 1990, JHK and the City of Los Angeles organized a trial of the prospective equipment in the City. When multiple transmitters were in use concurrently, inter-signal interference rendered the transmissions indecipherable. The supplier claims that the phase synchronization circuitry was malfunctioning and that the test was not representative of the equipment's capabilities. Clearly, the test was not conclusive and so the opportunity will be taken for a more formal testing of the equipment before accepting this technology for Smart Corridor.

Experience with this test stressed the need to clearly identify criteria by which the highway advisory radio system will be assessed. In so doing, it is necessary to take into account any test equipment which would be needed to derive measurements for use with the criteria. This will ensure the practicality and cost effectiveness of the test.

Typically, the most important characteristics to establish with respect to the highway advisory radio equipment are signal strength and quality. In addition, the criteria must identify the required characteristics of the test site or sites as input to the design of the evaluation plan. JHK's team includes a specialist in radio transmission design and analysis to guarantee the development of suitable test criteria and assist in the design of the test. The team also recognizes the experience of the City of Los Angeles in this area and will continue to work with the City's engineers in developing the test criteria.

Task D.2 - Design Pilot Test

Having established the criteria by which the equipment will be assessed, the Team will develop a pilot test to capture the relevant data. The test will ensure that the highway advisory

radio equipment is evaluated under a variety of conditions which correspond to the required test site characteristics and, in so doing, represent the actual working environment in practice.

This will encompass both freeway and surface street areas, including the CBD in the areas of dense, tall buildings. The effective zones of influence of various transmitter setting options (e.g. linearly or non-linearly distributed) as well as the effect of distance between transmitters will be incorporated into the test.

The test design will take into account the difficulties associated with the carrying out of on-street measurements by identifying and allowing for factors outside of the control of the evaluators. Again, the design will aim to be cost effective in collecting the necessary evaluation data.

The Pilot Test will be formally submitted for review and approval prior to the test being initiated.

Task D.3 - Conduct and Document Pilot Test

The Pilot Test will be executed in accordance with the Test Design. The team will encourage the participation of engineers from both the City of Los Angeles and Caltrans so that these agencies can gain first hand experience with the equipment.

JHK's team will carry out the tests in conjunction with the supplier of the highway advisory radio equipment. This kind of supplier participation has been found to be essential in other similar equipment studies that JHK has carried out such as Changeable Message Signs and Radio Communications evaluations for the City of Anaheim. During the course of such evaluation tests, questions arose regarding equipment application and operation; the presence of the supplier has been useful in providing on the spot replies which can sometimes affect the way in which the tests are conducted.

The results of the Pilot Test will be fully documented and a report compiled and submitted for review.

Task D.4 - Recommend Highway Advisory Radio Technology

The Pilot Tests will result in the development of a recommendation for highway advisory radio technology to be used in the Smart Corridor project. This will be used in the development of the Preliminary Design in Task A.

Task D.5 - Assemble Base Plans

Base plans will be assembled as previously discussed.

Task D.6 - Conduct Field Reviews

Field reviews required for the highway advisory radio will be more intensive than those required for the CCTV design. Precautions must be taken to ensure full radio coverage and that there are no zones of interference.

Task D.7 - Plan Preparation Process

Plans will be prepared as previously discussed.

Task D.8 - Finalize System Interface

The highway advisory radio interface with the various systems will be defined by the JHK Project Team. Consideration will be given to provide an interface that promotes timely and concise information to the motorist.

Task D.9 - Finalize Display Features

The principal concern is to develop an integrated control/display interface with the operator. This will be accomplished in a manner similar to that discussed for the CCTV subsystem.

Task D.10 to D.13

The highway advisory radio system design and PS&E development will continue following the process defined for the CCTV design, Tasks C.6 through C.9.

TASK E DESIGN OF CHANGEABLE MESSAGE SIGN ELEMENT

A key component of the changeable message sign sub-system is the trailblazer type changeable message sign to be used on the surface streets at 103 locations. While the conceptual design study contains an example of a possible sign configuration, JHK considers that further work is required prior to performing of the preliminary design to better establish the requirements for and constraints on trailblazer sign design.

The changeable message sign design task will therefore be carried out in two parts as detailed in Exhibit B.8. The first will concentrate upon the development of a preliminary design for the trailblazer sign and result in recommendations to be used in the changeable message sign Preliminary Design process of Task A. Following the development of the changeable message sign Preliminary Design, work will continue on the changeable message sign design task resulting in bid documents for the advertising of the supply and installation contracts.

Task E.1 - Changeable Message Sign Design Workshop

JHK is acting as a consultant to the City of Anaheim to design and develop a changeable message sign system for use with the City's Traffic Management System. In the process of designing the system, JHK found it extremely useful to organize a workshop at which changeable message sign design requirements and practices can be identified, discussed and established.

There is much to be gained from recent research into the use of changeable message sign's, drivers' ability to digest information presented on the signs and design options. Changeable message sign design is not only a function of equipment design, it is also dependent upon operational requirements. The workshop provides the opportunity for the researchers, designers and users to exchange knowledge to formulate design requirements.

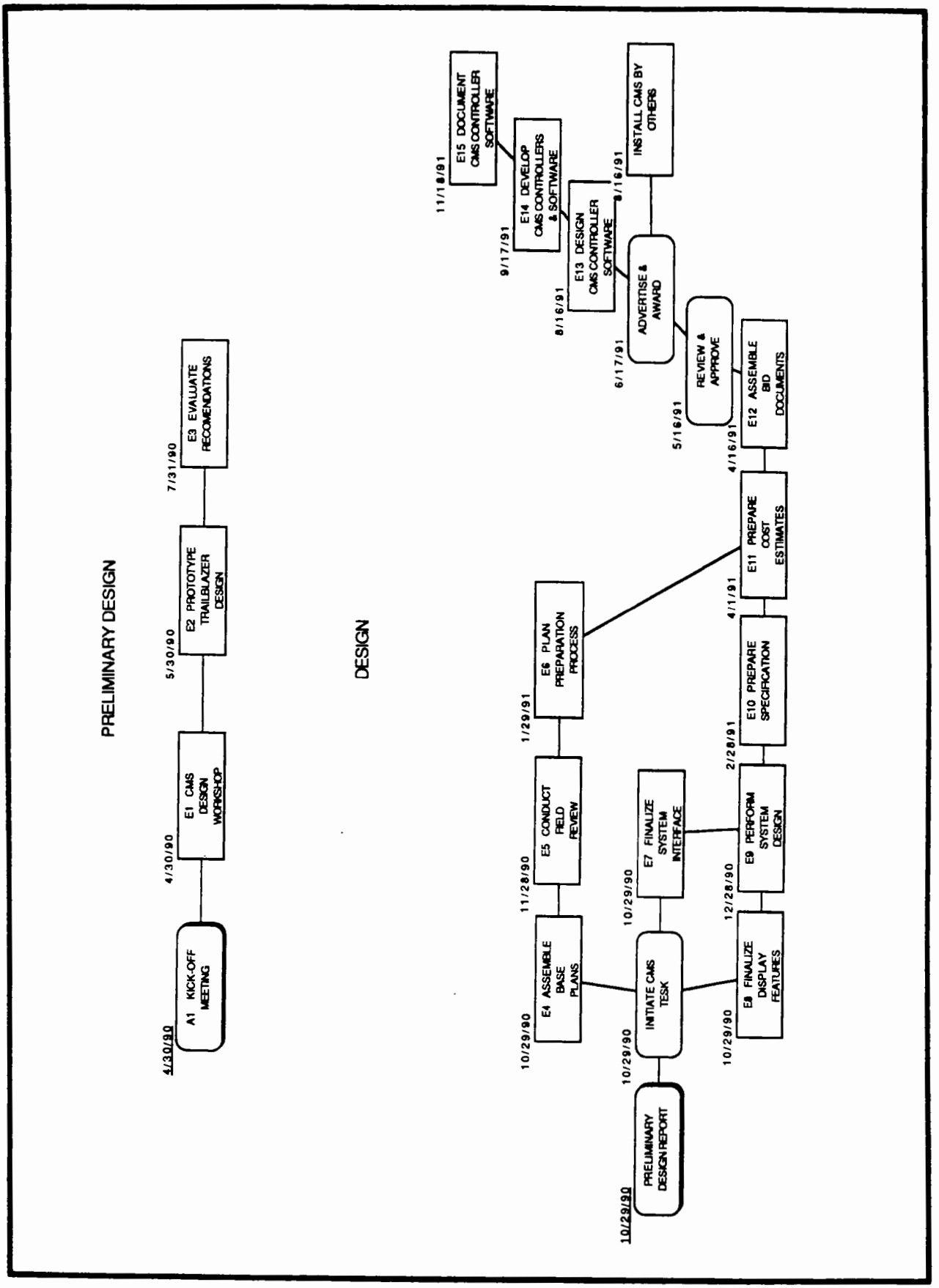


Exhibit B.8. Task E: Design Changeable Message Sign Element CPM Schedule

The JHK Project Team has members with extensive research and design experience essential for an effective workshop. The workshop will address all aspects of changeable message sign design and use and will specifically analyze the requirements for the trailblazer signs. As a result of the workshop, trailblazer sign design requirements will be formulated.

Task E.2 - Prototype Trailblazer Design

On the basis of the trailblazer design requirements, a sign design will be completed and a prototype sign developed. This will represent all the functionality of the final trailblazer sign even if it is not possible to use the same materials as anticipated in the final design. The sign will be used to establish and confirm sign layout, message content and form. Wherever possible, multiple options will be represented for comparative evaluation.

The results of the prototype trailblazer sign evaluation will be documented and submitted for review.

Task E.3 - Evaluate Recommendations

On the basis of the prototype trailblazer sign evaluation, recommendations will be formulated regarding the signs to be incorporated into the changeable message sign preliminary design.

Task E.4 to E.12

The changeable message sign design and PS&E development will follow the process previously described.

Tasks E.13 - Design Changeable Message Sign Controller Software

A key component of the changeable message sign sub-system is the sign controller. This is the unit which provides the link between the sign message requested at central and the message displayed by the signs. In the case of the full matrix sign, one controller will be needed per sign. The same controller will also be designed to control up to four trailblazer signs in place of the one full matrix.

The assumed hardware base for the changeable message sign controller is the Type 170 traffic controller; this is the State of California standard traffic signal controller hardware and its adoption will permit competitive procurement. However, the Caltrans changeable message sign software currently available does not satisfy either the known or anticipated sign controller requirements of the Smart Corridor project. Difficiencies include the lack of support for the trailblazer sign and the need for major modifications to the communications protocol (central to street) to support the Smart Corridor project requirements.

In the JHK Project Team's experience, the cost of modifying this software is likely to be of the same order of magnitude as developing a custom software package. Controller software design and development are therefore proposed by JHK and form part of the changeable message sign design task.

Up-front design is the prerequisite to efficient development of effective software. The software development is therefore preceded by a software design task. An objective will be to design software which can be used with both the full matrix and trailblazer signs. This means that the same firmware will be resident in all the changeable message sign controllers which is an important basis for simplifying system development and integration in the short-term, and maintenance in the long term.

The changeable message sign controller design will be documented in a software design report and submitted for review.

Task E.14 - Develop and Test Changeable Message Sign Controller Software

Using the changeable message sign controller software design report as the basis, software will be developed in JHK's Atlanta development center. The software will undergo a formal test

in Atlanta prior to delivery to Los Angeles. An acceptance test schedule will be developed which will address all functional aspects of the software. Shipment of signs to Atlanta to be used as part of the tests is not likely to be cost effective; final software testing will therefore be carried out as part of the integration task on-site in Los Angeles.

Task E.15 - Document Changeable Message Sign Controller Software

The changeable message sign controller software will be fully documented in the changeable message sign controller software description and will provide an experienced programmer with sufficient information to be able to maintain the software.

A typical table of contents for the software description is:

Section 1 Introduction
Section 2 Overview Changeable Message Sign Sub-system
Section 3 Changeable Message Sign Controller Hardware Environment
Section 4 Changeable Message Sign Controller Software
- Overview
- Communications Routines
- Internal Processing Routines
  - Full Matrix
  - Trailblazer
- Sign Interface
  - Full Matrix
  - Trailblazer
- Source Listings

TASK F MOTORIST INFORMATION SYSTEMS

A number of motorist information systems are to be accommodated and interfaced as part of the overall Smart Corridor System. Each has specific requirements in terms of the work plan and will be treated as such in this section. The public information interface design carried out in Task B will form the basis for the continuing sub-tasks in this task. The interrelation of the motorist information systems is shown in Exhibit B.9.

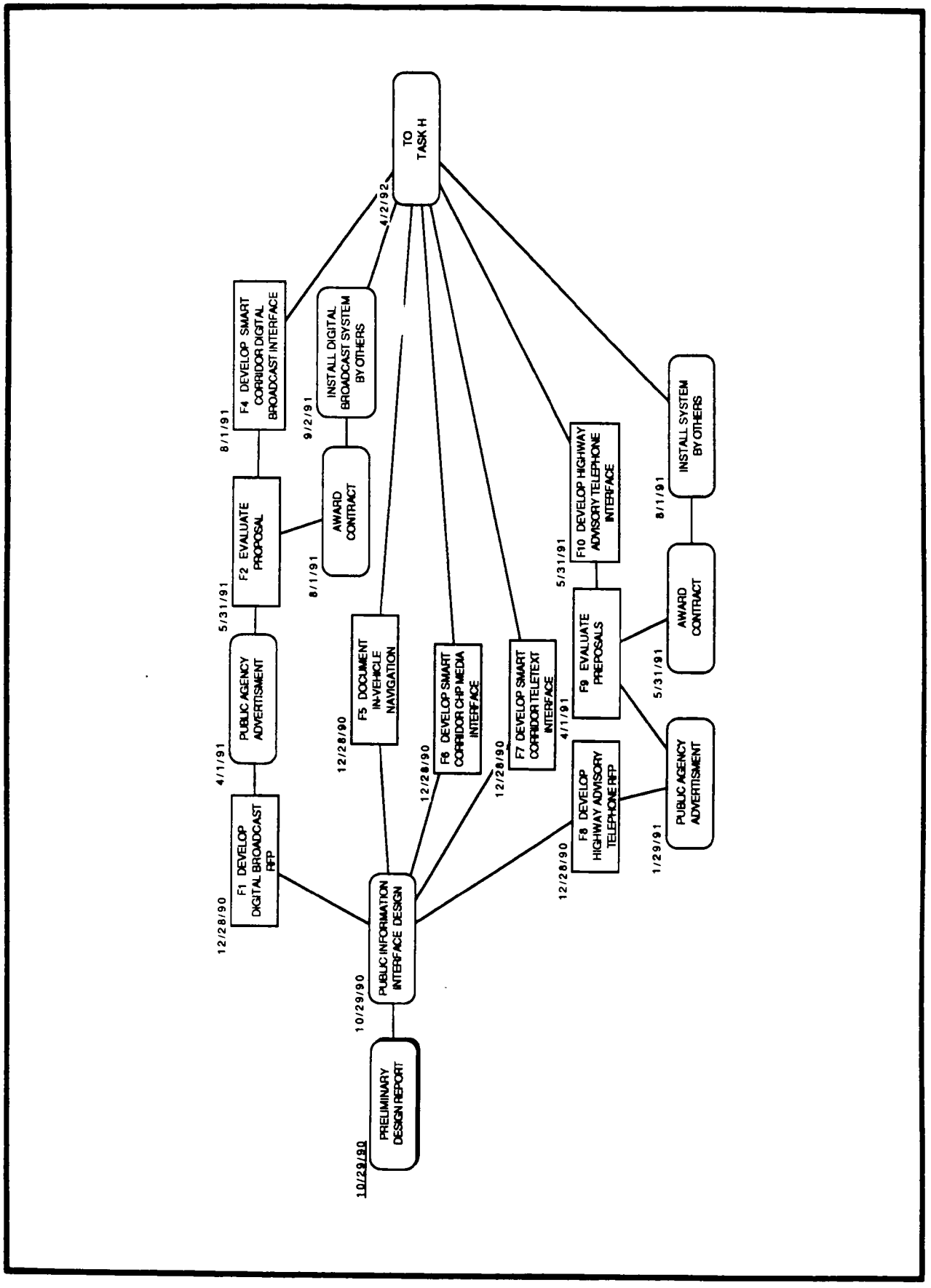


Exhibit B.9. Task F: Motorist Information Systems CPM Schedule

Task F.1 - Develop Digital Broadcast RFP

The Preliminary Design Report developed in Task A and the design of the public information interface from Task B will be the basis for the development of an RFP by JHK for the design, development and installation of an FM sideband digital broadcast system containing 200 receivers by an outside vendor.

Specific areas to be addressed in the RFP will include but not be limited to the following:

- Availability/reliability of technologies
- Applicability of developed system to wide scale application
- Feasibility of application in the Los Angeles Area
- Ownership rights to any hardware/software developed under the contract
- Ownership of information collected and processed as part of the project
- System support after installation

Task F.2 - Evaluate Digital Broadcast Proposals

It will be the responsibility of the designated agency to advertise the RFP and receive responses. JHK recommends that a formal pre-proposal meeting be organized at which potential respondents can submit questions and obtain clarifications on the RFP. The JHK Project Team will provide assistance at this meeting and assist in the preparation of any written responses to questions of a technical nature.

JHK will also assist in the evaluation of the proposals. For each of the responses to the RFP, written comments will be supplied together with questions to be answered either as part of an oral presentation or in formal written correspondence. The team will develop a recommendation for award of contract; however, it is recognized that the designated agency has the responsibility of final choice.

Task F.3 - Develop Digital Broadcast Evaluation Plan

Independent of the RFP process an evaluation plan will be developed with the objective of assessing the digital broadcast system for its effectiveness as an element of the motorist information sub-system of the Smart Corridor system. The major elements which make-up the evaluation plan are as follows:

- Identification of the objectives of the evaluation - The effectiveness of the digital broadcast system can be perceived from a number of view points such as the driver, the system operator and the highway agency. Objectives will be formulated which reflect the various users of the system.

- Development of measures of effectiveness (MOE) - For each of the objectives, at least one measure of effectiveness will be identified by which the system's performance or effect can be judged.

- Identify data collection methodology - For each MOE, the method of collecting data for application of the MOE will be identified.

- Design of the evaluation plan - The design of the evaluation plan will describe the means by which the data will be collected, analyzed and presented.

The evaluation plan design will present the procedures which will be used during the carrying out of the evaluation. These will include guidelines for the selection of the cars and/or drivers to be used in the experiment and design of the questionnaires which will be used to collect data from the drivers.

It is likely that the system tested will have the potential for direct transfer into a more widespread, possibly even commercial, application which is not the case, for example, with the current Pathfinder equipment. This implies that the test will need to directly address human factor issues such as data format, content and duration for acceptability by the driver more than is the case in the Pathfinder Evaluation Plan as currently proposed.

Task F.4 - Develop Smart Corridor Digital Broadcast Interface

In parallel with the installation of the digital broadcast system, the Smart Corridor central interface will move from design to the development stage. There will be a high degree of interaction between the Digital Broadcast System supplier and JHK due to the nature of the data transfer between the two systems. The Public Information Interface Design will provide the common starting point, but regular contacts between the two will be maintained.

During this development phase, preliminary integration of the systems will take place in JHK's software development facilities in Atlanta. This will precede the on-site integration task. Formal testing will be done in Atlanta according to a pre-defined test schedule which will, as far as possible, reflect the systems' functionality. This will be independent of any testing that the supplier proposes in response to the RFP.

Task F.5 - Document In-Vehicle Navigation System Interface

Exhibit B.10 shows the current schedule for the field trials of the Pathfinder In-Vehicle Navigation study. The evaluation of the Pathfinder In-Vehicle system is currently scheduled to commence in a limited form in July of 1990 although this may be delayed due to building modification to the Caltrans TOC. Assuming integration with some 85 intersections in the Santa Monica Corridor by December 1990, the data collection will be completed by September 1991. No decision has been taken, as yet, on future use of the equipment after completion of the data collection.

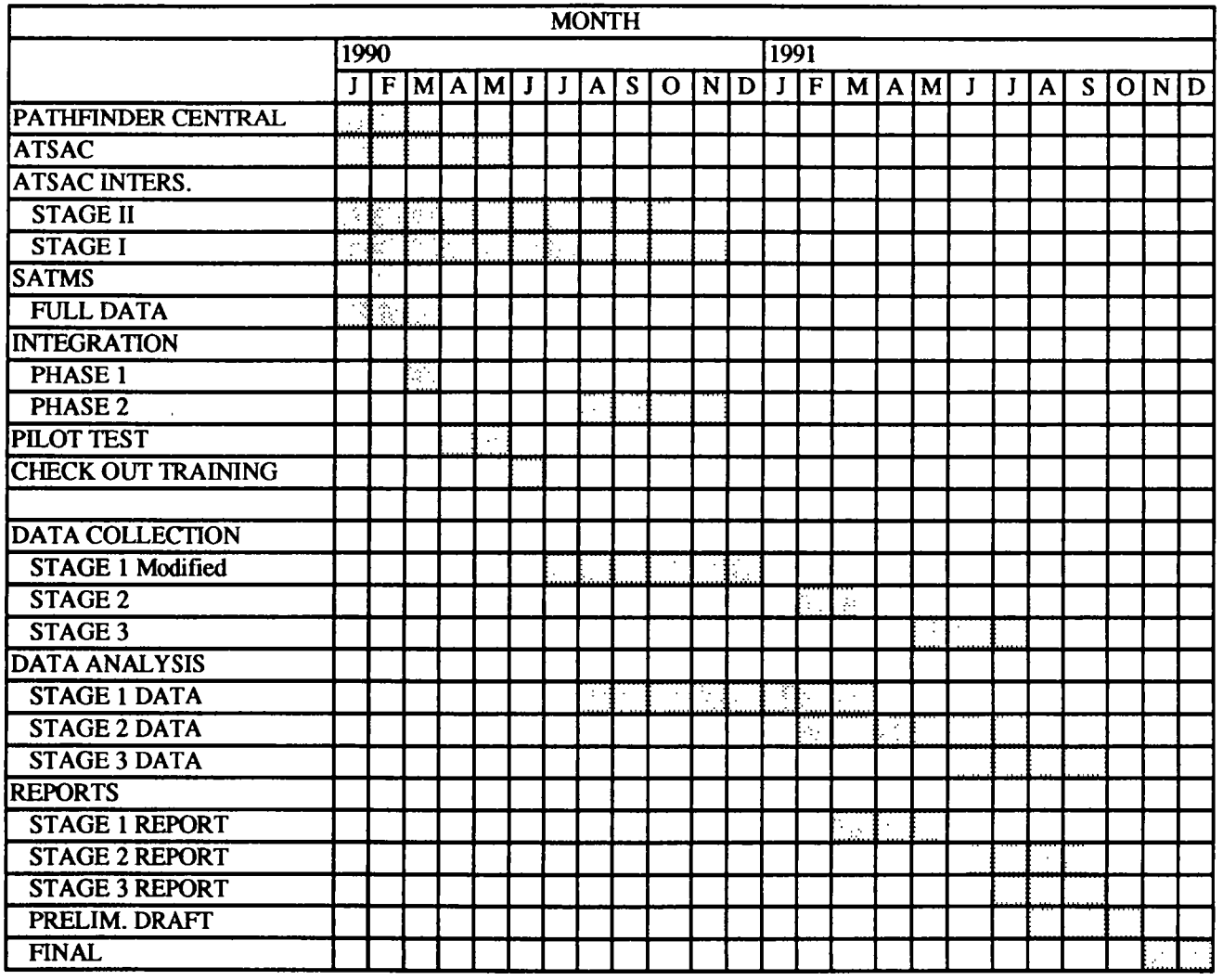
To leave open the possibility of interfacing the Smart Corridor System with Pathfinder or some other In-Vehicle Navigation system, those sections of the public information interface design which are relevant to an In-Vehicle Navigation system will be documented separately.

A typical table of contents for the In-Vehicle Navigation System Interface Design document would be:

Introduction
Smart Corridor System Overview
Smart Corridor Central Data Base
    Structure
    Accessing Data

PROPOSED REVISION OF PATH FINDER SCHEDULE

Revised February 23,1990



Procedures
Data Names
Hardware Interface
Operational Aspects
Pathfinder Central
Smart Corridor Central

Task F.6 - Develop the Smart Corridor CHP Media Interface

On the basis of the public information interface design, JHK will develop the interface to the CHP media communications network for dissemination of traffic information to the media.

A temporary dial-up link with the CHP system will be installed to permit remote testing of the interface while under development in JHK's Atlanta facility. With this configuration, formal testing will be carried out in Atlanta prior to delivery on-site in Los Angeles according to a test schedule. This will, as far as possible, reflect the systems' complete functionality

The interface documentation will comprise a design document. A typical table of contents for the media communications interface design document would be:

Introduction
Smart Corridor System Overview
Smart Corridor Central Data Base
Structure
Accessing Data
Procedures
Data Names
Hardware Interface

Task F.7 - Develop Smart Corridor Teletext Interface

On the basis of the public information interface design, JHK will develop the interface to the Caltrans Teletext system. A temporary dial-up link with the Caltrans system will be installed to permit remote testing of the interface while under development in JHK's Atlanta facility. With this configuration, formal testing will be carried out in Atlanta prior to delivery on-site in Los Angeles according to a test schedule. This will, as far as possible, reflect the systems' complete functionality.

The interface documentation will comprise a design document. A typical table of contents for the Teletext Interface Design document would be:

Introduction
Smart Corridor System Overview
Smart Corridor Central Data Base
    Structure
    Accessing Data
        Procedures
        Data Names
Hardware Interface
Operational Aspects
    Teletext Workstation
    Smart Corridor Central

Task F.8 - Develop Highway Advisory Telephone RFP

The Preliminary Design Report of Task A and the design of the public information interface of Task B will form the basis for the development of an RFP for the supply and installation of a system which services telephone call-in enquiries using synthesized and/or pre-recorded voice messages.

The RFP will be sensitive to the availability of pre-packaged commercial systems which are suitable for this purpose and so will allow for some degree of modification of the Smart Corridor Interface in order not to incur unnecessary additional development costs on the part of the HAT supplier.

Specific areas to be addressed in the RFP will include:

- Ownership rights to any hardware/software developed under this project
- Ownership of information collected and processed as part of the project
- Initial system delivery to JHK Atlanta
- System support after installation

The RFP will be developed in such a way that the designated agency responsible for the advertising of the RFP can conveniently addend that agency's terms and conditions.

The RFP will be submitted to the designated agency for review and eventual advertising.

Task F.9 - Evaluate Proposals

JHK does not envision that a pre-proposal meeting will be required in association with the highway advisory telephone system procurement RFP due to the "off-the-shelf" nature of the equipment. JHK will assist in the evaluation of the proposals and provide written comments on each of the proposals received. Questions will be prepared in writing and submitted to the designated agency for comment prior to JHK contacting the bidder. All correspondence and communication with the bidders will be documented.

JHK will formulate a recommendation for award and submit this to the designated agency. The agency will have the responsibility for final choice and notification of the successful bidder.

Task F.10 - Develop Highway Advisory Telephone Interface

In parallel with the procurement of the highway advisory telephone system, the Smart Corridor central interface will move from design to the development stage. There will be a high degree of interaction between the highway advisory telephone system supplier and JHK due to the nature of the data transfer between the two systems. The public information interface design will provide the common starting point, but regular contacts between the two will be maintained.

During this development phase, preliminary integration of the systems will take place in JHK's software development laboratories in Atlanta. To achieve this, the highway advisory telephone system will be delivered to Atlanta prior to shipping and installation in Los Angeles. Formal testing will be done in Atlanta according to a pre-defined test schedule which will, as far as possible, reflect the systems' functionality. This will be independent of any testing that the supplier proposes in response to the RFP.

Following successful testing in Atlanta, the highway advisory telephone system will be shipped to Los Angeles for on-site integration (Task H).

TASK G CONTROL CENTER LINKAGE

This task consists of the design of communications links to support information exchange between the control centers as defined in the preliminary design task. These intertie links will serve the LADOT, Caltrans, and CHP control centers. The activities to be performed by the JHK Project Team is shown in Exhibit B.11.

Task G.1 - Assemble Base Plans

This activity closely parallels that of Task C.1 of the CCTV Design. Plans will be required in the following areas:

1. Field Plans:

   Surface street

2. Control Centers:

   ATSAC Control Center
   Caltrans Control Center
   CHP Control Center

Task G.2 - Conduct Field Review

The field review is essential to verify conditions along the cable routing where dedicated cable connections are indicated in the conceptual design. The cable routing for the control center intertie links has yet to be defined, it is anticipated that considerable investigative work will be required to develop a preliminary design.

In addition, the field review will also consider factors such as the physical facilities available for interface equipment in the control centers and the cable egress facilities in the building housing the control centers. These activities are relevant regardless of the media selected.

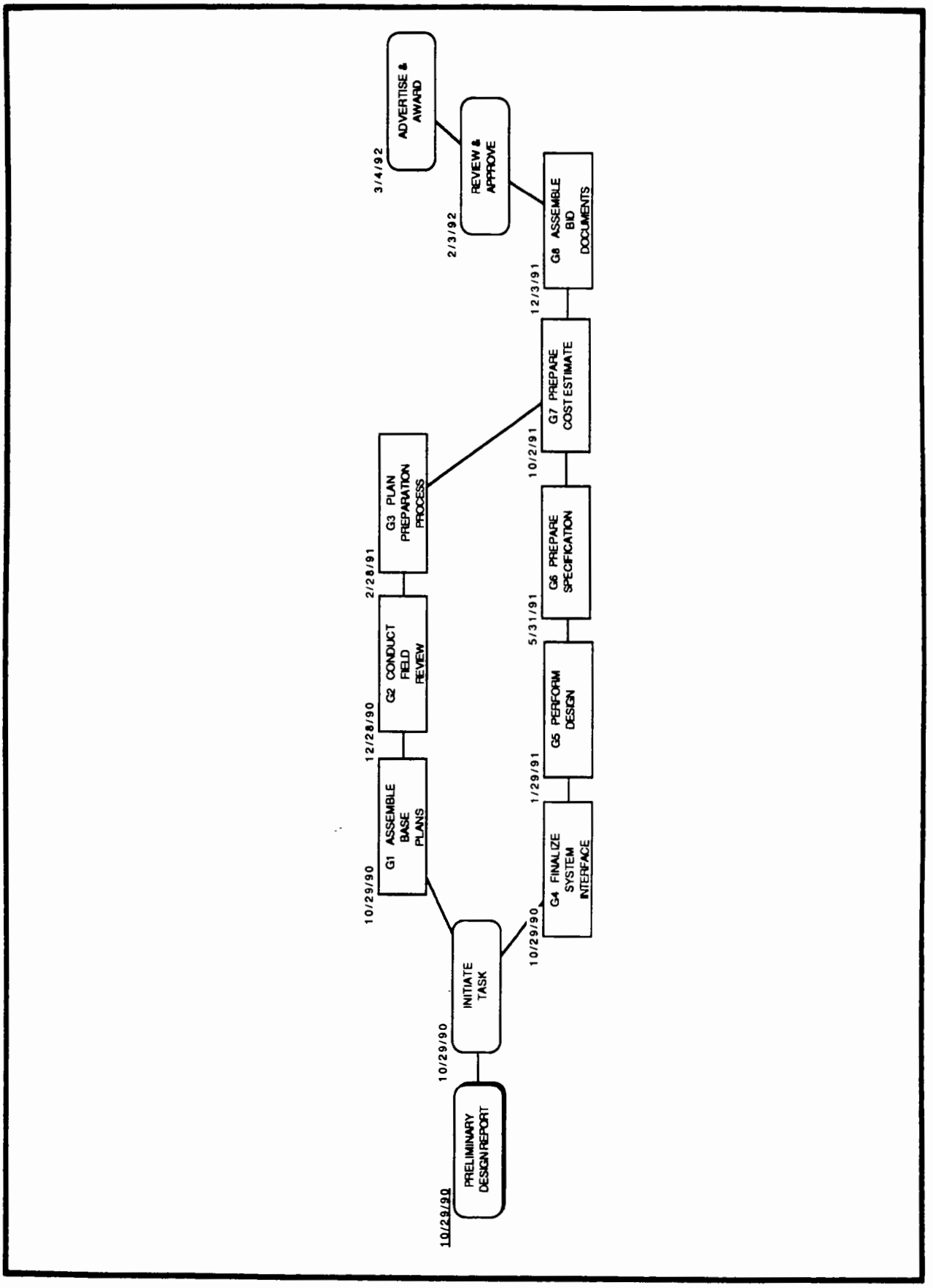


Exhibit B.11. Task G: Control Center Linkages CPM Schedule

Task G.3 - Plan Preparation Process

As described for Task C.3 of the CCTV design, JHK employs a rigorous quality assurance program throughout the final design process. This program will be applied in the plan preparation for the control center links.

All required design documents will be submitted for review and comments at the 30%, 60%, and 90% design stages. Final plans, specifications, and estimates incorporating all comments shall be signed, sealed, and submitted for review.

Task G.4 - Finalize System Interface

This task will build upon the detailed system interface definitions produced during the preliminary design. This task is especially important in the control center linkage design activity because of the number of interfaces to be provided. These include interfaces from the communications link to video and data processing hardware at each control center, as well as operator interfaces between the control systems linked. Furthermore, as this task may be impacted by on-going design decisions in other tasks, it is critical that the design of the intertie system interface be coordinated with other related tasks throughout its execution.

Task G.5 - Perform Design

JHK will design the control center linkages. Industry standard design standards and protocols will be adhered to.

Task G.6 - Prepare Specifications

The specifications for the control center links is a critical element of this design as the control center linkage design includes a relatively small amount of construction and a large amount of termination and interface equipment. The preparation of the specifications will run concurrently with the plan preparation.

Task G.7 - Prepare Cost Estimates

Complete cost estimates for the construction and implementation of the control center linkages will be prepared and furnished as part of the design.

TASK H INTEGRATE SYSTEMS

This task involves the integration of the expert system, CMS signs, CCTV cameras and monitors, central hardware, workstations, control center interties, motorist information systems, and communications subsystem into the Smart Corridor System. The integration activities are shown in Exhibit B.12. After the system has been tested to the satisfaction of the COMMISSION in a test environment, a small number of field components will be integrated and used as a test group. This will demonstrate the system's ability to operate successfully in the real world before the major integration activities and testing begin.

This system integration and computer take over task consists of several activities as described below:

- The operator workstations, CMS controller, and other peripheral devices will be connected to the central computer.

- JHK will integrate the computer assembly, expert system, highway advisory radio, and central communications interface hardware with the communications network. This will involve installing cabling at the control center between the computer and the communications racks, between the central communications and the communications cable termination interface, and between the communications network and TV monitors, video switchers and control units, and other video imaging devices. Connections will be made in accordance with the communications channel assignments.

- JHK will integrate the communication links from remote locations with the central computer and communications assembly. The control center intertie communications links will also be integrated.

- Local communications interface equipment will be installed in each field cabinet as required. After the field interface units have been installed, JHK will conduct an in-place test of each unit. Utilizing a local communications unit tester, which simulates the transmission of computer command messages and the receipt of monitor messages, all interface unit functions

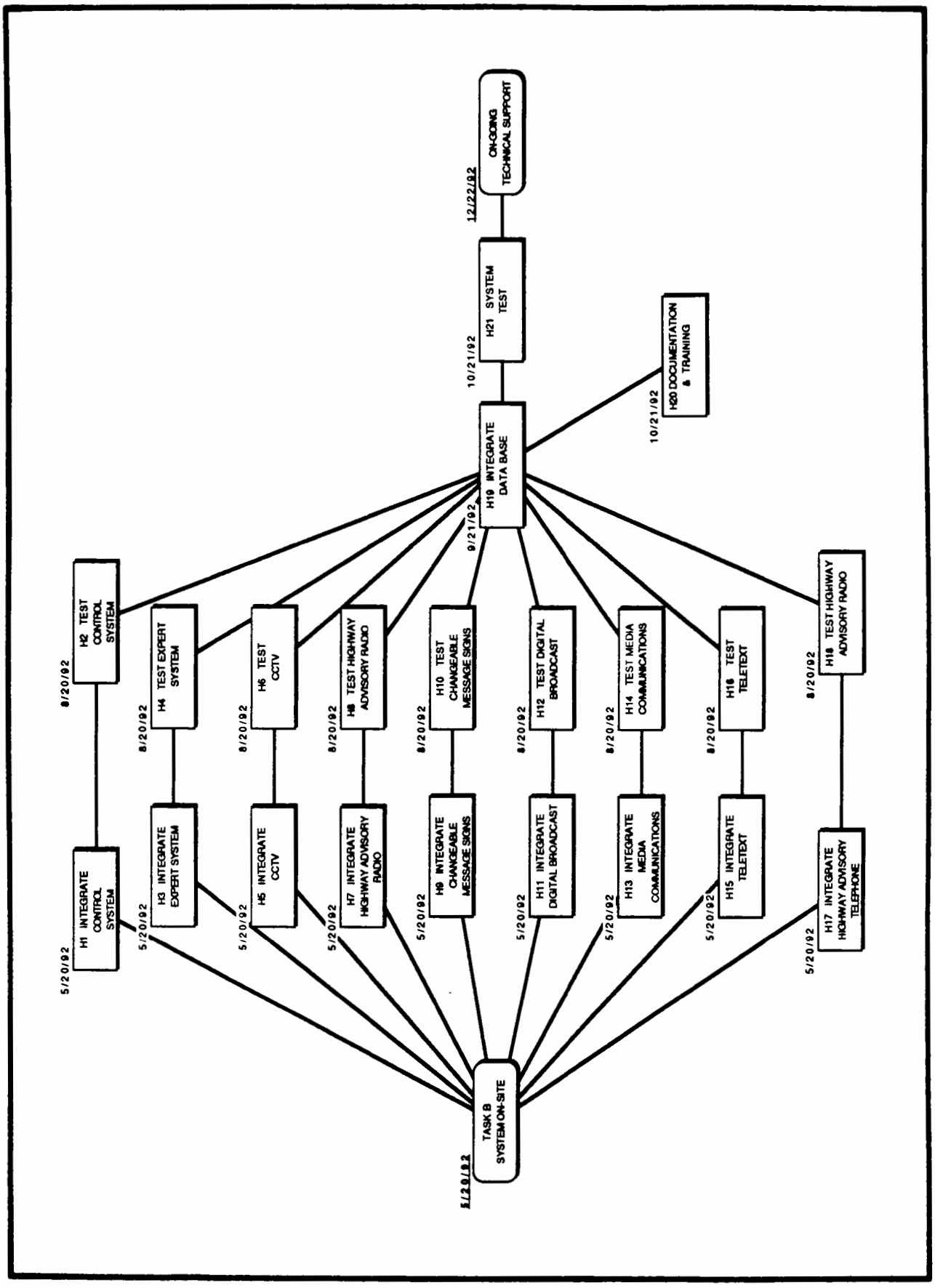


Exhibit B.12. Task H: Integrate Systems

will be tested. Any errors or deficiencies shall be resolved.

- JHK will review the central and expert system data base as may be required. JHK will also develop the real-time graphics display data base. The data bases will be compiled and tested.

- Proper operation of the highway advisory radio, digital broadcast, and teletext will be verified.

- Prior to initiating computer take over of the equipment, all in-place hardware subsystem tests will have been successfully completed. JHK will perform the work necessary to initiate control/monitoring of the field hardware by the system. This process will include a visual inspection of the signs, video images, and motorist information systems before and after take over to monitor any equipment malfunctions, computer program errors, communication problems, etc.

  After the components within the test group have been integrated, the operation of the system will be tested using the approved test plan. Upon successful completion of the acceptance test, the remaining components will be brought on-line.

After all system elements have been brought "on-line" and computer control and the remote workstations have been tied-in, JHK will provide written notification that the fully integrated system is operating functionally and ready for the final system acceptance testing. The System Performance Test will be performed in accordance with the system acceptance test plans and will ensure that the system is performing all required functions.

An "evaluation" phase will be performed to determine the results of the system performance test.

Upon satisfactory completion of the system performance test, the Smart Corridor System will be accepted by the COMMISSION.

TASK I PROVIDE TECHNICAL SERVICES

JHK will provide technical services throughout the project to ensure there is adequate project management and to make specialized skills available as needed.

Project Management

The task of project management is very important to the successful completion of any project. This is particularly true for system management projects where the consultant (JHK) assumes responsibility for the project's (and the system's) success. The JHK Project Team will be acting as a technical agent to the COMMISSION and will, in effect, be serving as an extension of LACTC. This task is a continuous activity throughout the course of the project, and is comprised of several activities.

JHK will use the Critical Path Method (CPM) for schedule control on the project. The overall project effort will be segregated into logical detailed work items, each with a measurable end product. Once these project activities have been defined, their relationships will be identified, start and completion dates set, and budget and controls established. The project schedule will show the relationships of these work items and the point in the project where they become critical. This document will be used to track the progress of JHK, as well as system contractors/equipment vendors throughout the course of the project. The schedule will also be accompanied by an anticipated payout curve.

JHK will act as a link between LACTC, LADOT, Caltrans, CHP, and all other agencies and organizations involved in the project to keep them informed of the project status and to gain their input. JHK will organize, prepare agenda, and conduct monthly project review meetings. The purpose of these meetings will be to resolve issues and any problems, discuss submittals, make decisions, and review the progress of the project. Following each meeting, minutes will be developed and distributed, along with a list of action items, to all attendees and others as appropriate.

JHK will ensure that all parties are kept informed of current progress by issuing a monthly progress report. Each report will be prepared in a manner that provides a comprehensive review of the previous month's activities. The monthly progress reports will include:

- Accomplishments and significant findings as a narrative discussion of the major activities that occurred during the previous month.
- Any problems encountered along with their recommended solutions.
- Work planned for the upcoming reporting period.

- o A graph showing work completed and costs expended by task versus scheduled work (CPM) and cost.

Technical Expertise

As part of the System Management services, JHK will provide the services of technical experts as required. These include systems engineers, software engineers, electrical engineers, and other specialists and consultants in the field of expert systems, freeway operations, and computer hardware.

C. Business Organization

SECTION C
BUSINESS ORGANIZATION

This proposal is submitted by JHK & Associates as the prime consultant. JHK maintains an office at 205 S. Broadway, Suite 907, Los Angeles, CA 90012, and will manage and conduct the work from this office. JHK is a California Corporation and licensed to operate in the State. The home office is located at 5801 Christie Ave., Suite 220, Emeryville, CA 94119. All accounting records are maintained at this location.

A portion of the software design and development work will be done at 3000 Northwoods Parkway, Suite 330, Norcross, GA 30071. This is the firm's major system engineering office and is located near Atlanta, GA; selected due to Atlanta's excellent air service throughout the U.S.

THE JHK PROJECT TEAM

As noted, JHK & Associates will serve as prime consultant for the Smart Corridor System Manager project. The firm is intimately aware of conditions in the corridor and the project requirements. The firm will direct the project from its office in Los Angeles. Staff that worked on the conceptual design phase will play lead roles in the system manager phase to insure knowledge transfer and project continuity. The firm accepts full responsibility for the successful completion of all technical and administrative aspects of the project. In addition to overall project management, JHK will provide the central system hardware and software and the expert systems for the project. JHK will also provide direct technical assistance as required and provide the design work for the high technology aspects of the project. JHK will also prepare the equipment specifications for the field elements to be designed by others.

Assistance on the project will be provided by two firms with specific experience related to well identified elements of the project. The first firm, Katz, Okitsu, is experienced in designing the field construction work for traffic systems. They are performing design work related to the ATSAC traffic signals in the Smart Corridor for LADOT and the changeable message sign system for Caltrans respectively. The firm is thoroughly experienced in the CAD system used by LADOT and Caltrans

and will use CAD for plan preparation. Katz, Okitsu, as noted, is performing design work in the Smart Corridor area and brings direct familiarity with the CAD drawings to be used as a base for the surface street CMS and CCTV elements. They will perform the work from offices located in Los Angeles County, and the firm is certified DBE.

The second subcontractor is Hughes Aircraft Company. Hughes Aircraft is located in Fullerton, CA. Hughes Aircraft will provide assistance in defining the requirements and designing the expert system to be developed as part of the Smart Corridor project.

In addition to the work by the subcontracts, technical consulting assistance will be provided to the project by Mssrs. Conrad Dudeck and Adolf May. Mr. Dudeck will assist in the area of motorist information using CMS and HAR. He will provide a workshop for the agency staff preparing the operations plans and will review and recommend CMS and HAR messages as developed. Mr. May will assist in defining operations plans requirements and in reviewing plans as developed. He will also assist in defining expert system requirements and decision support structure. Both Mr. Dudeck and Mr. May are well known for their expertise in the designated fields and have worked on aspects of the Smart Corridor project.

The JHK team, then, represents a unique combination of skills and direct experience needed to guide the Smart Corridor project toward a successful implementation and operation. All have worked with the involved agencies, are known quantities, and have direct experience with the Smart Corridor. All are committed to the successful completion of the project.

MANAGEMENT AND STAFFING

The management plan and the organizational of personnel assigned to the project are shown in Exhibit C.1. Information concerning the qualifications and experience of key personnel is presented in Section L of this proposal.

There are four major factors in the management approach which will be adopted by JHK and its team members for this study. First, all work will be managed out of our Los Angeles office. The Project Director, Mr. Clelland, is permanently assigned to the Los Angeles office and will direct all project activities on a day-to-day and week-to-week basis. The work performed by Katz, Okitsu & Associates will be done in Los Angeles. The work of Hughes Aircraft will be centered in Fullerton,

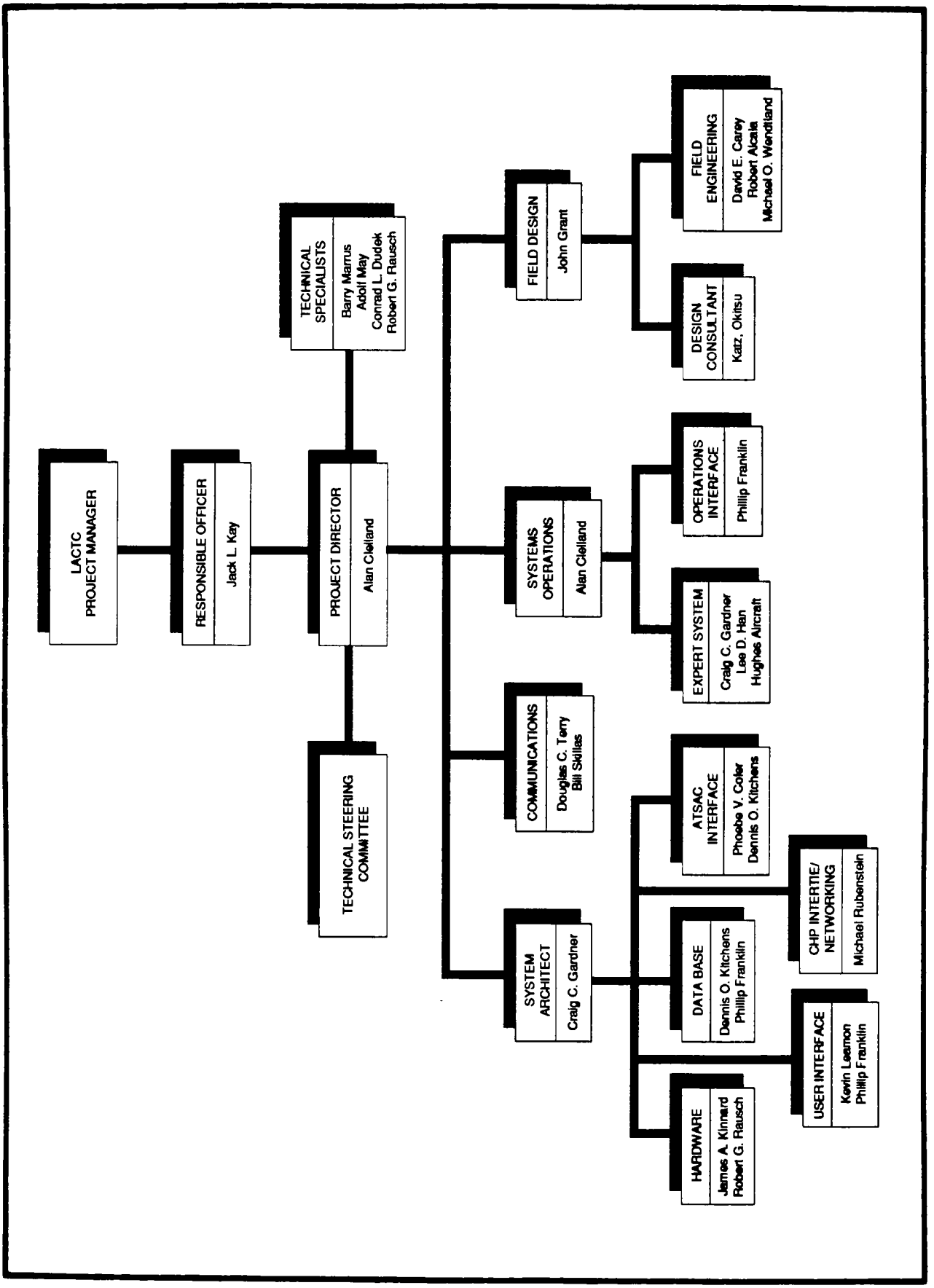


Exhibit C.1. Management and Staffing Plan

CA. Input from the expert panel will take place in Los Angeles and will occur at least three times during the project. JHK proposes to request of ADOT space in the Transportation Planning Division near the office of the ADOT Study Manager. In this way, the JHK team members can easily access and coordinate certain activities with ADOT's staff in a more direct manner.

The second factor in JHK's management plan is to require, on a monthly basis, brief and concise progress reports from Katz, Okitsu; Hughes Aircraft; Dr. May; and Mr. Dudeck. Each of these firms and technical experts will have specific identified tasks written into their subcontracts and completion dates and submittal dates will be established in the subcontracts. Thus, for each, the reporting to JHK of the exact progress and products produced on a monthly basis will be an important control mechanism. The material in each firm's and consultant's progress report will, of course, be incorporated in an overall report to LACTC on a monthly basis.

The third management proposal by JHK relates to the interaction with the LACTC Project Manager, LADOT, and Caltrans. It is proposed that every month, a specific period of at least two to three hours be set aside for an informal progress review session. Each session will have specific agenda items which are aspects which need to be resolved, issues which needs to be discussed or which has not been transmitted to the Study Team, reorientation or certain specific subtasks, and any new directions which may be appropriate for the JHK team. The intent of these working sessions is not to repeat items which appear in the progress reports but rather to dig into the technical aspects of the work and to resolve, on a regular basis, any questions or problems which might, otherwise, create either time delays or additional costs for the overall effort.

The fourth important factor proposed by JHK for its management of the project relates to the submission of reports, working papers, and design documents. JHK proposed to submit a report or working paper for each task in this project for which the consultant will have responsibility. This is important to allow a continuous flow of documentation so that toward the end of the project the development of the concepts and final deliverable items can be based on previously reviewed material.

D. DBE Report

SECTION D

CERTIFICATE OF NONDISCRIMINATION

Proposer hereby certifies under penalty of perjury under the laws of the State of California, that it does not unlawfully discriminate against any employee or applicant for employment with regard to race, color, religion, sex or national origin, ancestry, physical handicap, medical condition, marital status, or age; that it is in compliance with all applicable federal, state, and local directives and executive orders regarding nondiscrimination in employment; and that it agrees to pursue positively and aggressively the principle of equal opportunity in employment. Proposer and its subconsultants shall comply with the provisions of the Fair Employment and Housing Act (Gov. Code Section 12900 et seq.) and the applicable regulations promulgated thereunder (Cal. Admin. Code, Tit 2, Sec 7285.0 et seq.).

Proposer agrees specifically:

- To establish or observe employment policies which actively promote opportunities for minority persons and women at all job levels.
- To communicate this policy to all persons concerned, including all company employees, outside recruiting services, especially those serving minority communities and women, and to the minority communities and women at large.
- To state in all solicitations or advertisements for employees that the Proposer will consider all qualified applicants for employment without regard to race, color, religion, sex, age, or national origin.

Additional information regarding equal opportunity employment programs now in effect within JHK & Associates follow this Certificate of Nondiscrimination.

CERTIFIED BY: _____

Tom L. Stout, Senior Vice President

MINORITY UTILIZATION

JHK & Associates actively seeks minority employees in its' recruitment activities. The present breakdown of the total workforce is shown on the following tables.

Category	Total Employees	Male	Female
Professional	96	86	10
Technical	53	37	16
Clerical	50	10	40

	Minority Group					
	Male			Female		
Category	Black	Hispanic	Asian	Black	Hispanic	Asian
Professional	2	4	4	0	0	0
Technical	5	6	0	3	0	1
Clerical	1	1	1	4	1	3

DISADVANTAGED BUSINESS ENTERPRISE REPORT

JHK & Associates supports and endorses the COMMISSION's intent to provide Disadvantaged Business Enterprises (DBE) the opportunity of performing substantive work on this project. To achieve the COMMISSION's goals, JHK has taken good faith affirmative steps to subcontract work to DBEs.

JHK reviewed the work to determine areas that could be subcontracted. From this review two areas of work were defined that could be subcontracted as follows:

Expert System - The requirements of Task B to design the expert system and to develop the expert system software is a well defined work item to be performed by a DBE. It is also estimated that this work will approximate the COMMISSION's DBE goals.

Discussions were held with LACTC Contract Compliance Office and a copy of DBE Certified Firms, January, 1990, report was obtained. From the certified vendor list all firms in the Professional Services category that provided services in the same field as those required to design the expert system were contacted by telephone. Each firm contacted was provided a description of the work desired and was asked if they had capabilities in this area or an interest in the work. In all cases a principal of the firm was contacted. The results of this activity is documented in Exhibit D-1. JHK was not able to locate a DBE having interest in being a subcontractor for this area of work.

Field Design and Plan Preparation - This area of work consists of developing base maps, field engineering, design, and development of PS&E packages for the field construction work. This work is required in Tasks C, D, E, and F and is estimated to be 10 to 15 percent of the total services to be provided under this contract.

Two DBE firms having an interest in being a subcontractor were located. After extensive discussions to clearly define the work, one firm continued to have an unusually high estimated cost. As a result, the firm was eliminated from further consideration.

The following DBE firm, certified with the COMMISSION, has agreed to be a subconsultant for this work:

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 140
Monterey Park, CA 91754
(213) 260-4703

A copy of their certification is shown in Exhibit D-2.

REPORT ON DBE/WBE CALLS MADE FOR SMART CORRIDOR ON 3/9/90

QUESTION: Can your company design an Expert System for the Smart Corridor Demonstration Project?

The following are apparently one-person offices: all had only an answering machine or an answering service.

A.M.M.A.	Claremont CA	714-621-3101
Acutech, Inc.	Glen Ridge NJ	201-680-4720
Braukis & Associates	Los Angeles CA	213-662-6914
Gardner Cons. Planners	Los Angeles CA	213-642-7402
Patti Post & Assoc.	Los Angeles CA	213-470-0417

Acex Technologies — Oakland CA — 415-652-1412

Spoke with Jim Cox, engineer. They are not involved with ES.

Applied Management & Planning Group — Los Angeles CA — 213-820-0741

Spoke with Dr. Rose, President. Has to check with Transportation Director. Not sure if they do any work with ES. Never heard of Smart Corridor. Will call back. Called back and said they do not work with ES.

Heydar & Assoc. — Burbank CA — 818-566-7414

Spoke with Valerie Heydar. Never heard of ES.

KKO & Associates — Andover, MA — 508-470-3407

Spoke with Katherine O'Neil, President. Never worked with ES; not sure what it is.

Pat Piras Cons. Serv. — San Lorenzo CA — 415-278-1631

Spoke with Miss Piras. No experience with ES.

Project Info Serv. — San Juan Capistrano CA — 714-240-7535

Message on answering machine said company does project management and scheduling consulting.

Dean P. Bell & Assoc. — New Orleans LA — 504-486-3703

Spoke with Dean Bell's assistant, "Deidre". They do not write computer programs. Does not know what ES is.

Exhibit D.1. DBE Contact Report

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 140
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

Mr. Tom Stout
JHK & Associates
3000 Northwoods Parkway, Suite 330
Norcross, Georgia 30071

Dear Mr. Stout:

Attached is a 2-13-89 letter indicating Katz, Okitsu and Associates' DBE certification with LACTC. Our renewal of the DBE certification with LACTC is currently being processed.

Yours truly,

Kirby Leung

Kirby Leung
Senior Engineer

Exhibit D.2. DBE Certification

Los Angeles County
Transportation
Commission
403 West Eighth Street
Suite 500
Los Angeles
California 90014-3096
(213) 626-0370

February 13, 1989 Ref.: R01-S17-KA01

Mr. Walter Okitsu
Partner
Katz, Okitsu & Associates
4026 Bledsoe Ave.
Los Angeles, California 90066

Dear Mr. Okitsu:

Your certification by the Los Angeles County Transportation Commission (LACTC) as a Disadvantaged Business Enterprise (DBE) will expire April 21, 1989. If there has been a change in the ownership and/or control of the firm since submission of your original Schedule A application, you must complete and submit a new application. You can contact this office to obtain a new Schedule A (Form 108) application.

If the information provided in your original Schedule A application is still accurate, you are required to attest to its continued accuracy on the attached annual recertification affidavit. Please complete this form, have it notarized and return to the Contract Compliance Office.

This notice of certification expiration is being sent to you in advance as a courtesy and is the only notice your firm will receive. If we do not have a response from you by the expiration date stated above, we will assume you are no longer interested in DBE certification with LACTC, your firm will become inactive and you will be required to submit a new Schedule A application and any supporting documentation.

If you have any questions regarding this matter please contact the Contract Compliance Office at (213) 626-0370.

Sincerely,

JAN WALLS
Contract Compliance Analyst

JW:mkd

Form 210
Rev.12/88
Jan I
RMC

Exhibit D.2. Continued

JHK & ASSOCIATES

AFFIRMATIVE ACTION PLAN

The following points summarize the contents of the JHK Affirmative Action Plan.

1. Equal and fair treatment will be provided to all employees regardless of race, color, religion, ancestry, national origin, or sex.

2. A complete up-to-date record of employees classified by ethnic distribution, sex, and job classification will be maintained and annual reports will be submitted to appropriate public agencies.

3. All employees will be advised at time of employment that JHK is an Equal Employment Opportunity Employer and that hiring, promotion or demotion is based only on the individual's qualifications and ability to perform the work.

4. The company will cooperate with and support apprenticeship training programs based on strict nondiscrimination.

5. The company has appointed Walter P. Weber, Financial Vice President, to serve as the Equal Employment Officer who is authorized to supply reports and represent this company in California in all matters regarding this affirmative action program.

6. The name, address, and telephone number of the Equal Employment Officer will be posted in a conspicuous place or places. This officer will be responsible for:

    a. Supervision of periodic audits of employment practices and for any complaints concerning discriminatory practices.

    b. Maintenance of a close liaison with a representative of appropriate public agencies with regard to all matters pertaining to nondiscriminatory requirements.

    c. Instruction of all supervisory personnel and their responsibility regarding equal opportunity and nondiscrimination requirements.

    d. Periodic reviews with all supervisory personnel to insure that the program is being implemented at all levels.

e. Contacts with all minority recruitment sources who will be notified in writing that this company is an equal opportunity employer and notification of all eligible employees regarding promotions or vacancies to insure equal opportunity.

f. Making specific efforts to encourage present minority employees to recruit other minority employees.

g. Maintaining all facilities and company activities on a nonsegregated basis.

h. Seeking to utilize minorities and females to the same degree as all others, based on the following factors:

(1) Minority population in the area.

(2) Size of unemployed minority forces in the area.

(3) Percentage of minority work force as compared with the total work force in the area.

(4) Local availability of minorities having the skills JHK employs.

(5) Availability of promotable minority employees in the company.

(6) Existence of training institutions capable of training minorities in the area.

(7) The internal skills training for which JHK is capable of offering minorities for required job categories.

JHK & Associates is committed to the effective implementation of the company's affirmative action policy and program. Further, all supervisory personnel are directed to carry out their affirmative action responsibilities with the same dispatch and expertise normally applied to their regular job duties.

The affirmative action program is governed by the applicable laws, regulations, or executive orders listed below:

1. Executive Order 11246 and 11375

2. Equal Employment Opportunity Act of 1972
3. California Governor's Executive Order #3
4. A (76) Affirmative Action Requirements
5. Civil Rights Act of 1964
6. California Government Code Section 12990
7. Title 2, California Administrative Code, Section 8103

In recognition of its social, moral, and economic obligations to society in general, it is the policy and practice of JHK & Associates not to discriminate because of race, color, religion, age, sex, or national origin with respect to employment opportunities within the firm. The following are protected classes of individuals.

1. Blacks
2. Spanish Surnamed Americans
3. Asian Americans
4. American Indians
5. Women
6. Handicapped Individuals

The firm will not discriminate in the following employment process areas:

1. recruiting
2. advertising
3. hiring
4. upgrading
5. promotions
6. transfers
7. demotions
8. layoffs
9. terminations
10. rehires
11. employment
12. rates of pay and other compensation

MBE/WBE/DBE firms currently under subcontract or providing supplies to JHK & Associates include the following:

Firm	Services
Jackson & Tull, Chartered Engineers (DBE) 920 Broadway, Suite 704 New York, NY	$1.5 million subcontractor to provide construction inspection for computerization of traffic signals in Manhattan
Burns Gunther Associates (DBE/WBE) 2140 Shattuck Avenue Berkely, CA	Subcontractor to provide environmental planning services for State Wide California Smart Corridor Project
KAKU Associates (MBE) 1427 Santa Monica Mall Suite 201 Santa Monica, CA	Subcontractor to provide traffic analysis services for Smart Corridor Demonstration Project
Graphcom 127 Arch Street New Brittan, CT	Drafting services for New York and New Jersey Port Authority design projects

JHK & ASSOCIATES

AFFIRMATIVE ACTION PLAN

AFFIRMATIVE ACTION METHODS

In order to formulate a realistic Affirmative Action Plan, JHK has identified the following known barriers to participation by minority and women subcontractors, before describing its proposed affirmative action methods.

1. Lack of qualified minority and women subcontractors in our specific geographical areas of work.

2. Lack of certified minority and women subcontractors who seek to perform Department of Transportation work.

3. Lack of interest in performing DOT work.

4. Lack of response when requested to bid.

5. Limited knowledge of DOT plans and specifications well enough to prepare a responsible bid.

In view of the barriers to minority and women subcontractors stated above, it shall be the policy of JHK to provide maximum opportunity to minority and women subcontractors by utilizing the following affirmative action methods to ensure participation on contracts with the Department of Transportation. JHK will,

1. provide written notice to a reasonable number of specific MBE/WBE subcontractors in all areas of work to be subcontracted by the company.

2. advertise in minority focused media concerning subcontract opportunities with the Company.

3. select portions of the work to be performed by MBEs in order to increase the likelihood of meeting contract goals (including, where appropriate, breaking down contracts into economically feasible units to facilitate MBE participation).

4. provide adequate information about the plans, specification, and requirements of the contract, not rejecting minority and women subcontractors without sound reasons based on a thorough investigation of their capabilities.

5. establish liaisons with community organizations for the identification and utilization of minority and women construction contractors.

6. waiver requirements of performance bonds where it is practical to do so.

7. attend pre-bid meetings held by the Department to appraise minority and women subcontractors of opportunities with the Company.

8. assist MBE/WBE contractors in obtaining bonding, lines of credit, or insurance required by the Department or the Company.

9. follow up on initial solicitations of interest to MBE/WBE contractors to determine with certainty whether the company is interested in the subcontract opportunity.

JHK understands that this list of affirmative action methods are not exhaustive and will include additional approaches after having established familiarity with the minority and women subcontraction community and/or determined the stated approaches to be ineffective.

1.

JHK & ASSOCIATES

POLICY

STATEMENT

JHK & ASSOCIATES
POLICY ON
AFFIRMATIVE ACTION PROGRAM

As President of JHK & ASSOCIATES, I am personally committed to the effective implementation of the Company's affirmative action policy and program. Further, I direct all supervisory personnel carry out their affirmative action responsibilities with the same dispatch and expertise normally applied to their regular job duties.

The affirmative action program is governed by the applicable laws, regulations, or executive orders listed below:

1) Executive Order 11246 and 11375
2) Equal Employment Opportunity Act of 1972
3) Governor's Executive Order #3
4) A (76) Affirmative Action Requirements
5) Civil Rights Act of 1964

In recognition of its social, moral, and economic obligations to society in general it is the policy and practice of JHK & ASSOCIATES to not discriminate because of race, color, religion, age, sex, or national origin with respect to employment opportunities within the Firm. The following are protected classes of individuals:

1) Blacks
2) Spanish Surnamed Americans
3) Asian Americans
4) American Indians
5) Women
6) Handicaps

The Firm will not discriminate in the following employment process areas:

1) recruiting
2) advertising
3) hiring
4) up-grading
5) promotions
6) transfers
7) demotions
8) layoffs
9) terminations
10) rehires
11) employment
12) rates of pay & other compensation

JHK & ASSOCIATES

James H. Kell
President

2.

DISSEMINATION OF

AFFIRMATIVE ACTION POLICY

DISSEMINATION TO EMPLOYEES

Each employee, upon hire, will be provided with a copy of the JHK & Associates Affirmative Action Policy. During the employment interview and subsequent meeting upon the first day of employment, the employee will be indoctrinated in the Policy. Depending upon the status of the employee, his or her role will be clearly defined as to implementation of the program.

DISSEMINATION TO OUTSIDERS

Included are the following sample letters to be sent to:

Exhibit A - Personnel Agencies
Exhibit B - Subcontractors, Suppliers, and Vendors

ADVERTISEMENTS

All advertisements for employees must include the wording, "An Equal Opportunity Employer." When advertising for employees is done, such advertising must include media servicing minority communities.

jhk & associates

6085 Barfield Road / Atlanta, Georgia 30328 / (404) 252-4410

Exhibit A.

SAMPLE LETTER TO PERSONNEL AGENCIES

_____

_____

_____

Ms./Mrs.:

JHK & Associates is concerned that it fulfill its role as an equal opportunity employer. We request your vigorous support in our affirmative action efforts as it relates to providing employment opportunity for minority groups and women. We do not discriminate against any employee or applicant for employment because of age, race, sex, creed, color or national origin.

Utilization of any agency is predicated upon their full compliance with our equal employment opportunity policy. We request that qualified women and minorities be referred to us for any job opening listed with your agency. We also request that qualified males be referred for traditionally "female" jobs.

Please acknowledge your support of our commitment by signing a copy of this letter and returning it to us. Thank you.

Sincerely,

JHK & ASSOCIATES

Walter P. Weber
Controller and Equal Employment
Opportunity Officer

jhk & associates

6085 Barfield Road / Atlanta, Georgia 30328 / (404) 252-4410

Exhibit B.

SAMPLE LETTER TO SUBCONTRACTORS, SUPPLIERS, AND VENDORS, ETC.

_____
_____
_____

Ms./Mrs.:

As your firm is well aware, JHK & Associates is an equal opportunity employer.

Pursuant to Executive Order 11246 as amended, you are advised that under the provisions of government contracting and in accordance with the Executive Orders, contractors and subcontractors are obliged to take affirmative action to provide equal employment opportunity without regard to race, creed, color, national origin, age or sex.

We expect to see our commitment to equal opportunity employment to be reflected in the racial and sexual composition of your firm's workforce and urge a vigorous affirmative action program to overcome underutilization.

The attached form will need to be completed and returned to us at your earliest convenience. Thank you.

Sincerely,

JHK & ASSOCIATES

Walter P. Weber
Controller and Equal Employment
Opportunity Officer

3.

ASSIGNMENT OF RESPONSIBILITY

The assignment of responsibility is handled in the following manner.

1) Each employee has been provided with the firm commitment of the Firm as indicated by the written policy signed by the President of the Firm. The section on dissemination of policy states the manner that each employee will receive detailed instructions of his part in fostering and achieving the policy.

2) Secondly, the Company has had an "Equal Employment Opportunity Coordinator" at the officer level since inception of the Firm on July 1, 1971. Attached is the policy that details the duties and name of that individual.

   Each year at the June Board Meeting, a time is set aside to review each Company Policy to insure that the policies are still needed for the furtherance of Company goals. Each year, the Board has unanimously agreed that all efforts of the Company must be used to implement the "Equal Opportunity Employment" Policy.

   The date of July 1, 1972, on the policy merely indicates a change in the name of the Equal Employment Opportunity Coordinator.

EQUAL OPPORTUNITY EMPLOYMENT

In recognition of its social, moral, and economic obligations to society in general, it is the policy and practice of JHK & Associates to not discriminate because of race, color, religion, age, sex, or national origin with respect to employment opportunities within the Firm. It is the desire and intent of the Firm's policy that race, color, religion, age, sex, or national origin shall not be a factor in recruitment, hiring, promotion, transfer, rates of pay or other forms of compensation, selection for training, demotion, or separation. All decisions in these areas shall be based solely upon the individual's qualifications for the position involved.

All management and supervisory personnel will be responsible for the administration and application of this policy. To assure implementation and maintenance of this policy, the Controller (W.P. Weber) has been appointed as Equal Employment Opportunity Coordinator for JHK & Associates.

January 1, 1981

4.

GOALS AND TIMETABLES

In the professional area, JHK & Associates has been exceptionally successful in recruiting minorities as compared to the very limited number of minorities available.

In the office/clerical and technician area, an increased percent can only be met by replacement at the time of job turnover. This work force has remained stable for the last few years and we anticipate no change in the foreseeable future.

An area not shown is the area of temporary employees who are hired for a specific project. As indicated below, we have been very successful in recruiting minorities and will continue to foster this policy.

Temporary Staff Hiring

JHK has vigorously pursued an affirmative action program for temporary staff. Over the past two years JHK has set aside specific temporary hiring for minorities. These include:

- Baltimore Neighborhood Development Project - In this project JHK hired the entire field staff of ten persons from minorities in the community where the work was being done.
- Urban Traffic Control System Study Washington, D.C. - Six field staff were recruited for the project. All were minorities obtained through the local Youth Opportunity Commission. On this project we also hired research assistants from the Galludet College for Deaf Mutes.
- Selma Transit Study - The local staff used for surveys and field measurements were all minorities hired through the Selma/Dallas County Economic Opportunity Board.

5.
DEVELOPMENT AND EXECUTION
OF
PROGRAM

The principles of Affirmative Action are ingrained in the internal personnel procedures and practices of JHK & Associates.

The Equal Employment Opportunity Coordinator is responsible to ensure that these practices and procedures are enforced in regard to:

- Recruitment
- Selection Standards
- Upward Mobility Opportunities
- Wage and Salary Schedules
- Benefits and conditions of employment
- Any other conditions of employment

INTERNAL AUDIT AND REPORTING SYSTEMS

There will be a specific audit at the June Board Meeting each year of the Company Affirmative Action Plan.

The Equal Employment Opportunity Coordinator will be responsible to provide the following data at this annual review:

- Employee utilization analyses which detail changes of employment in regard to minorities and females by category
- Identification of any problem areas that have either affected the program or could hinder the forward progress
- Effectiveness of specific recruitment programs, advertising, personnel practices, etc.

The Board of Directors, under the chairmanship of the President, will be responsible for directing the Equal Employment Opportunity Coordinator to implement new programs or to modify current policies.

6.
GRIEVANCE PROCEDURE

Under the grievance procedure, the following procedures are in effect:

1. If an employee believes that a discriminatory act has occurred, the employee must file a written report with the Equal Employment Opportunity Coordinator (EEOC) within 30 days after the date of the alledged discriminatory act.
2. The EEOC must investigate and reply in writing to the complaintant within 30 days after receiving the written complaint.
3. The complaintant has the right to file with the appropriate state or federal agency if the complaintant is not satisfied with the determination of the complaint.

All necessary steps will be taken by the Company to ensure confidentiality of all steps of the grievance procedure.

The company specifically states that the employment status of any complaintant will not be jeopardized.

7.

PERSONNEL POLICIES AND PRACTICES COMPLIANCE WITH SEX DISCRIMINATION GUIDELINES

JHK & Associates does not discriminate on the grounds of sex. If a female applies for a draftsman or technician position, she will not be discriminated against because traditionally such positions went to males and vice-versa, if a male applies for a clerical position, he will not be discriminated against because traditionally, such positions went to females.

8.

CONSIDERATION OF WOMEN AND MINORITIES NOT CURRENTLY IN THE WORK FORCE

JHK & Associates states that if and when necessary, the firm will consider women and minorities not currently in the work force.

9.
RELIGIOUS AND NATIONAL ORIGIN DISCRIMINATION GUIDELINE

JHK & Associates does not and will not discriminate on the grounds of religion and national origin. If an employee celebrates a religious holiday (or a holiday related to his or her national origin) which may not be a holiday celebrated by the entire firm, he or she will not be discriminated against for honoring such a day.

E. Authorized Representatives

SECTION E

AUTHORIZED REPRESENTATIVES

The persons whose signature appears below are authorized to discuss this proposal, including cost, and to sign a contract on behalf of JHK & Associates.

Attest Kimberly A. Coffee

Jack L. Kay, President

Attest Donna G. Fowler

Tom L. Stout, Senior Vice President

Attest Rosa M Fetrow

Craig C. Gardner, Vice President

CERTIFICATION OF SIGNATURE AUTHORITY

CORPORATE BY-LAW AMENDMENT ADOPTED OCTOBER 2, 1981

ARTICLE III - OFFICERS

Section 2. Signatory Authorization

The president, any vice-president, and the chief financial officer of the corporation may enter into any contract or execute any instrument in the name of and on behalf of the corporation.

OFFICERS

President - Jack L. Kay
Chief Executive Officer - Morris J. Rothenberg
Senior Vice President - Tom L. Stout
Vice President - Craig C. Gardner
Vice Preident - Barry S. Marrus
Vice President - William R. Reilly
Chief Financial Officer and Secretary - Walter P. Weber

ARTICLE IV - CORPORATE RECORDS AND CERTIFICATION

Section 3. Certification and Inspection of By-laws.

The original or a copy of these By-laws, as amended or otherwise altered to date, certified by the Secretary, shall be open to inspection by the shareholders of the company or provided to outside parties as required by legal considerations. If required, any employee of the Company may attest to the signature(s) of the person(s) authorized to sign contracts.

I, **Walter P. Weber,** Secretary of **JHK & Associates,** hereby certify that the foregoing is true copy of the Corporate By-laws, duly and legally adopted by he Board of Directors of said corporation, at a legal meeting of the Board duly and regularly held October 2, 1981.

I further certify that said resolution has not been amended or revoked and is still in full force and effect.

Dated: June 7, 1988.

Secretary: Walter P. Weber

(SEAL)

President: Jack L. Kay

State of California
County of Alameda

On this 7th day of June, in the year 1988, before me Andrea Chin, the undersigned Notary Public, personally appeared Walter P. Weber and Jack L. Kay, personally known to me to be the persons whose names are subscribed to this instrument, and acknowledged that they executed it.

(SEAL)

OFFICIAL SEAL
ANDREA JOYCE CHIN
NOTARY PUBLIC CALIFORNIA
ALAMEDA COUNTY
My Comm. Expires Dec. 8, 1989

Andrea Joyce Chin
Notary Signature

F. Previous Experience

SECTION F
PREVIOUS EXPERIENCE

This section of the proposal provides a description of the qualifications of JHK & Associates to provide the systems management services required to design and implement the Smart Corridor System. Presented first is a general statement describing the scope of practice of JHK. This is followed by a description of JHK's specific experience in traffic control systems, including summaries of selected projects which are applicable to this study. This information is complemented by the firm's brochure which is appended.

GENERAL QUALIFICATIONS

JHK & Associates is a nationally-known engineering consulting firm specializing in transportation planning, traffic engineering, and systems engineering. JHK has offices in 12 cities in the United States, primarily covering the east and west coast. During the past 25 years, JHK and its predecessor firms have conducted engagements for a variety of clients in both the private and public sectors. These studies have covered all aspects of the transportation of people and goods, including areawide signal system design and operation, traffic engineering and management, analysis of parking facilities, travel forecasting, transit planning, toll facility feasibility and control, and comprehensive transportation planning.

The officers and senior professional staff members of JHK have performed as a cohesive team since 1966. Overall, individual senior professional staff members average over 25 years of specialized experience. The Firm continues to expand its sphere of services, resources, and capabilities to meet the needs of its U.S. and foreign clients in responding to the challenges of the future.

The engineering services are diverse, ranging from "soft" engineering, such as planning studies, to "high technology" engineering, such as the installation of traffic control systems. This blend brings the best of both worlds together as the Firm is sensitive to the diverse needs of the transportation official and can provide the skilled technicians required to complete a project on time and on budget.

AREAS OF EXPERTISE

The general areas of expertise in which JHK is qualified to provide professional engineering services are as follows:

Traffic Surveillance and Control Systems

- Feasibility studies
- Implementation assistance
- Communications design and implementation
- Software development
- System installation, integration and commissioning
- System design (PS & E)
- Signal timing analysis
- System management
- Operations
- Data Base development
- Construction engineering and inspection

Traffic Circulation

- Identification of improvement strategies
- Analysis of programs
- Selection and evaluation of alternatives

Transportation Research

- Evaluation of signal control strategies
- Freeway lane drops
- Pedestrian safety at urban intersections
- Freeway incident management
- HOV training course
- Delay at intersections
- Motorists aid systems
- Signal Removal Criteria
- Intersection simulation model validation
- Transit training course

- Urban street design training course
- Congested corridor study
- Vehicle detector installation handbook

Transportation Planning

- Comprehensive urban area transportation studies
- Transit planning and HOV treatments
- Corridor studies and alternatives analysis
- Travel demand forecasting
- Development of regional impact studies and reviews
- Recreational analysis
- Pedestrian and bicycle planning

Traffic Engineering Operations

- Urbanized systems
- Parking studies
- Inventory and evaluation of traffic control devices
- Bike studies
- Traffic impact studies
- Traffic safety studies and accident record systems
- Operational analysis of roadways and intersections
- Functional design

Special Services

- Training
- Community involvement/public information programs
- Disaster planning
- Preparation of manuals and handbooks

Transit Operations

- Transit operations training
- Market research
- Alternative analysis
- Ridership forecasting
- Ridership surveys

JHK has pioneered many frontiers of the traffic engineering practice. Some of these include:

- o Research for FHWA on freeway incident management.
- o Current research for FHWA analyzing complex congested corridors in six U.S. cities.
- o Research for the signalized intersection and weaving section chapters of the 1985 Highway Capacity Manual.
- o Research and demonstration projects on advanced technology (e.g. Smart Corridor and Pathfinder).
- o An NCHRP research project to develop an approach for selecting traffic control systems.
- o Training courses in traffic signal design and traffic control equipment.
- o Training course in transit and HOV planning and in travel demand forecasting and design traffic estimation.
- o Early research on ways to enhance traffic operations through one-way streets, optimizing signal timing, turn controls, parking strategies, and signing (NCHRP Report 110).
- o Extensive before and after studies to evaluate traffic signal systems and freeway surveillance and control systems.

The Firm has a proven record in developing innovative solutions to difficult problems, and places continued emphasis on expanding technical resources to solve today's complex transportation problems.

TRAFFIC CONTROL SYSTEM EXPERIENCE

Since the 1960's JHK & Associates has been a recognized leader in advancing the state-of-the-art of traffic control systems. This work has taken the form of providing engineering services and implementing computer based traffic control system as a Systems Manager and as a contractor. JHK's experience in the area of traffic control systems is extensive. A partial listing of the locations in which the Firm has or is currently conducting traffic control projects is as follows:

- Lee County, Florida
- New York City, New York
- Los Angeles, California
- Anaheim, California
- Chula Vista, California
- Tampa, Florida
- Jacksonville, Florida
- Phoenix, Arizona
- Tucson, Arizona
- New Haven, Connecticut
- Hartford, Connecticut
- Stamford, Connecticut
- Durham, North Carolina
- Greensboro, North Carolina
- Raleigh, North Carolina
- Mesa, Arizona
- Tempe, Arizona
- Scottsdale, Arizona
- Jackson, Mississippi
- Pasadena, California
- NY & NJ Port Authority
- Brandon, Florida
- Atlanta, Georgia
- Portland, Oregon
- Eugene, Oregon
- Seattle, Washington
- Denver, Colorado
- Casper, Wyoming
- Alexandria, Virginia
- Baltimore, Maryland
- Gainesville, Florida
- Evansville, Indiana
- Salt Lake City, Utah
- Sioux City, Iowa
- Albuquerque, New Mexico
- Minneapolis, Minnesota
- Burlington, Ontario
- Ottawa, Ontario
- Quebec City, Quebec
- San Jose, California

Realization of an effective traffic control system is a relatively complex process. The perceived needs of the user are diverse and there are numerous activities required from project inception to a fully operational system. JHK & Associates' personnel have been involved in all of these activities. The Firm's experience for selected projects is summarized on Exhibit F-1. These activities cover the following areas of specialization:

LOCATION	NUMBER OF SIGNALIZED INTERSECTIONS		CONTRACT SCOPE OR TASKS														
	Initial	Expanded	SYSTEM REQUIREMENT ANALYSIS	ALTERNATIVE ANALYSIS	DEVELOP IMPLEMENTATION PROGRAM	SYSTEM DESIGN	PLANS, SPECIFICATIONS AND ESTIMATE	HARDWARE DESIGN	SOFTWARE DESIGN	SOFTWARE DEVELOPMENT	SOFTWARE TESTING	BIDDER PREQUALIFICATION & BID EVALUATION	INSTALLATION SUPERVISION	DOCUMENTATION	TRAINING	SYSTEM ACCEPTANCE TESTING	SYSTEM EVALUATION
Alexandria, Virginia	120	260	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Atlanta, Georgia	350	800							●	●	●		●	●	●		●
Baltimore, Maryland	900	1200	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Brooklyn-Bronx-Queens, New York	1400	5400									●		●	●			○
Burlington Skyway, Ontario	*	*	●	●	●	●			●	●	●			●	●	●	○
Casper, Wyoming	60	255	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○
Denver, Colorado Ramp Metering	*	*							●	●	●		●	●	●	●	○
Evansville, Indiana	170	260			●	●	●	●	●		●	●	●	●	●	●	●
Eugene-Springfield, Oregon	150	200	●	●	●	●	●	●	●	●	●	○	○	●	●	●	○
Grand Rapids, Michigan	270	400	●	●	●	●	●	●			●	●	●	●	●	●	●
Greensboro, North Carolina	160	300	●	●	●	●	●				●	●	●	●	●	●	●
Hartford, Connecticut	90	256	●	●	●	●	●	●	◐	◐	○	○	○	○	○	○	○
Howard Frankland Bridge, Florida	*	*							●	●	●	●	●	●	●	●	
Jacksonville, Florida	143	256						●	●	●	○			○	○	○	
Los Angeles, California	200	600	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○
Mesa-Tempe, Arizona	210	400	●	●	●	●	●		●								
Minneapolis, Minnesota	660	860	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Ottawa-Carleton and Hull, Ontario	400	600					●		●	●	●			●	●	●	
Phoenix, Arizona	260	410	●	●	●	●	●		●		●	●	●	●	●	●	●
Portland, Oregon	200	600	●	●	●	●	●	●	●	●	●	○	○	●	●	●	○
Raleigh, North Carolina	160	260	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Route 44, Connecticut	40	260	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Salt Lake City, Utah	120	260	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Scottsdale, Arizona	60	100	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Sioux City, Iowa	70	160	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Taipei, Taiwan	112	112	●	●													●
Tampa, Florida	119	750							●	●	●	●	●	●	●	●	
Tucson, Arizona	130	260	●	●	●	●	●	●	●		●	●	●	●	●	●	●
Tucson, Arizona Retrofit	14	14					●	●	●	●	●			●	●	●	
Washington, DC	1260	1600	●	●	●												

LEGEND

● TASK COMPLETED BY JHK & ASSOCIATES
◐ TASK IN PROGRESS
○ TASK TO BE PERFORMED BY JHK & ASSOCIATES
* FREEWAY SURVEILLANCE AND CONTROL SYSTEM

EXHIBIT F-1 SUMMARY OF REPRESENTATIVE TRAFFIC CONTROL PROJECTS

System Concept

Frequently, a traffic control system project undertaken by JHK & Associates began with a System Concept Study to define an effective program to increase the efficiency of the transportation network. Elements of the study include defining existing and future conditions, defining system requirements, developing alternative traffic control systems to meet the requirements, evaluating alternative systems and selecting the most cost effective approach, and defining an implementation plan.

System Design

The Firm has performed traffic control system design studies for numerous public agencies. These systems range from small arterial traffic signal systems to large metropolitan areawide surveillance and control systems. Tasks performed included:

- Specifications - JHK & Associates has prepared specifications for many computerized traffic control systems and has advanced hardware and software state-of-the-art. The approach used by JHK has been to design system components to meet the unique requirements of the user taking maximum advantage of available elements. Exhibit F-2 presents examples of the major system components for various projects.

- Plans - The Firm has prepared detailed construction plans for major computerized signal systems, signal modernization, and new signal installations. This work has been accomplished using existing standards and procedures supplemented as required to fully define the work.

- Bidder Qualification - The JHK & Associates staff has reviewed and prequalified bidders for numerous major traffic control system projects. The prequalification of bidders has included detailed review and certification of design proposals from numerous vendors, including TRW, SDC, Econolite Computran, Sperry Rand, Honeywell, CSE, Eagle, Multisonics, Philips, Siemens, GECX-Eliott, TRT-Serets, and Sumitomo.

EXHIBIT F-2 SYSTEM COMPONENT CONFIGURATIONS

LOCATION	COMPUTER	COMMUNICATIONS	CONTROLLER
Baltimore, Maryland	(4) Modcomp II/20 (2) Modcomp IV/25	City Owned - 1200 Baud TDM	New (Microprocessor)
Phoenix, Arizona	Modcomp II/20	Telephone 300 Baud TDM	Modify Existing
Raleigh, No. Carolina	Interdata Model 70	Telephone-D.C.	New (Off-the-Shelf)
Greensboro, No. Carolina	Honeywell H716	City Owned - 1200 Baud TDM	New (Interval Type Controller)
Tucson, Arizona	DUAL Modcomp II/20, Modcomp Classic 7840	Telephone & City Owned 300/1800 Baud TDM	Modify Existing & Type 170
Ottawa-Hull, Canada	Honeywell H716	Telephone 1200 Baud TDM	Modify Existing
Minneapolis, Minnesota	(2) Modcomp IV	City Owned - 1200 Baud TDM	Modify Existing
Sioux City, Iowa	Modcomp Classic 7835	City Owned - 1200 Baud TDM	Modify Existing and New NEMA
Evansville, Indiana	Modcomp Classic 7830	City Owned - 300/1200 Baud TDM	Modify Existing and New NEMA
Alexandria, Virginia	Perkin-Elmer 832	City Owned - 1200 Baud TDM	New Pretimed and NEMA
Grand Rapids, Michigan	Perkin-Elmer 3220	Lease CCTV Broadband	Modify Existing and New NEMA
Howard Frankland Bridge, Florida	Modcomp Classic 7810	Radio, State Owned Broadband, 1200 Baud TDM	Modify Existing and Special Sign Controllers
Los Angeles, California	Host/Area Computer Networked System 3 - Perkin-Elmer 3230	City Owned 1200 Baud TDM & Fiber Optics	Type 170
Denver Ramp Control, Colorado	DEC VAX 11/750	Telephone 1200 Baud TDM	Type 170

EXHIBIT F-2 (continued) - SYSTEM COMPONENT CONFIGURATIONS

SITE	COMPUTER	COMMUNICATIONS	CONTROLLER
Route 44, Connecticut	Perkin-Elmer 3220	State Owned - 1200 Baud TDM	Modify Existing
Brooklyn-Bronx-Queens, New York	9 - IBM 1800's 1 - IBM 4341	Telephone D.C.	Modify Existing
Casper, Wyoming	SEL-Gould 32/27	Leased CCTV Broadband	Modify Existing
Tampa, Florida	Perkin-Elmer 3210	City Owned - 1200 Baud TDM	New NEMA and Modify Existing
Burlington Skyway Surv. & Control	DEC VAX 11/750	Province Owner Coax-Cable	Type 170 and Special
Jacksonville, Florida	2 - Perkin-Elmer 3210	Broadband City Owned	New NEMA and Modify Existing
Ottawa-Carleton, Canada	Perkin-Elmer 3210	Leased Telephone Lines	Nova Solid State Pre-Timed
Anaheim, California	Concurrent Computer Corp. 3212	City Owned - 1200 Baud	Type 170
Chula Vista, California	DEC MicroVax II	Leased Telephone Lines	Type 170
Eugene-Springfield, Oregon	DEC MicroVax II	City Owned - 1200 Baud	Type 170
Hartford, Connecticut	Concurrent Computer Corp. 3212	City Owned - 1200 Baud	NEMA and Pre-Timed e-m
Portland, Oregon	Concurrent Computer Corp. 3212	City Owned - 1200 Baud	Type 170

Implementation Assistance

JHK & Associates is serving, or has served, as technical inspector and advisor during system construction. In this capacity, the Firm acts as an extension of the agencies' staff or as the resident engineer, as required by the client. The work generally included technical monitoring, software inspection, developing system timing parameters, data base development, staff training, and on-site problem solving. JHK & Associates' level of participation during implementation has been tailored to meet the needs of client. This has included providing "over-the-shoulder" technical consulting and "hands-on" installation.

System Management and Construction Engineering

JHK & Associates has provided additional services during implementation as systems manager and/or construction engineer. As an example, the Firm has installed computerized traffic signal systems using software based on the Extended Version of UTCS, the Enhanced Version of UTCS, and software developed from the ground up. The Firm provided all systems installation services in Sioux City, Tucson, and Tampa, including hardware integration, computer procurement, construction engineering, field hardware service, system timing, training, documentation, and acceptance testing. Construction engineering management services have also been provided by the Firm.

Evaluation

JHK & Associates has completed contracts for the Federal Highway Administration to evaluate the UTCS/Bus Priority System in Washington, D.C. and in New Orleans. The Firm has also evaluated computer control systems in Phoenix, Tucson, Raleigh, Greensboro, Minneapolis, and Taipei, Taiwan.

Operations

In addition to the Firm's extensive involvement in the design, implementation, and evaluation of traffic control systems, JHK & Associates has provided assistance to users of operational systems. This includes: developing procedures for relocation of the computer center; assessing the impact of expanding system features; evaluating operating procedures and system capabilities; developing programs for system enhancement; and updating signal timing and data bases. In addition, the Firm provides the management and operation skills necessary for the full time operation of traffic control centers. JHK operates the Integrated Motorist Information System on Long Island seven days a week, 24 hours per day.

SUMMARY OF RELEVANT TRAFFIC CONTROL SYSTEMS

Listed below are brief summaries of a cross-section of representative projects undertaken by JHK & Associates. These summaries include various studies which are related to the issues to be investigated in this project as well as major traffic control systems which have been developed or are currently under development by JHK.

- "Smart Corridor" Demonstration: JHK is the prime consultant for the Smart Corridor Demonstration project to develop an integrated and coordinated traffic control system for the Santa Monica freeway and adjacent surface streets in Los Angeles, California. Elements to be considered during the conduct of the study include incident detection, route diversion, coordination of traffic signals and ramp meters, CCTV and variable message signs on freeway and surface streets, emergency response teams and roving service trucks, telephone call-in line, traffic advisory radio station, traffic information on public access channels of cable TV, in-vehicle navigation systems, CB radio, and similar technologies. Other elements include coordination between the various agencies, data sharing between adjacent traffic control systems, and the necessary communications subsystem to support the various elements.

- California State Wide Smart Corridor: JHK is completing a project for Caltrans to study the feasibility, and to develop preliminary costs for, developing Smart Corridors in various locations in the major metropolitan regions of California. Corridors studied are located in the Los Angeles, San Diego, Sacramento, and San Francisco Bay Area regions (Caltrans Districts 3, 4, 7, 8, 11, and 12).

- Anaheim/Caltrans Intertie Project: JHK is conducting a project for the City of Anaheim to provide an intertie between the Anaheim Traffic management Center and the Caltrans District 7 and District 12 Traffic Operations Centers. Completion of the intertie will provide coordination and communications between the Anaheim control center and the Caltrans Traffic Operations Centers.

- Pathfinder: For the Pathfinder Project, JHK is serving as a subconsultant for the development of the experimental design and as the prime consultant for the conduct of the Pathfinder evaluation study.

- Pasadena Signal System: For the City of Pasadena, JHK is serving as Systems Manager to design and implement a computerized traffic signal system. The system will control approximately 270 traffic signals. The design includes a new City-owned twisted pair communications network and the installation of about 200 Type 170 traffic signal controllers.

- Communications in Traffic Control Systems: JHK has recently completed this FHWA research project to assess the performance of existing and new/emerging communications technologies for use in traffic control systems. This report includes detailed discussions of several communication technologies (e.g., twisted-pair, coax, fiber-optics, microwave, radio, leased Telco) as they apply to the requirements of computer-based traffic control systems. Guidelines for analyzing and selecting the "best" technology for a particular system are also presented.

- Burlington Skyway Surveillance and Control System: This work included the development of a communications concept for the system, development of systems operations requirements, preparation of the traffic applications software and systems integration, training, and operational support. The project included the use of loop detectors for incident detection, coaxial cable communications, CCTV, changeable message signs, highway advisory radio, and provision for future ramp metering. The project resulted in the successful implementation of a sophisticated traffic surveillance and control and driver information system for a segment of the Queen Elizabeth Way near Hamilton, Ontario.

- Howard Frankland Bridge Surveillance and Control System: This project implemented a complete freeway surveillance and control system for the major freeway crossing of Tampa Bay and the approach roadways. The project included CCTV, coaxial broadband radio, digital communications, changeable message signs, motorist call boxes, incident detection, route diversion, and traffic signal control. JHK prepared the software for the system, procured central hardware, integrated the hardware and software system, and provided traffic engineering support for system operation.

- San Francisco Traffic Operations Center: JHK Conducted a comprehensive pre-design study covering 216 miles of freeway in the San Francisco Bay Area. A new traffic operations center was recommended jointly operated by Caltrans and the California Highway Patrol. The project includes the new traffic operations center, areawide incident detection, ramp metering, CCTV, changeable message signs, continuous highway advisory radio coverage, local option call boxes, centralized planning for special events, construction and maintenance traffic mitigation, an extension of motorist services beyond the toll bridges, and system communications.

- Denver Ramp Metering: JHK served as prime contractor for the installation of a centralized ramp metering control and data acquisition system covering portions of I-25 and I-225 in Denver, Colorado. JHK developed the software for the system, procured central control equipment, had the ramp metering signals installed, provided all contract software for the system, procured central control equipment, and provided all integration services.

- Integrated Motorist Information System (IMIS): This surveillance and control system which is operated by JHK covers a 40-mile corridor on Long Island, New York, and includes two freeways and a surface arterial highway. JHK provides 24 hour per day, seven days a week operation and supervises the maintenance of system hardware.

- Sioux City Signal System Retrofit: JHK is nearing completion of this system retrofit. JHK's responsibilities included software development, procurement of the central computer, detailed design and procurement of field communications hardware, development of communications firmware, and integration of the various hardware and software elements.

- Guidelines for Successful Traffic Control Systems: JHK has just finished this project for the Federal Highway Administration, resulting in the development of guidelines for the planning, design, implementation, and operations and maintenance of successful traffic control systems. The guidelines pertain to both freeway systems and traffic signal systems. Information for developing the guidelines was obtained from in-depth case study evaluations of operating systems, including freeway systems in Northern Virginia, Detroit, and Chicago.

- I-90 Tunnel Control System: This work nearing completion for Washington State DOT includes the development of a computer-based control system for control of traffic in the Mt. Baker Ridge and First Hill lidded tunnels which are currently under construction on I-90 in Seattle. The project includes the development of system requirements, integration with the tunnel environmental and safety systems, preparation of system software for control and operator interface, and providing assistance during system installation and integration.

- Raleigh Signal System Evaluation and Design Study: JHK recently completed a study to evaluate the City's computerized traffic signal system, to define the improvements to the system that are needed, and to develop an implementation plan to modernize the system. The study recommendations were to expand the system from its current size of 140 plus signals in the CBD to almost 350 signals to provide coordination and monitoring of signals on the arterial streets and outlying areas. The study findings also were to replace the computer and communications equipment, and the traffic signal controllers within the CBD.

  JHK is currently under contract to design the new system and to prepare the plans, specifications and estimate such that North Carolina DOT can let a contract for construction of the modernized system.

- Greensboro Signal System Evaluation and Implementation Project: JHK conducted an evaluation of the City of Greensboro's computerized traffic signal system. Greensboro has a Honeywell signal system that has reached its capacity. The study recommendations were to replace the computer, communications hardware, and all non-NEMA traffic signal controllers. Also, the study findings were to supplement several communications cable runs and to replace the underground cable serving traffic signals in the CBD and an underground trunk cable.

  JHK is currently under contract as a Systems Manager to develop the plans and specifications for the field construction work that will be let by North Carolina DOT, and has developed the computer hardware configuration, including workstations, for acquisition by the City. JHK will modify and implement Series 2000 software for initial control of 276 traffic signals.

- Charlotte Signal System Modernization: For the City of Charlotte, JHK conducted a study to evaluate their ageing computerized traffic signal system. The system uses the UTCS Extended version software that has been tailored for Charlotte. The study findings were to replace the computer and central communications unit with a DEC MicroVAX as the host computer and a VME based communications processor. JHK was given the responsibility of porting the software to the new computer environment and assisting with the changeover from the old computer system to the new one.

- Cedar Rapids Signal System Improvement Project: JHK was retained by the City of Cedar Rapids to evaluate their ten year old Eagle COMTRAC traffic signal system and to provide engineering services to design and implement the study recommendations. JHK also developed new traffic signal timing plans during the implementation phase of the project. JHK recommended that the City upgrade the COMTRAC system by acquiring a new computer and the current software, with modifications for Cedar Rapids directly from Eagle Signal Company.

- Arlington County Signal System: Arlington County, Virginia commissioned JHK to evaluate their Sperry SRT 4000 computerized signal system to provide an interim upgrade to the system. JHK replaced the disk drives with larger capacity units, replaced the map display with a high-resolution color graphics system, and modified the hardware/software to provide for more users to access the system -- including users that are remote from the computer center.

- New York City, CATS Projects: JHK in under contract to develop a Computerized Area Tracking System for the City of New York. This major project covers the development of a computer-based color graphics software for providing critical traffic data for all boroughs. JHK is developing the system design, preparing hardware specifications and preparing all software tasks.

PROJECT DESCRIPTIONS

The following is a partial summary of related projects in which JHK & Associates has been involved. These amplify the material previously presented.

Investigation of Successful Communications and Traffic Control System Design, Installation and Operations

JHK & Associates conducted this research study for the Federal Highway Administration, which resulted in the development of procedural guidelines for the design and implementation of successful traffic signal systems and freeway surveillance and control projects. To develop the final guidelines, the Project Team developed a preliminary set of guidelines based on previously published FHWA documents and project reports. The team visited six signal system sites and three freeway control operations, and developed case studies on how each agency designed and procured their field and computer hardware and software, and how their procedures affected the overall success of the system. A final report entitled "Guidelines for Successful Traffic Control Systems" has been prepared.

Another element of the research effort was to assess the performance of existing and new (or emerging) communication technologies for use in traffic control systems. Technologies addressed include twisted-pair cable, coax, leased circuits, fiber optics, and various forms of air-path media (radio, microwave). The final report, entitled "Communications in Traffic Control Systems", provides useful information for analyzing

alternative communication subsystems, selecting the most cost-effective technology, and communication design considerations.

Client: FHWA
Contact: Jeffrey A. Lindley Phone: (703) 285-2408 1988

Operation of Integrated Motorist System (IMIS)

JHK & Associates is under contract to the State of New York, Department of Transportation, to provide 24 hour per day, seven days per week operation of the IMIS system. The IMIS system includes metering at 66 freeway entrance ramps to assist in maintaining the smooth flow on the limited access highways, 74 changeable message signs to provide route selection information, 100 traffic signals along surface streets, and 2300 traffic sensors to identify congestion and incidents. Primary roadways included in the system are the Long Island Expressway, Northern State Parkway, and Jericho Turnpike, with several of the north-south connectors between these facilities being covered. In addition to operating the system, JHK is developing standard operation manuals, and providing traffic engineering and technical support during the critical first 22 months of IMIS operation.

Client: New York Department of Transportation
Contact: Joseph Contegni Phone: (516) 360-6781 Ongoing

San Jose, California Traffic Control System

JHK & Associates conducted a comprehensive study to determine the most appropriate traffic control system or systems to be employed throughout the City of San Jose, California for approximately 600 signals. The project evaluation and final recommendations included a detailed description of the type of system to be utilized, the number of signals to be included initially, the maximum size for future expansion, the capability to record traffic flow information, the ability to monitor signal controllers, detectors and lamps, a conceptual design of a Traffic Management Center, replacement of many of the existing traffic signal controllers and cabinets, additions in the number of staff assigned to traffic signal related engineering and maintenance as well as a description of their activities, a multi-year implementation plan, and the estimated benefits and costs of the overall program.

Client: City of San Jose, California
Contact: Mr. James Helmer Phone: (408) 277-4304 1989

New York City Computer Signal System Expansion

JHK & Associates served as systems manager to bring 1,400 signalized intersections in Bronx, Brooklyn, and Queens on-line using the City's existing IBM 1800 computers. An electrical contractor provided and installed communications units in existing traffic signal controller cabinets. The telephone company provided leased lines to each intersection. JHK's responsibility was to inspect and test all facilities provided by both, and

then to integrate the systems. Nine IBM 1800 area computers were reconfigured by JHK to control approximately 5,000 intersections. Approximately 1,500 intersections were controlled by computer prior to JHK beginning work. These were transferred to the reconfigured systems, and 1400 intersections were being added by JHK. Complete system documentation was also provided.

Client: State of New York
Contact: Mr. Raman Patel Phone: (718) 830-7526 1987

Greensboro Signal System and Design Study

A study of the City's traffic signal system was conducted to evaluate the existing computerized traffic signal system and to recommend a replacement system which best suited the City's needs. The study included investigation of the existing cable network, remote communications units, and central software and hardware to determine the feasibility of their use in the proposed system.

A preliminary System Design Report was prepared presented which a concise description of the requirements and components of the replacement system to control 276 signals initially with expansion.

JHK is currently conducting the design and development of plans and specifications for the field components of the system. This work includes preparation of plans for the replacement of local controllers, the installation of communications cable for new intersections to be added to the system, and the installation of new remote communications units.

Client: City of Greensboro
Contact: Mr. Harvey Winstead Phone: (919) 373-2332 Ongoing

Pasadena Areawide Traffic Control System

JHK & Associates is currently serving as System Manager for the design and installation of a new City-wide traffic control system for the City of Pasadena, California. The project is based on a feasibility study completed by the Firm as Phase 1 of the project. The project includes central computer control of all 270 signalized intersections in the City; installation of a new twisted wire pair communications system in existing conduit for the majority of the City, with limited use of leased telephone lines to outlying locations; replacement of approximately 220 local controllers with new California Model 170 controllers; installation of a new traffic control center in City Hall; intertie between the system and the California Department of Transportation traffic operations center in downtown Los Angeles; installation of close circuit television at approximately 5 locations; and the installation of changeable message signs at selected locations on the City street network.

The system management work includes complete pre-design and design of the system components; the preparation of bid packages for the various items of work; furnishing the central communications and control hardware and software; furnishing the color graphics display hardware and software for the central control room and remote workstations; construction inspection; training of City staff; and system documentation. The project is to be installed under a "fast track" program to obligate special funds received from the Los Angeles County Transportation Commission and is to be operational prior to the 1991 Rose Bowl Festival.

Client:	City of Pasadena, California		
Contact:	Mr. Jim Valentine Principal Engineer	Phone: 818/405-4265	Ongoing

Raleigh Signal System Evaluation and Design Study

JHK & Associates performed a study for the City of Raleigh to evaluate their computerized traffic signal system. The study included a review of the City's existing computer system that controllers traffic signals in the CBD and arterial signal systems. The study resulted in an implementation plan to upgrade or replace the systems. A utility/cost methodology was used for the study. Short and long term system requirements were defined, communications alternatives were defined, and an investigation of staffing requirements was made. The study included an investigation of the need and feasibility of expanding computer control of signals in the outlying areas.

Client:	City of Raleigh		
Contact:	Mr. Carl Dawson	Phone: (919) 890-3430	Ongoing

Jackson Signal System Evaluation

JHK was retained to perform a Feasibility Study for the City of Jackson. The purpose of the project was to determine the feasibility of up-grading the City's existing hardwire interconnected system to a micro-computer based distributed master system or a computer based central master system. The study included the determination of system requirements and objectives, analysis of communications alternatives, staffing requirements, and the need for auxiliary functions. The study recommended the optimum system configuration for the City of Jackson was a distributed master system and estimated costs. The evaluation utilized a utility/cost methodology.

Client:	City of Jackson, Mississippi		
Contact:	Mr. Dwight L. Fox	Phone: (601) 960-1651	1988

Chula Vista Traffic Control System

JHK is serving as System Manager for the design and implementation of a traffic signal control system in the City of Chula Vista. The system will utilize the UTCS-based Series 2000 software developed by JHK and will include high resolution PC-based color

graphics. The project includes the replacement of existing local controllers with Type 170 controllers. Communications will utilize leased telephone lines.

JHK developed PS&E for a competitive bid for the replacement of controllers, the construction of conduit to the telephone drops, and the installation of system detectors. JHK developed a detailed description of the central computing and communications equipment required for this project. Equipment procurement was carried out by JHK through direct quotation, costed proposal and existing City purchasing agreements. JHK is responsible for complete system integration including final termination and testing of the communications network, traffic signal timing plan generation, data base development and staff training.

Client: City of Chula Vista, California
Contact: Mr. Tom Garibay Phone: (619) 295-2248 Ongoing

Eugene and Springfield, Oregon Traffic Control Systems

JHK served as System Manager for the design and implementation of traffic signal control systems in the cities of Eugene and Springfield, Oregon. The systems utilize the Series 2000 software developed by JHK and include high resolution, PC-based color graphics. The project included the replacement of existing local traffic signal controllers with Type 170 controllers and the installation of new city-owned interconnect cable.

JHK worked with the cities to develop PS&E for competitive bids for the replacement of signal controllers and the construction of the new cable network. JHK developed a detailed description and coordinated the procurement of the central computer and communications equipment. JHK was responsible for complete system integration including final termination and testing of the communications network, timing plan generation, data base development and staff training.

Client: City of Eugene, Oregon
City of Springfield, Oregon
Contact: Mr. John Emmons Phone: (503) 687-5128 1988

Hartford Signal System

JHK & Associates assisted the City of Hartford in the implementation of a computer based traffic signal control system. This implementation resulted from a preliminary engineering study and the preparation of plans, specifications, and estimates by JHK.

The preliminary engineering study resulted in a detailed functional description and cost estimate of a computerized signal system specifically tailored to meet the present and future traffic demands of Hartford. Based on the results of this study, JHK developed several construction contracts for procurement of equipment and installation services. JHK provided the traffic applications software utilizing the UTCS Extended baseline software

package. JHK provided the technology for hardware integration and developed and implemented the system signal timing plans.

Client: City of Hartford, Connecticut
Contact: Mr. John Burke Phone: (203) 722-6170 1988

Atlanta Computerized Traffic Control System

The Atlanta Traffic Control System utilizes Sperry SRT 4000 software running on a Perkin-Elmer 3220 minicomputer in a dual-processor configuration with an Interdata Model 70 minicomputer. JHK's task was to expand the control system to control 62 additional intersections. Included in this expansion was the replacement of controllers and detectors, additions to the communications hardware, and enhancement of display facilities by replacement of the map display by a computer based graphics subsystem. Modifications to the central communications equipment included increasing total capacity by 62 intersections while providing equipment for a ten percent spare capacity. All necessary changes to the system software and data base, to accomplish the required expansion of capabilities, were performed by JHK & Associates.

Client: City of Atlanta, Georgia
Contact: Mr. Howard Harris Phone: (404) 330-7025 1986

Fluer Drive Signal System Study

JHK & Associates conducted a study for the City of Des Moines, Iowa, to determine the feasibility of coordinating traffic signals along Fluer Drive and Army Post Road. The objective of the study was to provide more flexible traffic signal control which would reduce delay and increase the safety and capacity of the existing street network.

Six alternative system configurations were evaluated, and plans and specifications were developed for the selected system. In addition to the design of system components, display, phasing, and roadway changes were recommended at several of the locations.

Of particular interest was the development, by JHK, of a screening detection strategy for protective-permissive left turn phases. Using the assumption that at least two vehicles may turn left on the permissive phase's clearance interval, turn lane detectors were configured to call the left turn phase only when more than two vehicles were queued in the left turn lane.

Client: City of Des Moines
Contact: Mr. James Thompson Phone: (515) 283-4973 1984

Norwalk Signal System

JHK & Associates completed a corridor study and system evaluation for the City of Norwalk.

The purpose of the project was twofold: to evaluate the City's existing computerized system and recommend a signal system which will provide the necessary coordination and flexibility for future growth; and, to investigate and recommend geometric changes and other modifications to intersections and roadway links for improving the capacity and traffic flow along the East Avenue and West Avenue corridors.

The system analysis consisted of evaluating the City's existing system as compared to other state-of-the-art systems. The evaluation focused on the system needs of these corridors a City-wide requirements. A closed-loop system was recommended and, a functional specifications for a competitive procurement were prepared.

Client: City of Norwalk, Connecticut
Contact: Mr. Martin Overton Phone: (203) 854-7797 1988

Anaheim Traffic Signal and Motorist Information System

JHK & Associates is serving as System Manager for the implementation of a traffic signal control system for the City of Anaheim. The project covers centralized control of traffic signals and variable message signs to provide a coordinated traffic management system. The control system uses the Enhanced Version of the UTCS software and new software for sign control. The sign and signal control software will be integrated to provide a single user interface, schedule, display, and data base system. This will allow traffic control plans to be prepared for implementation that provides both changes in signal timing and sign messages. The control center includes provisions for two systems operators and a police dispatch and control position. Closed circuit television is also provided as part of the system.

The system is designed to cover 350 traffic signals and 30 changeable message signs. Initial implementation covers approximately 125 traffic signals. Communications is via City owned twisted wire pair network using time division multiplexing and the integral communications capabilities of the local traffic signal controllers.

In addition to the unique combination of elements of control on the City streets, the system is designed to interface with the California Department of Transportation (Caltrans). Direct ties will be provide to the Caltrans Traffic Operations Center and to the local District office for Orange County. System graphics and report data will be transmitted between systems to allow for increased coordination of responses to traffic conditions.

Client: City of Anaheim, California
Contact: Mr. Donald Dey Phone: (714) 999-5183 Ongoing

I-595 Corridor Study

This project, conducted for the Virginia Department of Highways and Transportation (VDH&T), involved traffic forecasting, geometric design, alternatives review, alternatives evaluation, and development of a recommended plan for improving a highly

congested corridor in Crystal City, near Washington, D.C. Public hearings were included to attempt to achieve consensus on a development plan. The work by JHK was in response to a court injunction against VDH&T. The recommended plan has been accepted by the local jurisdiction.

Additional projects involved a 21 mile sections of Interstate 95 in Northern Virginia where alternatives were developed for extending HOV facilities. Geometric design, ramp locations, and operating concepts developed by JHK are currently under design for construction of the first 12 miles of the extension. JHK also conducted the feasibility analysis for the toll road leading to Dulles International Airport. The facility is now open and is meeting or exceeding the forecasts developed by the firm.

Client: Virginia Department of Highways and Transportation
Contact: Richard C. Lockwood Phone: (804) 270-4315 1985

I-66/I-395 Traffic Management Studies

These projects were also conducted for VDH&T and covered approximately 25 miles of urban freeways in Northern Virginia. The I-395 project included minor geometric improvement to balance the network capacity as well as a major freeway management system. The I-66 project dealt primarily with operational plans for the facility so that they could be integrated with the overall construction work. The work was mandated by the Secretary of Transportation prior to approving the construction budget for this 12 mile section of interstate highway. JHK's report was accepted, funding was released and the improvements were constructed.

Client: Virginia Department of Highways and Transportation
Contact: C. D. Hall Phone: (804) 270-4315 1984

San Francisco Bay Area Traffic Operation Center

JHK & Associates conducted a comprehensive pre-design study covering 216 miles of freeway in the San Francisco Bay area. The network included the busiest sections of freeway plus 6 major bridge crossings of the Bay and Sacramento River. A new traffic operations center (TOC) was recommended with operation by Caltrans and the California Highway Patrol. The project, estimated a $72 million in current dollars, includes the new TOC; areawide incident detection; ramp metering at approximately 400 locations; CCTV at 140 locations; 55 changeable message signs; continuous coverage by a highway advisory radio system; local option call boxes; centralized planning for special events, and an extension of motorist services beyond the toll bridges.

The project also included a review of communications requirements and central system configuration. A distributed procession alternative was recommended using Type 170 controllers, area communications and control hubs, and central supervision and operator interface. The recommended communications concept uses fiber-optics trunking

and coaxial cable hub area networks. A requirements workshop was conducted at an initial stage of the project to provide technical focus to the work.

Client: California Department of Transportation
Contact: Ethlyn A. (Ann) Hansen Phone: (415) 557-2907 1988

Howard Frankland Bridge Surveillance and Control System

JHK & Associates provided systems hardware and software for all control aspects of this major surveillance and control system. The Howard Frankland Bridge is a four-lane divided bridge crossing the bay between Tampa and St. Petersburg, Florida. Incidents on the bridge cause extreme congestion and delay. Only one significant alternative route exists.

The project involved installation of a detection system to identify incidents on the bridge or approaches; closed circuit television cameras (automatically turned on by the system) for identification of the nature of the incidents; changeable message and lane control signs to alert motorists and provide direct traffic control; a route diversion signing and control system to divert motorists to the alternative bridge; and traffic signal control to support the route diversion actions. The communications schemes include radio, broadband coaxial, and time division multiplex over a user owned cable. The control of the system is accomplished by a 128 KB MODCOMP Classic computer located in the Highway Patrol offices.

JHK was fully responsible for furnishing and installing master control hardware; developing and testing the system software; traffic engineering and system calibration; and, hardware integration to insure overall system performance. Three different incident detection algorithms were implemented in parallel to provide for additional responsiveness to specific conditions experienced on the bridge.

Client: State of Florida Department of Transportation
Contact: Jack Brown Phone: (904) 488-4284 1983

Los Angeles Area Traffic Control and Surveillance Project

JHK & Associates is serving as System Manager for the design and installation of the Los Angeles Area Traffic Surveillance and Control project (ATSAC). The project is to serve as the basis for a program for complete computer-based traffic control in Los Angeles. The project covers an area with over 1,600 signalized intersections. The system concept utilizes area master computers and a supervisory computer. All local controllers are being replaced with Type 170 microprocessor equipment. Communications within each area is via dedicated telephone type cable using 1,200 baud FSK modems. Between the master site and remote areas, fiber-optics and microwave links are used or to be used.

Stage 1 of the project is complete. This stage covers 247 signalized intersections and a total budget of $12,150,000. JHK provided design services and furnished color-graphics and test hardware, prepared software for the area computers using the UTCS

Enhanced Version software, inspecting controllers and the communications system, providing all technical supervision, and performed system integration.

Client: City of Los Angeles, California
Contact: Mr. S. E. Rowe Phone: (213) 485-4281 Ongoing

I-95 HOV Study, Palm Beach County

JHK is subcontractor on this major project to examine alternatives and design concepts for the reconstruction of I-95 in Palm Beach County, including possible accommodations for high occupancy vehicles. JHK's role was to develop the long-range traffic forecasts and the design traffic volumes for five cross-section alternatives on I-95. Interchange volume forecasts and capacity analyses have also been conducted. In addition, traffic operational analyses are being conducted of interchange designs using TRANSYT-7F and other analytical tools.

Client: FDOT District 4
Contact: Rich Pierera Phone: (305) 524-8621 Ongoing

Capital Beltway, Washington, D.C.

JHK is completing a major alternatives analysis and operational analysis of the Capital Beltway (I-95/495) in Northern Virginia. The roadway is the major circumferential freeway in the Washington Metropolitan area. JHK investigated both long-term and short-term mainline and interchange design concepts to accommodate volumes into the 21st Century. The alternatives were based on traffic volume forecasts developed using JHK's SYSTEM II travel demand forecasting system. Traffic operational alternatives included freeway surveillance and control elements, motorist information, tow truck and service patrol improvements, and accident investigation sites.

Client: Virginia DOT
Contact: Phil Hopkins Phone: (804) 786-2985 Ongoing

I-95 HOV Lane Extension Study, Virginia

JHK conducted an alternatives analysis for approximately 20 miles of I-95/395 in Northern Virginia. The project focussed on the extension of the highly successful Shirley Highway HOV lanes further south. JHK conducted all phases of this study, including traffic demand estimation, alternatives development, functional geometric design, operational simulation modelling, public involvement, and reports.

Client: Virginia DOT
Contact: Dick Lockwood Phone: (804) 786-2985 1984

Analysis of Complex Congested Corridor

JHK is under contract to the Federal Highway Administration to conduct a major research project entitled "Analysis of Complex Congested Corridor Locations." The objectives of the study are to:

> Analyze real-world, complex congested freeway locations to assess the relative costs, benefits and effectiveness of a wide range of potential alternative solutions for improving traffic flow in the corridor. The type of potential solutions will generally fall into three categories:
>
> Compare and contrast the performance of various computerized analysis tools (e.g. microscopic and macroscopic freeway simulation models and the 1985 Highway Capacity Manual) in replicating and analyzing complex congested freeway and corridor locations.

Case study investigations are being conducted at a total of six sites with complex corridor freeway congestion problems. Sites include I-5 in Seattle, the George Washington Bridge/Cross Bronx Expressway Corridor in New York, I-94 in Milwaukee, I-494 in Minneapolis, I-70/71 in Columbus, and I-880 in San Francisco. A wide range of alternative solutions are being evaluated for effectiveness in solving existing congestion problems such as providing additional capacity, managing existing capacity, and making low-cost geometric improvements. A preferred solution is being recommended for each site.

The Federal Highway Administration (FHWA) plans to use the results of this research as a means of disseminating information on successful freeway traffic management techniques and analysis tools to planners and engineers needing guidance in selecting an effective means of combating urban congestion in freeway corridors.

Client:	FHWA and Six State Agencies		
Contact:	Jeff Lindley	Phone (703) 285-2408	Ongoing

Tucson Transportation Corridor Project

A broad investigation into alternative surface transportation improvements is being conducted for the metropolitan area of Tucson, Arizona. The project will result in detailed land use and travel forecasts to the year 2000 for a projected population of 700,000 or 800,000. The findings will be documented in a set of documents for each of three major travel corridors. The documents will be comprised of a location/preliminary engineering report, an environmental impact statement, and a summary report.

Specific areas of study in the project include: land use forecasts; travel demand forecasts; air quality measurement and analysis, noise measurement and forecasts; archeological surveys; biological, architectural, social, and economic impacts; community participation programs; transit options and impacts; preliminary engineering of alternative

alignments, including geometry, drainage, structures, and cross-section; and cost estimates of alternatives.

Generally, the alternatives in each corridor vary not only in location but also in configuration. One-way arterials, two-way arterials, expressways, grade separated major intersections, new alignments, and widening of existing arterials are the types of physical improvements being considered. Additionally, the impacts of varying levels of carpooling and transit are being reported.

The work is being conducted by JHK & Associates, in concert with the civil engineering firm of Marum and Marum, Inc. A multi-disciplinary team is being used to ensure that the environmental impact statements are well documented and fully developed.

Client: Arizona DOT
Contact: Robert Ohnleiter Phone: (602) 255-7562 Ongoing

I-95 Surveillance and Control System in Dade County

JHK is conducting a major study for FDOT District 6 to develop a master plan for a regional freeway surveillance and control system for Dade County and to conduct preliminary engineering work for a system on I-95 in the County. Alternative components of a possible system include variable message signs, video surveillance, loop detection, ramp metering, highway advisory radio, and other advanced technology communication and information components. A series of technical papers are being prepared to document the alternatives, and an evaluation of the alternatives is being conducted using freeway simulation modelling (FREQ) and cost-effectiveness analysis. An extensive set of interviews are being conducted with State and local officials, and a public information program is to be developed to communicate the information to the public.

Client: FDOT District 6
Contact: John Dovel Phone: (305) 238-0023 Ongoing

Gainesville Signal System

JHK & Associates assisted the Florida Department of Transportation and the City of Gainesville with the design and installation of a distributed ("closed-loop") computerized signal system for Gainesville. A state-of-the-art report on distributed systems was prepared. Final bid documents for system construction were prepared, submitted for advertising, and the system is now in successful operation. JHK also provided on-site construction engineering and inspection services during system installation and testing, and was responsible for the development of signal timing plans.

Client: FDOT District 2
Contact: F.M. Lynch Phone: (904) 752-3300 1988

Tampa Signal System

JHK & Associates served as the prime contractor for the development and installation of a computerized traffic signal control system in Tampa, Florida. The project, designed and supervised by the Florida Department of Transportation, involved the development of specialized traffic control software and the installation of central control equipment, communications cable, and detector and controller equipment.

System control is accomplished by a Perkin-Elmer 3210 computer located in the Tampa City Hall. The traffic applications software is based upon JHK's version of UTCS Extended software package which includes many enhancements over the baseline package. A system control console and three large map displays enhance operator interface with the system.

Communications between the central site and local intersections utilize time-division multiplexing techniques over city-owned, twisted pair cables. Local controller equipment is new NEMA type controllers plus existing solid-state and electro-mechanical controllers.

While the system is capable of controlling 256 intersections, 63 intersections were implemented in the first phase. JHK was also retained by FDOT for the design for an additional 115 intersections.

Client: FDOT Districts 1/7
Contact: Brian Bennett Phone: (813) 533-8161 1988

Lee County Feasibility Study

JHK & Associates was retained by the Florida Department of Transportation to conduct a justification and conceptual design study for the Lee County Urban Area, including the City of Fort Myers and the City of Cape Coral. Using a utility/cost methodology, the study determined system requirements, analyzed communications alternatives, and investigated staffing requirements. The study recommended the signal system configuration and estimated the costs.

Client: FDOT District 1
Contact: Brian Bennett Phone: (813) 533-8161 1989

Escambia County Signal System

JHK is under contract to the Florida Department of Transportation to design the signal system for Escambia County, Florida (Pensacola). The system is to be a distributed (closed-loop) system, for which JHK will develop plans, estimates and costs.

Client: FDOT District 3
Contact: Jimmy Bush Phone: (904) 638-0250 Ongoing

Florida Freeway Operations Study

JHK conducted the Urban Freeway Operations Study for the Florida DOT. The project involved working with state and local transportation and emergency service agencies in Jacksonville, Orlando and Tampa to develop strategies to address the congestion caused by accidents, spills, breakdowns, and other incidents blocking traffic. JHK conducted training for these interagency teams, provided documentation of recommendations, coordinated presentations from special speakers with hands-on experience in freeway management, and developed alternate route maps for use in incident preplanning.

Client: FDOT
Contact: Robert Freeman Phone: (904) 488-4284 1987

Capital Beltway (I-95/I-495) Conceptual Improvement Study

JHK & Associates is directing a project team which is developing short and long term operational and physical improvements for the Virginia portion of the Capital Beltway around Washington, D.C. This 15 month study is geared to increasing the capacity and improving the safety of this heavily traveled freeway which not only handles locally generated traffic but also serves as a link for long distance traffic along the eastern.

The work includes several major components. Existing conditions are being thoroughly inventoried and evaluated and short term improvements are being developed to address existing problems. Twenty year traffic forecasts have been made to determine the expected traffic growth in the corridor considering alternative development and transportation scenarios. From these forecasts, a long term conceptual improvement program have been developed which addresses ultimate Beltway needs in the 21st century.

A major element of the study is the preparation of a Freeway Management Plan. The plan includes procedures for incident detection, identification and removal; motorist information procedures and the development of a surveillance and control system including CCTV. Ramp metering will be analyzed as potential element of the system. JHK worked with VDOT to establish the freeway management team, and to develop a variety of incident management strategies (e.g. accident investigation sites and expanded service patrols).

Alternative improvement concepts include opportunities for HOV facilities and integrating HOV options with existing and proposed HOV facilities on I-395, I-66 and the proposed extension of the HOV lanes south on I-95.

Truck operations on the Beltway have also been evaluated and specific recommendations have been developed for truck operations. An operational plan is being prepared which addresses roadway and interchange lighting and guide signing for all approaches to the Beltway.

Several existing bottleneck areas including the Wilson Bridge/Route 1 interchange, the Capital Beltway/Shirley Highway interchange; the I-66/Capital Beltway Interchange and the closely spaced interchanges between Route 7 and the Dulles Access Road are being examined in more detail during the course of this project.

Client: Virginia DOT
Contact: Phil Hopkins Phone: (804) 786-2985 Ongoing

Los Angeles Smart Corridor

JHK completed a conceptual design study for the Los Angeles Smart Corridor. The Smart Corridor is a demonstration project being jointly sponsored by the City of Los Angeles, Caltrans, and the Federal Highway Administration. The purpose of the project is to test existing and emerging technology in this highly congested corridor, with emphasis on demand/capacity balancing and route optimization between freeway and arterial facilities. The conceptual system includes many techniques for providing motorist information, system surveillance, and traffic control, and addresses the many institutional issues involved in implementing the program.

Client: City of Los Angeles
Contact: Ed Rowe Phone: (213) 485-4281 1989

NCHRP Suburban Activity Centers

JHK conducted a major research project to examine the travel characteristics of persons travelling to and from major suburban activity centers. The project was conducted as part of the research program of the Transportation Research Board. The study involved intensive data collection and surveys at office buildings, residential complexes, hotels and shopping centers. Emphasis was on the assessment of trip generation, pass-by trips, and internal capture. The data are needed to assist planners and engineers with the accurate analysis of the transportation impact of new development. The data gathered included mode of travel, trip origin and destination, trip linking characteristics, number of trips generated and related data to define the trip-making characteristics at both individual sites and at the activity center as a whole.

Client: Transportation Research Board
Contact: Dan Rosen Phone: (202) 334-3231 1989

NCHRP Project 20-19, Pedestrian Convenience and Safety on Suburban and Rural Highways

JHK & Associates was contracted by the Transportation Research Board to conduct a study of how to improve the safety and convenience of pedestrian travel on suburban and rural highways. This research study responds to the often cited lack of consideration given to pedestrian needs in these areas. Pedestrian travel in suburban and rural areas is often difficult, and many individuals are forced to take risks they should not or are

forced to use their motor vehicles when, except of the lack of planning, pedestrian travel would be a viable alternative.

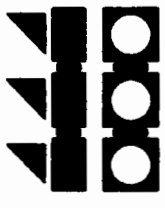
The general objective of this research is to develop a planning and implementation methodology to assist planners, designer, decision-makers, and the public in providing convenient and safe pedestrian movements for suburban and for rural areas that are in, or are likely to be in, transition to suburban areas. Particular attention is given to addressing barriers to the implementation of such facilities, including institutional and legal barriers.

The study included a comprehensive review of literature documenting problems in providing convenient and safe movement of pedestrians and potential solutions to those problems. A survey of public and private agencies was conducted to obtain the viewpoint of practitioners across the country. An extensive series of case studies, documenting both successes and failures in pedestrian circulation systems, is also being conducted.

The result of the study was a synthesis of the state-of-the-art in pedestrian planning and design for the situations under study and a manual containing guiding principles and design considerations oriented toward planning and design professionals, assisting them in providing coherent pedestrian circulation systems. The results of the study are documented in NCHRP Reports 294A and 294B.

Client: TRB
Contact: Dan Rosen Phone: (202) 334-3231 1987

I. RFP Deviations



SECTION I
RFP DEVIATIONS

The JHK Project Team have reviewed the RFP and are familiar with the work desired by the COMMISSION. Neither JHK & Associates nor any of its subcontractors or consultants take any omissions or deviations from the requirements set forth on the RFP.

J. Joint Ventures

SECTION J
JOINT VENTURES

JHK & Associates is proposing to provide the system management services as a prime consultant. JHK & Associates will be fully responsible for all work to be performed. We do not propose to form any joint venture arrangements for this project.

K. Subcontractors

SECTION K

SUBCONTRACTORS

JHK & Associates intends to utilize the services of two subcontractors for the conduct of this project. The subcontractors and the work they will perform is as follows.

JHK will subcontract the field design work and the development of plans, specifications and estimates required in Tasks C, D, G, and E to:

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 140
Monterey Park, CA 91754
(213) 260-4703

Katz, Okitsu will also provide limited assistance in Task A to conduct field studies. Katz, Okitsu has performed traffic signal design, lighting design and road design for numerous agencies in the Los Angeles basin, including Los Angeles County Department of Public Works. The firm is also a major subcontractor responsible for the development of PS&E for the ATSAC signal system expansion in the Smart Corridor study area. The firm is well qualified to perform the tasks required by JHK. Katz, Okitsu & Associates is a Disadvantaged Business Enterprise.

JHK will subcontract the concept design of the Smart Corridor expert system in Task B to:

Hughes Aircraft Co.
P.O. Box 3310
Building 606, MS M236
Fullerton, CA 92634-3310
(714) 732-0610

Hughes Aircraft has pioneered the development of expert systems technology for the military. Their knowledge of expert system design and the appropriate programming and system environment will ensure that the objectives of the Smart Corridor System are met at the lowest cost.

The qualifications of both firms follow.

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 140
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

March 8, 1990

Mr. Jack L. Kay
JHK & Associates
Post Office Box 3727
San Francisco, CA 94119

Dear Mr. Kay:

This letter will serve as a statement of my willingness to participate with JHK & Associates on the LACTC SMART CORRIDOR System Manager Service Project.

I understand my responsibility will be to provide design plans, specifications and estimates for the Highway Advisory Radio (HAR), Changeable Message Sign (CMS) and Closed Circuit Television (CCTV) elements of this project. It is my understanding that this project is scheduled to start in April, 1990.

I look forward to the opportunity to work with you and your firm on this very interesting and important project.

Sincerely,

Moses Katz
Partner

MK:su

Statement of Qualifications

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 100
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 100
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

Overview of Firm

Katz, Okitsu & Associates (KOA) is a consulting engineering firm providing traffic, transportation and engineering services to the government and private sectors. Fields of emphasis include:

- o Traffic Signal and Ramp Meter Design
- o Signing and Striping Design
- o Street Lighting Design
- o Worksite Traffic Control Design
- o Computer Aided Design Services
- o Traffic Signal Timing
- o Street and Highway Design
- o Traffic Impact Studies

Katz, Okitsu & Associates was founded in 1987. The two primary principals, Moses Katz and Walter Okitsu, have extensive professional experience in Southern California. Moses Katz has worked in Southern California for over 30 years, with experience in all areas of traffic designs, roadway geometric designs, traffic signal timings, and road design. Walter Okitsu has worked in the Los Angeles area for 8 years in the field of traffic signal design, signal timing, impact studies, and general traffic designs. Together, the principals of KOA have been responsible for the design and implementation of traffic signals at over 2000 intersections.

Recently, KOA was awarded the SMART CORRIDOR Signal Design Project (312 signals along the Santa Monica Freeway corridor) by the City of Los Angeles. Work begins in Fall, 1989.

KOA is recognized as a forerunner in traffic designs. With extensive capitalization in state of the art Computer-Aided Design (CAD), KOA has developed strong CAD capabilities, resulting in high quality plans, fast turnaround times and low costs.

KOA's high productivity is obtained via:

- o 10 work stations
- o Two Sun-MicroSystem computers for our engineering applications
- o Customized AutoCAD Menu
- o Full time programmers to constantly improve AutoCAD and proprietary software
- o Hands on engineering managers monitoring and trouble-shooting the whole process

All KOA design products are supervised by a Professional Civil Engineer and Traffic Engineer, registered in the State of California. KOA is a certified Disadvantaged Business Enterprise.

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 100
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

FIRM DATA

DISCIPLINES:	Transportation engineering designs, street and highway designs, traffic signal timing, and traffic impact studies.
TOTAL EMPLOYEES:	15 Traffic Engineers Civil Engineers CAD Operators
ORGANIZATION:	Partnership
DATE OF FORMATION:	August 17, 1987
OFFICERS:	Moses Katz and Walter Okitsu, Partners
OWNERSHIP STATUS:	MBE (Minority Business Enterprise)
STATUS CERTIFICATION:	State of California, Dept. of Transportation Los Angeles County Transportation Commission
INSURANCE COVERAGE:	General Liability Insurance, $1 million Professional Liability Insurance, $1 million

TRAFFIC SIGNAL DESIGN

Katz, Okitsu & Associates is well known for applying the specialized attention needed for proper signal design. Our emphasis is to collect accurate "as-built" information, by means of meticulous field investigation. The principals of the firm have been responsible for the design of over 2200 intersections in Southern California. As a firm, KOA's experience includes the following projects:

Los Angeles, Culver City, & Beverly Hills
Santa Monica Freeway SMART Corridor
312 intersections (to start September 1989)

Los Angeles and unincorporated L.A. County
Baldwin Hills Regional Shopping Center
9 signalized intersections

Los Angeles (Westchester)
Westchester Parkway
10 signalized intersections

Long Beach
Long Beach-Los Angeles Rail Transit Project
9 intersections, featuring special light rail transit signals, and modular signal poles

Unincorporated L.A. County, (Santa Clarita and CalTrans)
McBean Parkway & I-5
10 signal conduit plans, 2 signalized intersections, and 4 ramp metering plans.

Los Angeles and UCLA
UCLA Medical Center Expansion
4 intersections

Pasadena
Ahmanson Properties
4 intersections

Rancho Cucamonga
Archibald & 4th Street
1 intersection

Unincorporated Orange County (Mission Viejo)
Plano Trabuco Road
2 new intersections

Beverly Hills
Rodeo Drive & Dayton Way
Traffic signal design for a construction site.

Irvine
Alton Parkway and Technology Drive
1 intersection

Lancaster
Avenue J and 15th Street East
1 intersection

Oxnard and CalTrans
U.S. Highway 101 and Rose Avenue
1 intersection

Santa Monica
Cloverfield Boulevard
3 intersections

Alhambra
Main Street and Poplar Boulevard
1 intersection

Oceanside
Douglas Drive and Vandergrift Boulevard
1 intersection

SIGNING AND STRIPING DESIGN

Katz, Okitsu & Associates possesses strong expertise and knowledge in roadway geometric, signing, striping, and pavement marking design, both for permanent works and for temporary construction worksite traffic control requirements. The following is a sampling of projects exhibiting KOA's experience in traffic signing and striping design:

Los Angeles (Westwood)
Wilshire Boulevard
600 feet

Los Angeles (Van Nuys)
East San Fernando Valley Sewer Project
3700 feet of staged, temporary signing and striping

Pasadena and CalTrans
Gateway West Project
2000 feet

Lancaster
20th Street East
2500 feet

Oceanside
Douglas Avenue and Vandergrift Avenue
1700 feet

Rancho Cucamonga
Archibald Avenue
1000 feet

Unincorporated L.A. County (Agoura)
Thousand Oaks Boulevard
2500 feet

Beverly Hills
Rodeo Drive, temporary striping

Los Angeles (Fairfax district)
Third Street Storm Drain
1700 feet of staged, temporary signing and striping.

Lancaster
Avenue J and 15th Street East
2200 feet

Unincorporated Orange County (Mission Viejo)
Alicia Parkway
800 feet

Montebello
Vail Avenue
1200 feet of staged, temporary signing and striping.

Culver City and CalTrans
Slauson Avenue and Marina Freeway
2000 feet of conceptual signing and striping, featuring reverse flow left turns.

New York City (Brooklyn)
Tillary Avenue Corridor
1500 feet of conceptual signing and striping, featuring reverse flow left turns.

Cerritos
Shoemaker Avenue
1400 feet of striping

TRAFFIC SIGNAL TIMING

The principal engineers at Katz, Okitsu & Associates have been involved in traffic signal timing at several thousand intersections. They have been involved in the following projects:

Los Angeles (City-Wide)
General timing services
About 1500 signals

Pasadena
FETSIM
58 signals

Los Angeles (San Fernando Valley)
Ventura Boulevard Bus Preemption
51 signals, featuring optical detection to provide bus priority.

Los Angeles (City-Wide)
Interconnected System Design
Several large interconnected systems, each involving as many as 200 signals.

Los Angeles (Hollywood)
FETSIM
700 Signals

Manhattan Beach, El Segundo, Redondo Beach, Hawthorne, and Los Angeles County
FETSIM
48 signals, featuring the installation of time-base coordination.

Long Beach
Long Beach-Los Angeles Light Rail Project
79 signals

Los Angeles (Exposition Park)
ATSAC Installation
Provided signal timing and system database for the first control system in Los Angeles. Developed special timing plans for the 1984 Olympic Games.

STREET LIGHTING

Engineers working with Katz, Okitsu & Associates have been responsible for approximately 80% of the street lighting design performed by private engineers within the City of Los Angeles. The project sizes ranged from single lots to entire tracts. Some recent projects in the City of Los Angeles include:

Sylmar
El Casco St. & Herrick Ave.

Downtown L.A.
L.A. County Reception Center

Pacific Palisades
Sunset Blvd. & Muskingum Ave.

West L.A.
Beloit Avenue

Silver Lake
Glendale Blvd. & Riverside Dr.

Panorama City
Nordhoff St. & Lemona Ave.

Chinatown
Sunset Blvd. & Grand Ave.

West Adams
Baldwin Hills Shopping Center

Van Nuys
Rhodes Avenue

Boyle Heights
White Memorial Hospital

Studio City
Laurel Canyon Blvd. & Ventura Blvd.

Reseda
Keswick St. & Reseda Blvd.

ROAD DESIGN

Katz, Okitsu & Associates services include expert street and highway design plans. One of the principals of the firm has over 30 years street design experience, designing over 317,000 feet of streets in 1987 alone. One of KOA's Senior Engineers has over 12 years experience at the Los Angeles County Department of Public Works, where he was responsible for the County approval/review of over 500,000 feet of roads in one year. As of July, 1989, we have been contracted by the Los Angeles County Department of Public Works to be one of five consultants to check road plans as well as other improvement plans. Our experience includes the following projects:

Location: **Los Angeles County**
Tract: 39509
Scope: 48,000 feet

Location: **Los Angeles County**
Tract: 44344
Scope: 4800 feet

Location: **Los Angeles County**
Tract: 46365
Scope: 4800 feet

Location: **Ventura County**
Tract: 4403
Scope: 5600 feet

Location: **Ventura County**
Tract: 4335-3
Scope: 2400 feet

Location: **City of Moreno Valley**
Tract: 10273
Scope: 12,000 feet

Location: **City of Moreno Valley**
Tract: 21612
Scope: 10,400 feet

Location: **City of Thousand Oaks**
Tract: 38151
Scope: 1600 feet

Location: **Orange County**
Tract: 10273
Scope: 12,000 feet

Location: **Orange County**
Tract: 9455
Scope: 8000 feet

Location: **City of Lancaster**
Tract: 46107
Scope: 8000 feet

Location: **City of Palmdale**
Tract: 45705
Scope: 10,400 feet

Location: **City of Palmdale**
Tract: 46140
Scope: 9600 feet

Location: **City of Rancho Cucamonga**
Tract: 23485
Scope: 8000 feet

Location: **City of Rancho Cucamonga**
Tract: 23389
Scope: 7200 feet

HUGHES AIRCRAFT COMPANY

INFORMATION ON DESCRIPTION OF RESOURCES

Hughes Aircraft's qualifications as subcontractor for the Smart Corridor Systems Manager Project are:

> Knowledge of "state-of-the-art" technology gained from its military and civilian command and control programs, including air traffic control, air defense, and intelligence systems,
>
> Understanding of vehicle aspects of the traffic management problem gained from its work with its parent corporation, General Motors,
>
> Experience in the application of the System Engineering methodology to the systematic development of large, multi-technology projects.

TECHNOLOGY

Human Factors - The Command and Control centers designed by Hughes are dependent upon the successful interfacing between man and machine under very stressful scenarios, leading Hughes to develop considerable expertise in Human Factors. This include the physical design of workstations, and the placement of these workstations and Large Screen Displays in a Command and Control room. It also includes the man-machine-interface itself, which involves the design of the display graphics and fonts, the use of colors in the display, the choice of interfaces (touch screen, mouse, keyboard, etc.) and the specification of the software to achieve the desired interactiveness.

Real-time Software - The Command and Control systems are real-time software-intensive systems. Because of the importance of extreme system availability. Hughes has become knowledgeable in the design and testing of software for extreme levels of reliability and security.

Data Base Engineering - The information-oriented Command and Control systems involve critical data bases which are physically dispersed and which are each "owned" by different

organizations. The solutions to problems of data integrity, security and availability are achieved through Hughes' knowledge of Data Base engineering.

Expert Systems - As a support to the man-in-the-loop in a Command and Control system, Hughes has developed a knowledge of how to apply Expert Systems technology.

Infra-Red - Hughes is the world leader in the application of Infra-Red technology to military systems. It is felt that this technology will become available at commercial pricing and then can be applied to a new generation of vehicle surveillance which does not require in-road installation and which is capable of day and night operation.

VEHICLE ASPECTS OF TRAFFIC MANAGEMENT

Hughes has been working with General Motors in the adaptation of its technology to motorist information products, including General Motors' version of the Etak Navigator for use in the vehicle. This has given Hughes an insight into the significance of the availability of real-time traffic information to the motorist information product. It is a necessity that excellent-quality information be available from the Traffic Operations Center to be broadcast to vehicles so that they have information to navigate around traffic congestion.

Hughes has been involved in a Demonstration project, known as "Travtek" under the direction of General Motors. Although the Project has not yet been approved by all of the sponsors, Hughes has been working on the system design. This Project would have similarities to the Pathfinder Project, but would introduce a number of additional features, such as route selection and route guidance.

Hughes is also heavily involved with General Motors in research and development of vehicle products for collision warning and control. These include adaptive cruise control, blind-spot detectors, and headway and lane control. Although these products are further down stream, they will each have an impact on the total Traffic Operations System, and must be considered in the design of a system which will have the extensibility to interface with vehicles equipped with these products.

SYSTEM ENGINEERING

Hughes has evolved its principles and practices of System Engineering to enable it to successfully develop and implement large systems involving multiple technology disciplines, multiple team members, large numbers of suppliers, and even multiple customers. The systematic, top-down techniques ensure customer involvement, performance which meets the project measures of effectiveness, and a system which truly works as a system.

L. Key Personnel

SECTION L
KEY PERSONNEL

The overall staffing plan presented in Section C is repeated again as Exhibit L.1 for convenience. As discussed in Section C, the staff assigned to the project have been selected to assemble a team having all of the qualifications and experience necessary to conduct the Smart Corridor Systems Management Project.

The following is an overview of JHK's senior staff to be assigned to the project. The assignments will insure continuity with the conceptual design phase of the project.

Mr. Alan Clelland, Senior Associate and Manager of JHK's Los Angeles office will serve as Project Director for the Smart Corridor System Manager Services project. Mr. Clelland participated in several aspects of the conceptual design study, is completing an assignment as Region Leader for the Statewide Smart Corridor project, and is project director for the Pathfinder evaluation study to be conducted in the Smart Corridor area. Mr. Clelland has also led JHK's subcontract work to intertie the ATSAC system with Pathfinder and to intertie the SATMS and the Anaheim systems, bringing immediate experience with the methods to be used to gather information from these two critical elements of the overall Smart Corridor system. Mr. Clelland will dedicate 50% of his time to the project.

Mr. Jack L. Kay, President of JHK will serve as the firm's Responsible Officer for the project and will provide technical assistance throughout the project effort. Mr. Kay served as project director for the conceptual design study and is completing a similar role in the Statewide Smart Corridor project. He also assisted in early stages of the ATSAC project, bringing a long term perspective to the project. Mr. Kay is the person most familiar with the overall Smart Corridor concepts and will bring that direct experience to bear on the system manager work.

Mr. Craig C. Gardner, Vice President, will serve as System Architect for the project. He will have the overall responsibility for the central system hardware and software configuration and for the applications software. Mr. Gardner was responsible for the implementation of the ATSAC system, is directing the development of the intertie to Pathfinder, is supervising the intertie of SATMS to Anaheim, and directed the systems analysis and preliminary design work during the

Smart Corridor conceptual design study. He is JHK's most experienced system designer.

Mr. John K. Grant, Senior Traffic Engineer, will supervise the design of the field elements of the project. Mr. Grant was responsible for the majority of the field related elements in the conceptual design project and is directly familiar with all aspects of the design requirements. He will also serve as independent plan checker for the design work to be conducted by the subcontractors for the project.

Mr. Doug C. Terry, Senior System Engineer, will direct the work to develop the communications interties between the systems. Mr. Terry is directly familiar with the ATSAC communications system, having worked on several stages of the design. He is also familiar with the Smart Corridor project requirements, having served as JHK's monitor for the earlier work done by Kaiser Engineers. Mr. Terry is the primary author of JHK's report on communications for traffic control which was prepared for the Federal Highway Administration.

As shown on the exhibit, JHK and its subcontractors will commit the senior and technical staff required to successfully complete the project and will dedicate the resources needed to support LACTC and the other agencies in the highly visible and critical project.

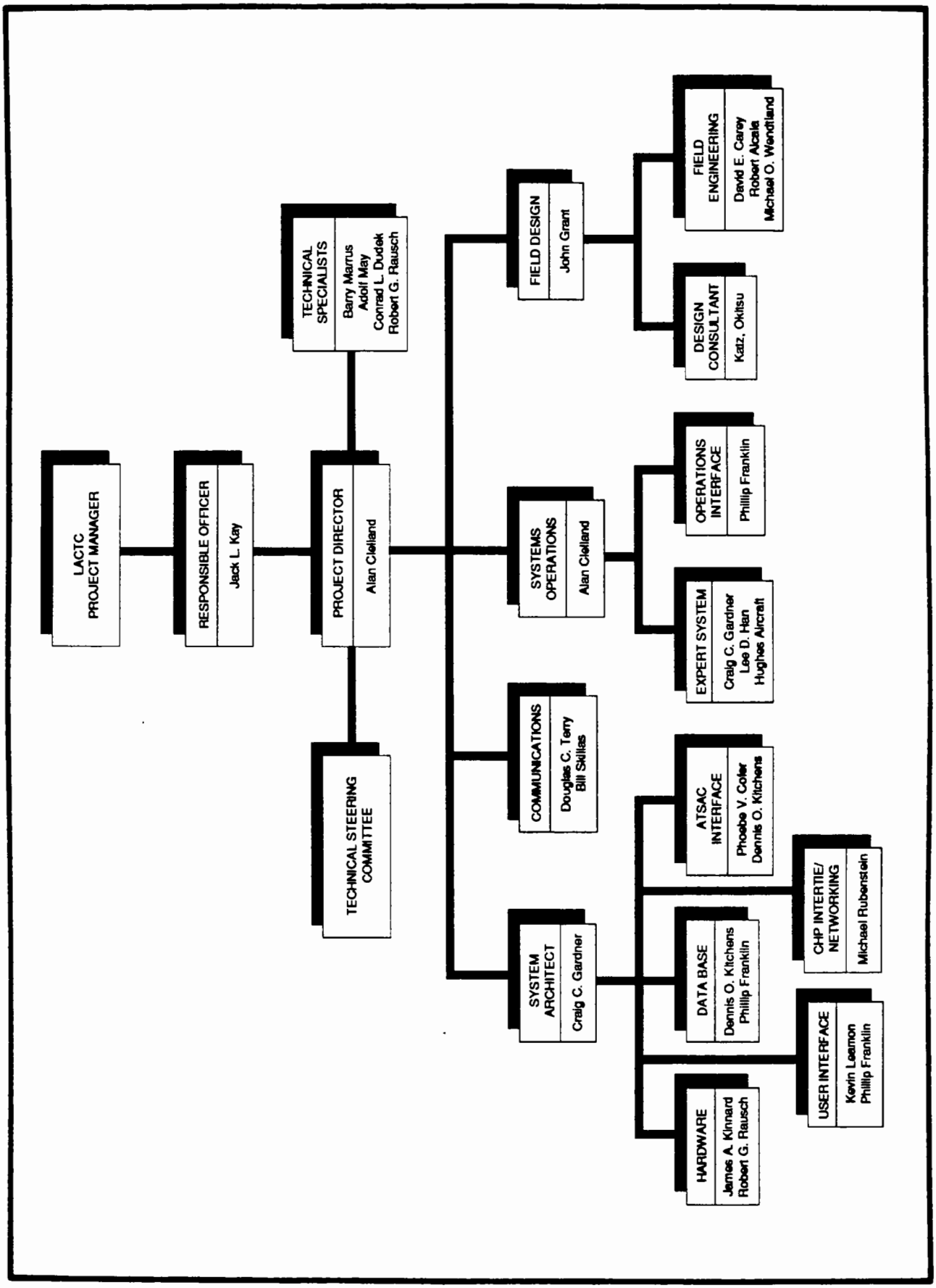


Exhibit L.1. Management and Staffing

RESUMES

Robert A. Alcala
David E. Carey
Alan Clelland
Pheobe V. Cofer
Phillip Franklin
Craig C. Gardner
John K. Grant
Lee D. Han
Jack L. Kay
James A. Kinnard
Dennis O. Kitchens
Kevin A. Leamon
M. Scott MacCalden, Jr.
Barry S. Marrus
Robert G. Rausch
Willim A. Skillas
Douglas C. Terry
Michael O. Wendtland
Adolph D. May
Michael L. Rubinstein
Conrad L. Dudek

ROBERT A. ALCALA'

Mr. Alcala' is a Senior Electrical Engineer for JHK & Associates. He has more than 24 years experience in electrical engineering design and electrical construction in the fields of power distribution, lighting, controls, instrumentation, energy management, overhead and underground high voltage power distribution, project management, and installation supervision.

Specialized lighting systems design projects include roadway lighting for seven miles of the Outer Loop Freeway Project, Phoenix, Arizona, Wells Avenue in Reno, Nevada, four miles of the Superstition Freeway, Mesa, Arizona; I-10 high mast lighting from 24th Street to 44th Street, Phoenix, Arizona; 10 miles of arterial street lighting in Mesa, Arizona; and over 10 miles of arterial street lighting in Tucson, Arizona. California projects include 2 1/2 miles of the Fletcher Parkway in the La Mesa, California, and three miles of Route 15 in San Diego, California. Other specialized lighting systems include flight line security lighting at El Toro, California and Yuma, Arizona Marine Corps Bases and over 20,000 feet of high mast radio controlled apron lighting at Nellis AFB, Nevada and Davis-Monthan AFB, Tucson. Runway and taxiway lighting modifications have been completed for airports in Arizona and Michigan. Sports field and special use areas are among the other types of lighting systems designed by Mr. Alcala' in California, Arizona, Ohio, and Michigan.

Mr. Alcala's experience in both electrical engineering design and construction provide the basis for sound practical design applications. The dual experience also provides the unique insight into the proper preparation of construction cost estimates as well as proper field inspection techniques during the construction phase of projects.

Mr. Alcala' obtained his BSEE degree from Lawrence Institute of Technology and his MSEE from Western Michigan University. He is a registered professional engineer in several states, including Arizona, California, Michigan, New Mexico, Florida, Nevada, and Ohio. He is a member of various professional organizations and past President of the Southern Arizona Section of the Illuminating Engineering Chapter of the Electric League of Arizona.

DAVID E. CAREY, P.E.

Mr. Carey is a Senior Transportation Engineer with JHK & Associates with nine years of experience in traffic design and operations, highway design and highway safety. He is experienced in the areas of site impact studies, signing and marking, and roadway lighting design. Mr. Carey is also proficient in the areas of personal computer applications, data management, and software development. Mr. Carey's experience with JHK & Associates includes:

- Project Director for a section of SR117 (Outer Loop Highway) in Phoenix. This project involved management of the design of signing, striping, signals, and lighting for this project.

- Project Director for a site development study for a national headquarters for MeraBank. Mr. Carey was responsible for a traffic and circulation analysis of the proposed site which included a 15 building campus to contain MeraBank's Corporate Headquarters.

- Project Director for a site selection study to determine the best location for the MeraBank Corporate Headquarters. This study involved a travel time analysis as well as circulation studies of the surrounding street system for each potential site.

- Project Director for the H.E.L.P. Development of Weigh-in-Motion (W.I.M.) Performance Specifications. In this capacity, Mr. Carey supervised field testing of Weigh-In-Motion equipment and provided liaison with states participating in the Cresent Project.

- Project Engineer for a Federal Highway Administration sponsored project to assess the feasibility of automatic updating of traffic volume data for signal timing development.

- Project Director for the Butler Road Improvement Project in Flagstaff, Arizona. This project involves the design of signing, markings, signals, and lighting for an urban arterial street.

Mr. Carey has served more than five years with the City of Austin, Texas as Staff and Senior Staff Engineer , in both the Urban Transportation and Land Development Services Departments. In the Urban Transportation Department, his responsibilities included the design and operation of a major portion of the City's traffic control system. He was a member of the City's One-Call Utility Coordination Committee and he was responsible for the beginning of the computerization of the Traffic Engineering Section of the Department.

In the Office of Land Development Services at the City of Austin, Mr. Carey supervised the Engineering staff for subdivision construction plan engineering and was responsible for the

coordination and administration of the alignments of the City's proposed arterial roadway network. He was also responsible for the design of various applications for a major multi-departmental computerization effort using a DEC VAX computer system as well as designing applications for microcomputers.

Mr. Carey also served with the State of Texas Department of Highways and Public Transportation. In this capacity, he was primarily responsible for the final analysis of highway construction plans, including cost analysis and construction cost estimating on various highway construction projects.

Mr. Carey holds MS and BSCE degrees from the University of Texas at Austin. He also holds a Bachelor of Electric Engineering Technology (BEET) degree and an Associate degree in Applied Science from DeVry Institute of Technology. He is a Registered Professional Engineer in the States of Arizona and Texas and is a member of Civil Engineers, and the Illuminating Engineering Society.

ALAN CLELLAND

Mr. Alan Clelland is a Senior Associate with JHK & Associates specializing in traffic control systems and traffic operations. During his 13 years working in these areas, Mr. Clelland has been involved in hardware and software design, system specification, traffic control system implementation, and traffic system operations. He has gained this experience working not only in consulting, but also in University Research, manufacturing, and in the Traffic Management Department of a City Authority.

Since joining JHK, Mr. Clelland has been active in the following projects:

- Project Manager of the Arlington County (VA) System Upgrade which included replacing the wall map display with color graphics equipment.
- Project Manager of the Port Authority of New York and New Jersey's Accident Retrieval System Upgrade Project.
- Responsible for carrying out an evaluation study for traffic control and surveillance equipment for the City of Kaohsiung, Taiwan. This also involved preparation of P,S and E and Bid documents.
- Responsible for coordinating development and other technical aspects of the Los Angeles ATSAC system. This involves software design and supervision in such areas as the 1.5gc sub-system and TRANSYT Interactive Utility software development.
- Responsible for the design of the evaluation plan for the "Pathfinder" joint FWHA/Caltrans/Industry In-Vehicle Navigator Field Trials.

Prior to working for JHK & Associates, Mr. Clelland was employed by Philips Traffic Control Systems of The Netherlands where he was responsible for software specification in their range of traffic control systems and equipment and also for the traffic engineering aspects of Philips' projects.

Some of the projects in which Mr. Clelland has been involved are as follows:

- Chief Traffic Engineer on the Mexico City traffic control system project which comprised the renewal of all traffic control equipment in a network of 950 intersections. Mr. Clelland trained and headed a staff of five engineers developing intersection designs and timing plans for all intersections. In addition, Mr. Clelland was involved in the specification, design and implementation of the traffic control software. (JHK was also involved in the initial stages of this project.)

- Working together with JHK on before-and-after study evaluation of the Taipei traffic control system in Taiwan as part of the installation of the 120 intersection system.

- As Traffic Engineer on the Yanbu, Saudi Arabia traffic control system was responsible for the design of the intersection control software and the training of the local staff in the operation of the system.

- Participated in the implementation of the Urban Traffic Control System part of the Glasgow, Scotland Centrally Integrated Traffic Control System (see below). Mr. Clelland's prime responsibilities were in the specification and design of the Vehicle Responsive Plan Selection Software, specification of field equipment software and liaison with the City Authority on system operation and control strategies.

Mr. Clelland also worked on the University of Newcastle, England Transport Operations Research Group feasibility study of Centrally Integrated Traffic Control (CITRAC) in Glasgow, Scotland. His prime responsibility was for the definition of traffic control equipment to implement corridor control strategies arising from the study. He wrote the specification for the Freeway Control and Surveillance System part of the CITRAC system. Mr. Clelland also lectured to post-graduate students on traffic control equipment.

Mr. Clelland holds a Bachelor of Science degree with honors in Physics and Electronic Engineering from the University of Leeds, England. He is a registered Chartered Electrical Engineer in Great Britain, Member of the Institution of Electrical Engineers and Member of the Institute of Transportation Engineers.

Publications include, "A System's Approach to Area Traffic Control", Traffic Engineering and Control and "Maintenance of Centrally Integrated Traffic Control Systems", Proceedings of the International Road Traffic Signalling Conference, IEE, London.

PHEOBE V. COFER

Ms. Cofer is a Systems Engineer with JHK & Associate's Atlanta office. Her qualifications include a working knowledge of FORTRAN, BASIC, PASCAL, COBOL and assembly language including over four years experience on various mainframes, minis, and micros. In particular, Ms. Cofer has extensive knowledge of data acquisition and processing algorithms commonly used in urban traffic control systems.

Ms. Cofer is currently the Software Team Leader of the Los Angeles ATSAC System Project. Her responsibilities include design and coding of the extensive software revision necessary to achieve optimum performance of the Enhanced version of the UTCS software, coordination of the 1.5 Generation Control Software development and the supervisor area computer interface, continued implementation, testing, and enhancement of various functions of UTCS Enhanced such as traffic responsive operation, critical intersection control, and accumulation and processing of historical detector data, and continued administration of the Enhanced data base. Additional duties include revision and updating of existing Enhanced documentation and continued training of Los Angeles city staff in the development of Enhanced data base and its use by the traffic control software.

As a member of the software development group for the Los Angeles project, Ms. Cofer performed a number of tasks.

- Recording and testing of the communications and detector data processing modules in order to interface with the communications hardware specific to the ATSAC installation.
- Revision of an existing intersection communications simulator which was used as a diagnostic tool in conjunction with Enhanced.
- Administration of the Enhanced data base.
- Formulation of timing procedures which enabled JHK & Associates to accurately project CPU usage as data base was increased.

In addition to her work on the Los Angeles project, Ms. Cofer has contributed to various other projects.

- Installation and testing of TRANSYT on the Perkin-Elmer 3230.
- Development of ramp control and coordination routines for Denver Ramp Metering and Control.
- Revision and documentation of an existing detector volume and occupancy count summary module for the Tampa Traffic Control System and the Sioux City Traffic Control System.

Ms. Cofer holds a Bachelor of Science degree in Mathematics from Kennesaw College with an emphasis in computer science.

PHILLIP FRANKLIN

Mr. Franklin is a Systems Engineer with JHK & Associates. He holds a Bachelor of Science degree in Computer Science from the University of Georgia. While attending the University of Georgia, Mr. Franklin obtained experience on several mainframe, mini and microcomputers. His software experience includes work in C, FORTRAN, COBOL, PL/I, PASCAL, BASIC, and assembly languages.

Since joining JHK, Mr. Franklin has made significant contributions in the following projects.

- He was the lead programmer on the Accident Records System installed in Greensboro, N.C. This responsibility involved personally implementing a major portion of the software, integration of the entire system, and any ongoing maintenance and support of the installed system. The system was installed on a Perkin-Elmer 3230 minicomputer.

- Mr. Franklin was a team member on the Burlington Freeway Traffic Management System. He worked on parameter update, the event scheduler, and other tasks. The work was done on a VAX 11/750.

- An input tool for the interactive input of TRANSYT-7F data was developed by Mr. Franklin. This utility reduces the laborious task of data entry to the TRANSYT-7F optimization model and provides for a more useful and productive environment. This utility has also been modified to operate on an IBM PC.

- Mr. Franklin served as Software Team Leader for an implementation of a 1.5 Generation Control System for the City of Los Angeles. This system uses real-time detection data as input to TRANSYT-7F for the purpose of developing timing plans using current information.

- Mr. Franklin served as on-site support representative for the City of Los Angeles. His duties involved assisting with technical and operational system problems, coordinating current activities between the City of Los Angeles and JHK, and support of all JHK software.

- Mr. Franklin's work with JHK has involved use of several types of computers and a varied degree of applications. Currently, Mr. Franklin is serving as a software support person for the Los Angeles office.

CRAIG C. GARDNER

Mr. Gardner is a Vice President with JHK & Associates specializing in traffic control systems and traffic operations. His experience in traffic control systems ranges from software and hardware design to computer-based signal system operations management. Mr. Gardner has over a decade of real-time system software design and programming experience.

Mr. Gardner served as Director of Software Implementation for the Ottawa Ontario and the Tampa, Florida Traffic Signal System Projects. In this capacity, he was responsible for performing the system installation and integration. Other duties include design, inspection, and testing of computer and communications equipment.

Mr. Gardner also served as Project Director, responsible for software design and integration, for the Howard Frankland Bridge Surveillance and Control System. This project involved the design, integration, and testing of a computer-based system to detect and manage traffic incidents on a heavily traveled bridge linking the cities of Tampa and St. Petersburg, Florida.

Some representative projects in which Mr. Gardner has been involved while with JHK & Associates include:

- Project Director for the design and implementation of a traffic signal control system expansion project which demonstrated the feasibility of utilizing California Model Type 170 microprocessor-based traffic controllers and specially designed software to efficiently control seven diamond freeway interchanges within the city of Tucson, Arizona.

- Special Systems Consultant for an FHWA project to develop evaluation methodologies for the Integrated Motorist Information System (IMIS) being implemented for the Long Island, New York, freeway corridor. Mr. Gardner conducted a review and evaluation of state-of-the-art data collection devices. This included an assessment of support services required and suitability for automated data reduction and analysis purposes.

- Participated in an FHWA research project entitled, "Definition and Measurement of Delay at Intersections." Mr. Gardner's primary responsibilities were in the areas of programmed data management and data analysis.

- Project Director on a Traffic Signal Control System Upgrade project for the City of Tucson, Arizona. This project involved CPU equipment change-out and the conversion of the City's existing traffic applications software to run under a more capable operating system software package.

Mr. Gardner holds a Bachelor of Science degree in Transportation Engineering from the California State Polytechnic University at San Luis Obispo. He has completed all graduate course work at the University of Arizona toward a Master of Science degree in Civil Engineering.

He is the co-author of "A Technique for Measuring Delay at Intersections" published in Transportation Research Board Record Number 644 and is an Associate Member of the Institute of Transportation Engineers.

JOHN K. GRANT

Mr. Grant is a Traffic Engineer with JHK & Associates currently operating out of the Los Angeles office. He specializes in traffic signal system operations and design. The following are representative examples of projects in which Mr. Grant has been involved since joining JHK & Associates.

- Project Engineer assigned to help identify potential Smart Corridors throughout the state of California.

- Project Engineer assigned to the Los Angeles County Traffic Signal Synchronization, Operation and Maintenance program. Mr. Grant assisted in developing a county-wide program to improve traffic signal operations, coordination and maintenance between the various cities (86), the county and the state.

- Project Engineer for the Smart Corridor Conceptual Design Study.

- Traffic Engineer assigned to the Smart Corridor project. He is responsible for studying the operational components of new technologies and their benefits to improving flow along Santa Monica Freeway.

- Traffic Engineer for the Anaheim, California Enhanced version traffic signal system. Mr. Grant was responsible for developing and implementing four timing plans and three special event patterns for 118 traffic signals in compliance with the City and FETSIM requirements; developing the plans and specifications for installing system sensors, CCTV, changeable message signs; and for preparing and testing the CSC T1 Signal controller communication protocol to upload/download timing parameters to the central computer. Mr. Grant was also the responsible traffic engineer for the computer integration in Anaheim. This entailed developing/establishing the communications with each intersection and creating the UTCS timing and schedule data base.

- Traffic Engineer for the Gainesville Traffic Signal Design Project and the Cedar Rapids, Iowa Traffic Signal Computer Timing Project. Mr. Grant assisted in the development of signal timing plans using the TRANSYT-7F optimization program. He also helped implement the new TRANSYT controller timings and directed the initial fine tuning process for Gainesville, Florida.

- Traffic Engineer for the Series 2000 computer system in Eugene, Oregon. Mr. Grant was responsible for field testing and quality assurance of the traffic signal interconnect cable, and for developing the channel assignments for the system.

- Traffic Engineer for the Raleigh, North Carolina feasibility study. Mr. Grant assisted in analyzing different traffic signal computer systems. This work included a test of the existing communications network, studies of existing traffic flows and networks, defining potential signal groups and analyzing their system goals and objectives.

Prior to joining JHK & Associates, Mr. Grant was employed by the City of Tucson Traffic Engineering Department. Some of the major projects he was involved in include:

- Manager of Tucson's computerized traffic signal system data base. Mr. Grant was responsible for the day-to-day operation of more than 300 system and isolated traffic signals. His duties included revamping, organizing and maintaining the entire signal timing data base and event schedule, developing, fine tuning and monitoring of signal timings (computer and local controller), coordinating special plans for events or construction, responding to citizen inquiries, and providing technical information to interested parties.

- Project Manager for implementing a real time, variable speed message sign system within the urban area to reduce vehicle delay. This project included structural analysis of the sign poles, field supervision of the sign and communications network installation, developing and testing the data base, and conducting before and after studies.

- Coordinated between the State and County for inclusion of their respective traffic signals into the City's computerized traffic signal system.

- Project Manager of Tucson's "Lag Left" turn traffic signal project. This project involved identifying the computer software changes required to accept the lag left turn display feedback, and coordinating with the news media the project purpose and changeover times. Mr. Grant was responsible for all signal modification, signing, and signal retiming required to implement the project.
- Project Manager and liaison between the telephone company and the City for the conversion of Tucson's computerized traffic signal system data communications facility from half to full duplex.

- In addition, Mr. Grant has designed traffic signal installations, performed construction inspection, performed traffic safety and impact studies, prepared proposals for State and Federal Grants, and worked with other public and private agencies whenever signal progression or timings were a concern.

Mr. Grant holds a Bachelor of Science degree in Civil Engineering from the University of Arizona. He is an associate member of the Institute of Transportation Engineers. He is also a registered Engineer-In-Training with the State of Arizona.

LEE D. HAN

Mr. Lee D. Han recently joined JHK & Associates as an Associate Traffic Engineer. Prior to joining JHK, Mr. Han has completed extensive research on Knowledge-Based Expert Systems (KBES) and has gained valuable experience as a Research Assistant at the University of California, Berkeley and previously at Virginia Polytechnic Institute and State University and National Taiwan University.

While currently enrolled in the Ph.D. Program in Civil Engineering, Transportation Engineering Group, Mr. Han has acquired skills in the following:

- Computer programming
- Computer technology applications
- Logistics
- Mass transit planning and operation
- Statistics
- Traffic operation

Mr. Han has researched and published papers such at the following:

Automatic Detection of Traffic Operational Problems on Urban Arterials, presented at the Transportation Research Board 69th Annual Meeting, Washington, DC, January, 1990.

Artificial Intelligence Approaches for Urban Network Incident Detection and Control, Proceedings of the Engineering Foundation Conference on "Traffic Control Methods", at Santa Barbara, February, 1989.

On-line Expert System for Urban Network Control, presented at the Transportation Research Board 68th Annual Meeting, Washington, DC, January, 1989.

Artificial Intelligence Approaches for Network Control Systems, presented at the 58th Annual Meeting of ITE, September, 1988.

Artificial Intelligence Approaches for Signalized Network Control, Working Paper, Institute of Transportation Studies, University of California, Berkeley, June 1988.

Logistics Decisions Following Urban Disasters, Microcomputers in Civil Engineering, 1988, pp. 13-27.

A Decision Support System for Mass Evacuation and Emergency Management, Dissertation submitted to the faculty of the Virginia Polytechnic Institute in partial fulfillment of the requirement for the degree of Master of Science in Civil Engineering, June, 1987.

System Dynamics Model of Infrastructure Induced Development on Taiwan, presented at the 1987 International Conference of the System Dynamics Society, Shanghai, China, June, 1987.

TEDSS - Transportation Evacuation Decision Support System, proceedings of the 2nd European Conference on Computer Simulation, Antwerp, Belgium, September, 1986.

Computer Aided Design - Programming and Application, (In Chinese), National Taiwan University, June 1985.

Mr. Han received a Master of Science in Civil Engineering from Virginia Polytechnic Institute and State University and has a Bachelor of Science in Civil Engineering from National Taiwan University. Mr. Han is an Individual Associate Member of the Transportation Research Board, and a Student Member of the American Society of Civil Engineers and The Institute of Transportation Engineering.

JACK L. KAY

Mr. Jack L. Kay, President, specializes in providing technical consulting in the areas of traffic control, traffic engineering and research, and implementation and funding program development. He has over 25 years of experience in traffic engineering, including over 20 years as a consultant to public and private agencies.

Mr. Kay is currently acting as Project Director of the Smart Corridor Demonstration Project Conceptual Design Study. This involves directing a team of some twenty personnel from four companies supported by a group of expert advisors. The study involved substantial data collection and analysis with the objective of defining control strategies and system requirements for the demonstration project.

Additionally, Mr. Kay is serving as Project Director on a California Department of Transportation Study entitled the "Statewide Smart Corridor Study". The scope of work on this project embodies investigating the feasibility of applying the Smart Corridor concept to different corridors within the State. This project is similar to the Los Angeles Smart Corridor Demonstration Project, but encompasses corridors throughout the state of California.

Mr. Kay is also serving as program manager for the implementation of a sophisticated traffic control system in the City of Anaheim. The project includes computer control of traffic signals and changeable message signs, as well as the development of a traffic management center that will include CCTV, highway advisory radio, and coordinated operation by traffic and enforcement staff.

He also completed a project for the California Department of Transportation to define the traffic surveillance and control requirements for the San Francisco Bay Area. The project resulted in a recommendation for a $72 Million system covering 216 miles of congested freeways.

Mr. Kay also served as responsible officer and instructor for a project with the Florida Department of Transportation to establish and train freeway incident management teams in Jacksonville, Orlando, and Tampa. He is currently serving as responsible officer for the evaluation of the operation of the Integrated Motorist Information System (IMIS). This research project, being conducted for the FHWA, covers all aspects of this surveillance and control system located on Long Island, New York.

He is also responsible officer for the firm's research project for the FHWA entitled "Investigation of Successful Implementation, Operation, and Maintenance of Traffic Control Systems". This project is to result in a set of guidelines for practicioners to use in implementing areawide signal systems or freeway surveillance and control systems in their jurisdictions. The project also includes developing recommendations regarding existing and emerging communications technologies for use with traffic control systems.

Prior traffic control projects in which Mr. Kay has been involved include those in Los Angeles, Baltimore, Phoenix, Tucson, Hartford, Alexandria, Salt Lake City, and the FHWA UTCS program. Mr. Kay has been directly involved in numerous research projects including developing traffic control requirements for major incidents, measures of effectiveness for traffic management techniques, low cost motorist information concepts, freeway data collection, criteria for traffic signal removal, signal warrants using gap detector data, pedestrian actions at traffic signals, and automatic highway advisory radio.

Mr. Kay's traffic operations experience includes major circulation projects for Dulles Airport, Baltimore County, the Northern Virginia area, Salt Lake City, San Bernardino, Riverside, Stockton, and numerous other city and state agencies.

Mr. Kay has worked extensively as an advisor on traffic and transportation projects for The World Bank. He has consulted on projects in Manila and Cebu, the Phillipines; Jakarta, Indonesia; Kuala Lumpur, Malaysia; and Bangkok, Thailand. Mr. Kay also served as a co-instructor with a Bank staff member for a transportation course given for Chinese public works officials in Shanghai. He has also served as guest lecturer for courses as the Bank's training facility in Washington, D.C., at American University, at the University of South Carolina. Mr. Kay's international experience also includes projects in Iran and Columbia.

Prior to becoming a consultant with JHK & Associates, Mr. Kay worked for Caltrans in the traffic department, was Assistant Traffic Engineer in Riverside and Traffic Engineer in San Bernardino, California.

Mr. Kay is a Fellow of the Institute of Transportation Engineers, a member of the Transportation Research Board Committees on Freeway Operations and Traffic Signal Systems, and a Professional Traffic Engineer in the State of California.

JAMES A. KINNARD

Mr. Kinnard is a Senior Engineer with JHK & Associates with particular expertise in hardware and software design, computer and systems engineering, traffic control equipment and the integration of equipment into traffic control systems. Mr. Kinnard has participated in the integration of all major types of signal controller equipment into computerized signal control systems. Mr. Kinnard's expertise also includes development of software to interface graphical devices to real-time applications software, development of real-time communications software and development of firmware for microcomputer-based traffic controllers.

Examples of Mr. Kinnard's experience include:

- City of Sioux City, Iowa - Project Manager during the replacement of the City's UTCS-Extended system with JHK's Series 2000 system. Responsibilities included the overall management of all system software work, budget management, equipment procurement, the redesign of local interface units to allow time-based coordination backup, and management of all on-site activities, including integration, acceptance testing, and training.

- City of Portland, Oregon - integrated fixed-time and actuated controller firmware packages written for the Model 170 Controller into a UTCS-based traffic control system, providing once-per-second control and monitoring functions from the host computer.

- Software design, development and software task leader of a complete distributed processing traffic control system, consisting of a host computer communicating with master controllers which, in turn, communicated with local intersection controllers.

- Communications software for a freeway traffic management system installed for the Burlington Skyway in Toronto, Canada. The system communicates with 128 control devices consisting of detector stations, lane control stations, ramp metering stations, intersection controllers, sign blankout stations, a changeable message sign submaster and a freeway illumination management system.

- Graphics software for a data acquisition and control system for Piedmont Road in Atlanta, Georgia. The software monitors real-time intersection and detector status in a graphical format.

- Mr. Kinnard was on-site in Sioux City, Iowa during the integration of the city-wide communications cable network. His work included the modification of controller wiring for adapting to the field communications units, termination of trunk line cables in controller cabinets and design and construction of a standby master/watchdog timer unit, used to provide synchronization pulses to the field communications units in the event of a communications failure.

- Developed for the City of Denver, Colorado, real-time graphics software for each of three different graphics devices, developed and integrated system communications software and tested ramp metering controller firmware. In a recent system expansion project, Mr. Kinnard provided substantial feature enhancements to both the central computer system software and the ramp metering controller firmware.

- Developed for the City of Columbus, Ohio, a ramp metering firmware package for a Model 170 Controller, to provide time-of-day, traffic responsive, manual and queue-override modes of operation.

Mr. Kinnard's qualifications also include an excellent working knowledge of FORTRAN, Pascal, BASIC and assembly languages with over eleven years of experience on a variety of mainframes, minicomputers and microcomputers.

Mr. Kinnard is an honor graduate of the Georgia Institute of Technology with a Bachelor's Degree in Electrical Engineering, and is also a member of the Institute of Electrical and Electronics Engineers (IEEE).

DENNIS O. KITCHENS

Mr. Dennis Kitchens is a Senior Systems Engineer with JHK & Associates. Mr. Kitchens has a working knowledge of FORTRAN, COBOL, PASCAL, C, and various assembly languages and several data base software packages. He also has experience on several mainframe, mini and micro computers.

Mr. Kitchens is currently working on data base applications for a contractor billing mechanism for the City of New York and an accident records system for the Port Authority of New York/New Jersey. Mr. Kitchens also assists in the software maintenance of JHK & Associates' UTCS Enhanced installations (Los Angeles, Ottawa, Anaheim, Jacksonville).

Mr. Kitchens' experience includes:

- Participation in the conceptual design of a mulit-agency project to provide coordinated control of both arterials and freeways in the Los Angeles, California area -- requiring integration of existing traffic control systems, expert system technology and advanced data base/access methodologies through a central mechanism.

- Task leader for software enhancements performed on the Los Angeles Traffic Control System. His responsibilities included design and implementation of software allowing UTCS intersection control and communication to be performed by coordinated peripheral processing hardware.

- Project leader for a maintenance record keeping system developed for the Federal Highway Administration. Mr. Kitchens' responsibilities on this project included system design and an implementation incorporating high level language, screen management, and data base techniques on the IBM AT personal computer.

- System design of parking citation management system implemented on the IBM personal computers.

- Team leader of the software development group for the Los Angeles ATSAC System Project. Mr. Kitchens' responsibilities on this project included, the development and adoption of traffic control system software to the enhanced version of the UTCS software of the Federal Highway Administration and system administration for the Perkin-Elmer 3230 installed in Los Angeles.

- Maintenance of JHK & Associates's signal timing program library which includes a full complement of state-of-the-art signal timing development tools.

- Performance of system timing tests for Perkin-Elmer 3220 in Grand Rapids, Michigan.

- Installation and testing of timing optimization programs including TRANSYT, PASSER II-80, SIGART, and SIGRID on several mini-computers.

- Adaptation of above signal timing programs to interface with time-space plotting and time-space printer/plotting programs.

- Prior to joining JHK & Associates, Mr. Kitchens was a programming assistant with the United States Army Corps of Engineers, South Atlantic Division Laboratory. Work consisted of development and implementation of new computer programs, revising existing programs, and education of personnel in program and system usage.

Mr. Kitchens holds a Bachelor of Science and a Master of Science in Biology and Health Systems with emphasis in computer science from the Georgia Institute of Technology and partial completion of a Master of Science in Information and Computer Science at Georgia Institute of Technology.

KEVIN LEAMON

Mr. Leamon is a Systems Engineer with JHK & Associates' Atlanta office. His qualifications include over four years of extensive experience with FORTRAN and other programming languages such as COBOL, BASIC, Assembler, and C on a variety of mainframe, mini-, and microcomputers. Mr. Leamon specializes in development of general purpose software, user interface software, system and program documentation, and user training.

He is currently involved in the development of remote data access software additions to the Los Angeles, California Automated Traffic Surveillance and Control (ATSAC) System. This will enable the Supervisor computer to graphically display traffic control data obtained from remote area computers.

Mr. Leamon has had primary responsibility for the coding, testing, documentation, maintenance, installation, and training for JHK's On-Line Real-time Interactive Graphics and Screens (ORIGAS) software. This software provides a user defined operator interface system for real-time control systems, including urban traffic control systems or freeway traffic surveillance and control systems.

Mr. Leamon's involvement includes:

- Supervision and direct involvement in installation of real-time color graphics language software systems, including Perkin-Elmer, VAX, IBM AT, and Motorola VME computers.

- Development of and personnel supervision in the use of real-time color graphics language software for the following traffic monitoring and control systems:

  - Freeway Traffic Management System (FTMS) in Burlington, Ontario, Canada.

  - Traffic Control System (TCS) in Atlanta, Georgia, utilizing a remote Motorola graphics workstation.

  - Enhanced based UTCS also utilizing a remote Motorola graphics workstation and a large scale projection system, in Jacksonville, Florida.

- Development of and personnel supervision in the use of screen management software used for user interface in the following applications:

  - TRANSYT-7F Interactive Input Utility (TIU) and Supervisor Operator Interface Language (SOIL) in the Los Angeles, California ATSAC system.

  - Burlington Skyway Freeway Traffic Management System (FTMS) operator interface.

- Portland, Oregon Extended based UTCS operator interface.

Additional contributions by Mr. Leamon include:

- o Development of data base systems on data base/reports/query software packages such as FOCUS.

- o Design and implementation of general software utilities for numeric conversion.

A graduate of Olivet Nazarene College, Mr. Leamon holds a Bachelor of Science degree in Computer Science with an emphasis in accounting.

M. SCOTT MAC CALDEN, JR.

M. Scott Mac Calden is a Senior Systems Engineer in JHK's Emeryville office. The following highlights Mr. Mac Calden's experiences in the field of traffic engineering.

- Senior Systems Engineer with JHK & Associates: Project Director for the Traffic Surveillance and Control Feasibility Study conducted for the OKI Regional Council of Governments in the Greater Cincinnati area. The project developed a plan for implementing surveillance and control measures to expedite traffic both during commute periods and when incidents occur.

- A team leader for the Sacramento/San Francisco region of the California Smart Corridor Statewide Study which is investigating the feasibility of employing Smart Corridor technologies throughout the urbanized areas of the State.

- Senior Traffic Engineer with Bechtel Civil, Inc.: Responsible for traffic system management on the Central Artery-Third Harbor Tunnel Project. This included planning for traffic control and mitigation measures during construction and developing traffic management systems needed for the continued operation of the project upon completion of construction.

- Senior Engineer for California Department of Transportation - Highway Operations: Implemented ramp metering operations, primarily in the San Jose area. This included start-up procedures, evaluation studies, and on-going monitoring of ramp metering projects once they were on-line. These activities involved considerable coordination with local agencies, enforcement officials and contact with the travelling public.

  A system was set up to provide lane closure recommendations which are now included in the Special Provisions of all contract documents. The purpose of these recommendations is to provide bidders with a reasonable expectation of the amount of time the Contractor will have available for working on the existing highway system. At the same time, it alerts the engineering staff to those situations where special consideration must be given to traffic controls in order to allow the Contractor sufficient time to accomplish the work.

  Special Event traffic control was also developed. This was especially necessary for football games and other events at Candlestick Stadium in San Francisco. Other events where special effort was needed include major events at the Sears Point International Raceway, the Democratic National Convention, and Superbowl XIX at Stanford Stadium.

Initiated the work in Caltrans District 4 for developing major incident response teams to work with the Maintenance Branch and the Highway Patrol to minimize incidents and delay caused by major incidents such as overturned trucks and toxic spills. These teams were patterned after the successful operations pioneered in District 7 in the Los Angeles area.

Mr. Mac Calden was also in charge of traffic management operations including development of a Bay Area traffic operations center and a traffic management system for the San Francisco-Oakland Bay Bridge.

- Traffic Systems Engineer for California Toll Bridge Administration: In charge of regional traffic planning, revenue forecasting and financial feasibility studies for proposed toll projects. Supervised operational studies such as: priority lanes for buses and carpools, one-way toll collection, TV surveillance and emergency roadside service.

- Assistant Bridge Engineer for California Toll Bridge Administration: Performed structural analysis and design for the reconstruction of the San Francisco-Oakland Bay Bridge.

Other experience includes Structural Engineering for Jackson and Moreland, Inc. of Boston; SP-2 Surveyor for the U.S. Army in Panama; and Structural Engineering for Glenn L. Martin Aircraft Structural Analysis Department in Baltimore.

Mr. Mac Calden received his BS and MS from MIT. He currently holds a California Civil Engineering license, a Professional Engineer license in Illinois and is a member of the American Society of Civil Engineers and a Fellow of the Institute of Transportation Engineers.

BARRY S. MARRUS

Mr. Marrus, Vice President, is located in the San Francisco Office of JHK & Associates. He specializes in the development, management, and research associated with traffic control systems.

Mr. Marrus has been involved as project director or senior technical advisor in many of JHK's major traffic control system projects. The projects have involved the feasibility, design, implementation and/or signal timing plan development for traffic signal control systems in various cities including: Phoenix, Tucson, Scottsdale, Mesa and Tempe, Arizona; Pasadena, San Jose, Chula Vista and Los Angeles, California; Albuquerque, New Mexico; Portland, Eugene, and Springfield, Oregon; Salt Lake City, Utah; Ottawa and Toronto, Canada; Tel Aviv, Israel; and Manila, Philippines.

In particular, Mr. Marrus served as Manager of the JHK projects in Portland, Eugene, Springfield, Pasadena and San Jose. These projects included the design and implementation of traffic signal control systems utilizing JHK's state-of-the-art Series 2000 system. The design size of these systems ranged from Springfield (96 intersections) to Portland and San Jose (more than 700 intersections). All of these systems utilize City-owned twisted pair cable as a primary means of communication. In Portland, expansion will make use of leased CATV facilities and in San Jose, leased telephone facilities. These projects have included the use of both Model 170 and NEMA traffic signal controllers.

Mr. Marrus served as Project Manager for the design phase of the Los Angeles Automated Surveillance and Control System. The system has an ultimate capacity of over 3000 intersections. The overall system concept incorporates a central supervisory computer connected to several area computers with stand-alone capability. The system software is based on the UTCS Enhanced Version modified by JHK. The hardware configuration incorporates an open architecture design to be able to take advantage of changes in technology as the system is expanded.

Mr. Marrus has also served as the Manager of the consulting teams responsible for the predesign analysis, final design and implementation monitoring for signal systems developed by others. Examples are Seattle, Salt Lake City and Phoenix as described below.

- Most recently, Mr. Marrus directed the team responsible for the development of the traffic signal system in Seattle. This system has a design size of 500 intersections. The project included the development of a long range communications master plan for the on-going expansion of the system. The system utilizes a City-owned twisted pair cable network for both data and voice communications. A specially designed display graphically indicates when and where emergency vehicle preemption is activated in the downtown area.

- Mr. Marrus served as JHK's Project Manager during the feasibility, design, and implementation phases of a computerized traffic signal system project in Salt Lake City, Utah. The system controls approximately 175 signals. Implementation included inspection of the central system and monitoring of activities by the contractor.

- The Phoenix project involved the implementation of computerized signal control for over 260 intersections. In his role as project manager, Mr. Marrus supervised preparation of PS&E, conducted prebid conferences, and evaluated bidder proposals. He also monitored contractor activities and established the traffic signal timing strategies, as well as providing continuing technical and project control assistance to the City.

Mr. Marrus also directed a project to evaluate all traffic signals in the Denver Metropolitan Area. The purpose of the project was to develop a range of strategies which would improve signal operation and, thereby, reduce fuel consumption and air pollution. The project covered 19 jurisdictions and over 2000 traffic signals. The recommendations included a program of traffic signal related projects for each jurisdiction which estimated both potential benefits and projected costs. The implementation plan included a prioritization of all projects within the region as well as within each individual jurisdiction.

Mr. Marrus had senior technical responsibility on a feasibility study for a Tel Aviv Metropolitan Area Traffic Control System in Israel. This major JHK project included the surface street signal system and the new freeway under construction adjacent to the C.B.D.

Mr. Marrus has also played a major role in transportation research projects, including strategy design for a bus priority demonstration project in Ottawa, Canada and the development of SIGOP for the Federal Highway Administration.

Mr. Marrus has been a special lecturer in Traffic Control to graduate students in the department of Civil Engineering, University of Toronto, and undergraduate civil engineering and geography students at McMaster University (Hamilton, Canada).

Mr. Marrus has served as an alternate delegate to international committees on urban traffic control systems and electronic aids for freeways, sponsored by the Organization for Economic Cooperation and Development (OECD).

Mr. Marrus received the degree of Bachelor of Civil Engineering from Cornell University. He is a registered Professional Engineer in California (Traffic) and Ontario, Canada (Civil). He is a member of the Institute of Transportation Engineers.

ROBERT G. RAUSCH, P.E.

Mr. Rausch is a Senior Associate at JHK & Associates with expertise in traffic control systems, variable message sign systems, traffic control hardware product development, and communications systems. His experience includes the design and implementation of communications systems and equipment, changeable message signs and systems, traffic signal controllers, time-based coordinators, centralized traffic control systems, "closed loop" traffic signal systems, and water management telemetry and control systems. Mr. Rausch has more than 20 years experience in real-time control systems and product development.

Mr. Rausch is currently the Project Manager for the development of the traffic control system to perform the on-line control of all (12,000) signalized intersections in New York City. This equipment configuration consists of a complex network of over 200 parallel processors, 2,700 Remote Communications Units, 20 workstations, and discrete input-output for direct control of selected local intersections. The system employs CCTV networks, voice-grade leased facilities, leased DC-interconnect, broad band LAN's, leased T-1 facilities, and a local Ethernet.

Mr. Rausch held the position of Chief Engineer for Winko-Matic Signal Company from 1972 to 1988. In 1986, he was appointed to the position of Vice President of Winko-Matic and Multisonics. As Chief Engineer, Mr. Rausch was responsible for the development of a wide range of traffic control products and systems. Mr. Rausch has served as the Project Engineer for the installation of a number of UTCS traffic control systems. As prime contractor, he had the responsibility of coordinating the efforts of product development, construction, field installation, and final system integration. Representative samples of systems include: Paterson, NJ; Tucson, AZ; Lubbock, TX; Evansville, IN; Lexington, KY; Clearwater, FL and Columbus, OH.

Mr. Rausch has extensive experience in developing and implementing a wide range of communications technologies for the traffic control industry, including twisted pair, CCTV, CATV, leased telephone lines, cellular phone, radio telemetry and DC pulse interconnect systems. Mr. Rausch has designed and integrated CATV based traffic control systems in 6 major cities. For changeable message sign systems, Mr. Rausch has designed and installed lamp matrix sign systems, disk matrix sign systems, drum signs, portable disk and lamp matrix signs, flap signs, and tri-color signs. These systems included centralized computer control and communications networks. Some representative systems include: Eisenhower tunnel CO; Newburgh Beacon Bridge, NY; Lake Ponchartrain Causeway, LA; Bakersfield, CHP System, CA; and the Howard Franklin Bridge, FL.

Prior to joining Winko-Matic, Mr. Rausch held a position on the permanent research staff at Massachusetts Institute of Technology in the Electronic Systems Laboratory, where he completed contracts involving air traffic control, electronic mail, and system software (ICES - Integrated Civil Engineering System) for IBM mainframe computer systems. Mr. Rausch holds Bachelor and Master of Science Degrees in Electrical Engineering from Massachusetts Institute of Technology. He is a registered Professional Engineer and was an active participant in the NEMA technical committee developing the next generation of traffic signal controller standard.

WILLIAM L. SKILLAS

Mr. Skillas is an Electrical Engineer with JHK & Associates with experience in both traffic and communications engineering. His experience with JHK thus far includes:

- Project Engineer for the Tampa Computerized Traffic Control System, Phase 2 Design Group 4 project. Mr. Skillas was heavily involved in several aspects of this project, including the evaluation and updating of the existing communications cable network, the design of the expansion communications cable network, equipment inventory, and bid-ready plans and specifications development.

- Project Engineer for the Charlotte, North Carolina Signal System Computer Replacement project. Mr. Skillas performed an in-depth testing and evaluation program with the existing communications cable network.

- Project Engineer for the Gainesville Computerized Traffic Signal System, Phase 2 Design Group 1 project. Mr. Skillas assisted in the review of the bid-ready plans package, tabulation of quantities, and the development of micro-computer and communications hardware specifications.

- Communications Engineer for several central control systems. Mr. Skillas has assisted in the design and construction of the Central Communications Unit hardware for the Los Angeles, California; Portland, Oregon; Ottawa-Carleton, Canada; and Springfield, Oregon; traffic control systems.

- Resident Engineer for the Seattle Central Business District/Mercer Street Signal System Implementation Project. Mr. Skillas was heavily involved in all aspects of the system integration including cable plant design and testing, software testing and system pickup.

- Project Engineer for the Eugene and Springfield Computerized Traffic Signal System Implementation Projects. Mr. Skillas was heavily involved in all aspects of the system integration including cable plant testing, system pickup and training.

- Assistant Project Manager for the Chula Vista Computerized Traffic Control System Implementation Project. Mr. Skillas is heavily involved with all aspects of the system including, system configuration, software and firmware modification and testing. Mr. Skillas also conducted negotiations with Pacific Bell concerning leased telephone line service for system communications.

- Project Engineer for the Pasadena Computerized Traffic Control System Implementation. Mr. Skillas is involved in all aspects of the system. Mr. Skillas' primary responsibilities are in system configuration and software and firmware modification and testing.

Mr. Skillas is a graduate of the Georgia Institute of Technology with a Bachelor's Degree in Electrical Engineering specializing in Communication and Control Systems Design. He maintains a Membership in IEEE and holds an EIT certificate from the State of Georgia.

DOUGLAS C. TERRY

Mr. Terry is a Senior Electrical Engineer with JHK & Associates. Since joining JHK & Associates in April of 1984, Mr. Terry has been involved in many aspects of traffic control systems. His experience in traffic control systems includes computer hardware and software design, the development of technical design specifications, management of system construction and implementation, and evaluation of traffic control communications systems.

Mr. Terry is currently serving as Series 2000 System Coordinator in JHK & Associates' Norcross office. In this capacity, he is responsible for the coordination of implementation and development activities for JHK's Series 2000 traffic control system throughout the United States.

Some other projects in which Mr. Terry has been involved since joining JHK & Associates include:

- On-Site Project Engineer, Seattle Signal System. Provided assistance to the City during signal system implementation in construction management, interim system operation, and system testing.

- Project Engineer, Portland, Oregon Traffic Control System. Performed a feasibility study on the use of a CATV network for traffic control system communications. Work included the preparation of specifications for broadband communications equipment.

- Project Engineer, Los Angeles ATSAC System. Preparation of specifications for data multiplexing equipment for traffic control communications over a fiber optic transmission network.

- Project Engineer, Traffic Control System Design for the completion of the communications system for Anaheim, California traffic signal system. This work includes completion of a City-owned twisted pair cable network for data communications, as well as CCTV video and control communications and a field voice communications system.

- An FHWA research project entitled "Investigation of Successful Communications and Traffic Control System Design, Installation and Operations Practices." Mr. Terry's primary responsibilities are in the area of communications and include a review of literature on current communications media and techniques, as well as a series of site visits to evaluate existing and new communications technologies.

- Hardware and software design and development of an intelligent central communications processor. This communications processor will be used in systems in Ottawa, Ontario; Portland, OR; Eugene, OR; and Los Angeles, CA.

- On-Site Project Engineer for the Atlanta Piedmont Road and One-Way Pair expansion projects. This work included the integration of 60 new intersections into their current system. The work also involved the expansion of the central communications system and the balancing and fine-tuning of the entire TDM communications system.

- Evaluation and trouble-shooting of communications systems, including central and field hardware and cable for the cities of Los Angeles, CA; Greensboro, NC; and Sioux City, IA. This work involved complete cable testing, performance tests of both central and local intersection communication, control, and interface hardware.

- Design and development of a low cost, miniaturized Communications Interface and Control Unit. This unit was designed to allow electromechanical controllers in small cabinets to be incorporated into a system without the cost of installing additional cabinets.

- Co-author of the technical specifications for New York City's Computerized Area Tracking System (CATS) computer and graphics hardware. This system is a data base/graphics system which will allow information on events affecting traffic patterns to be shown on maps of the City using color graphics displays.

- Design of a custom minicomputer hardware interface to an autoplexor/driver for control of full-size traffic control map display panels for the City of Tampa, Florida.

Mr. Terry is a graduate of the Georgia Institute of Technology with a Bachelor of Electrical Engineering degree. The majority of his elective course work was in analog and digital communications theory and techniques. He is a member of the Institute of Electrical and Electronics Engineers (IEEE) and an Associate Member of the Institute of Transportation Engineers (ITE). Mr. Terry holds a Georgia Certificate of Engineer-in-Training.

Mr. Terry is the co-author of a paper entitled "Data Communications Technology for Traffic Control and Surveillance Systems", which was published in the Compendium of Technical Papers for the 1987 ITE Annual Meeting.

MICHAEL O. WENDTLAND

Michael Wendtland is a recent addition to JHK & Associates' Los Angeles Office having joined the company from the Los Angeles County Department of Public Works.

While working in the County's traffic signal system group, Mr. Wendtland was responsible for signal timing plans at pretimed, semi-traffic actuated and fully traffic actuated intersections. He is familiar with many types of traffic signal controller including electromechanical, NEMA and Type 170 models. Mr. Wendtland has programmed Type 170 controllers using both the Q5 and LACO 1 (Los Angeles County) software.

With respect to coordinated signal operation, Mr. Wendtland has prepared timings using time-space diagrams, is experienced with several types of time-based coordination equipment including WWV radio referencing as well as both direct and leased telephone interconnect methods.

Prior to working for the County, Mr. Wendtland was a student Assistant-Transportation Engineer with Caltrans District 7 in Los Angeles where he worked in the Traffic Operations Center with the Semi-Automated Traffic Management System (SAMTS). Here he was responsible for the monitoring of and response to freeway traffic conditions which included adjusting ramp metering rates, preparing traffic advisory teletype messages, operating Changeable Message signs and coordinating traffic management efforts with the California Highway Patrol.

Mr. Wendtland has a Bachelor of Science degree from the California Polytechnic State University, San Luis Obispo and has obtained his Engineer in Training certificate.

January 1984

EDUCATIONAL BACKGROUND AND TECHNICAL EXPERIENCE

of

Adolf D. May

1. PERSONAL BACKGROUND

Born in Little Rock, Arkansas on March 25, 1927
Graduated from Little Rock High School in 1945
Military Service (V-5 Program) 1945-1947
Married Margaret Folsom in San Marino, California, 1948
Four children, Dolf, Barbara, David, and Larry

2. EDUCATIONAL BACKGROUND

B.S.C.E., Southern Methodist University, 1949
B.S.C.E., Iowa State University (Ames), 1950
Ph.D., Purdue University, 1955

3. TEACHING EXPERIENCE

1949-50, Iowa State University, Part-time Instructor
1952-56, Clarkson College of Technology, Assistant and Associate Professor
1956-59, Michigan State University, Associate Professor
1962-65, Northwestern University, Visiting Professor (part-time)
1965-67, University of California, Associate Professor
1967-Present, University of California, Full Professor

4. FULL-TIME INDUSTRIAL EXPERIENCE

1959-62, Thompson Ramo Wooldridge, Research Engineer
1962-65, Chicago Expressway Surveillance Project, Director

5. PART-TIME INDUSTRIAL EXPERIENCE

1954-56, Institute of Traffic Engineers, Assistant Executive Secretary
1955-56, Consultant to the Cities of Messena and Potsdam, New York
1957-59, Consultant to the City of East Lansing, Michigan
1967-83, Consultant to the Raytheon Electronics, Teknekron Inc., Alan Voorhees and Associates, Stanford Research Institute, Kell and Associates, Orincon Corporation, Ecological Impact Studies, Inc., Ruden and Associates, World Bank, Southeastern Wisconsin Regional Planning Commission, Peat-Marwick-Mitchell, Charles River Associates, Parsons-Brinckerhoff, and Verac Incorporated
At Present, Polytechnic Institute of New York and Midwest Research Institute

. PROFESSIONAL SOCIETIES AND ACTIVITIES

Transportation Research Board, Member
Chairman, Traffic Signal Systems Committee
Member, Highway Capacity and Level of Service Committee
Member, Freeway Operations Committee
Member, International Committee
Institute of Transportation Engineers, Member
American Society for Engineering Education, Member
Traffic Engineering and Control Journal
Editorial Advisory Board, Member
Transportation Research Journal
Editorial Advisory Board, Member

7. HONORS AND AWARDS

Tau Beta Pi, Sigma Xi
Honorable Mention, Past President's Award, ITE 1959
Best Technical Paper, Western Section ITE, 1960
Travel Award from National Science Foundation, 1963
Outstanding Civil Engineering Teacher, University of California, 1965-66
Fulbright-Hays Award, Technical University at Delft, 1977-78
Visiting Scholar, Massachusetts Institute of Technology, Spring 1978
Outstanding Purdue University Alumni Award, Spring 1978
Alexander von Humboldt Foundation, Senior U.S. Scientist Award 1984

. FOREIGN GUEST PROFESSORSHIPS

Europe - 1963, 1966, 1968, 1971, 1972, 1973, 1974, 1977, 1980
Japan - 1972, 1977
Mexico - 1968, 1969, 1972, 1973
New Zealand - 1979
South Africa - 1982
South America - 1969, 1970

Adolf D. May's PUBLISHED PAPERS (1/1981 thru 6/1984)

1. Adolf D. May and Said M. Easa, Assessing Traffic Management Strategies in Residential Neighborhoods. Transportation Research Board, Record 812, pp. 51-59, January 1981.

2. Said M. Easa and Adolf D. May, Evaluation of Traffic Management Strategies in Central Business Districts. Transportation Research Board, Record 816, pp. 1-10, January 1981.

3. Adolf D. May, Freeway Corridor Analysis. Published in Transportation Research Board, Special Report 194, The Application of Traffic Simulation Models, pp. 23-32, June 1981.

4. Suk June Kahng and Adolf D. May, Energy and Emission Consequences of Improved Traffic Signal Systems. Published in Transportation Research Board, Record 881, pp. 34-41, January 1982.

5. Adolf D. May, Ergun Gedizlioglu, and Lawrence Tai, Comparative Analysis of Signalized Intersection Capacity Methods. Presented at 1983 session of the Transportation Research Board on January 17, 1983. 29 pp. Also published in Transportation Research Board, Record 905, pp. 118-127.

6. Adolf D. May, State-of-the-Art in Control of Integrated Networks and Large Scale Systems. Paper prepared for the Engineering Foundation Conference of "Traffic Monitoring and Control Systems" held in Henniker, New Hampshire during June 26-July 1, 1983. 18 pp. Revised to Control of Networks and Large Scale Systems, to be published in the Proceedings. 12 pp.

7. Adolf D. May, Integrating the Control of Interacting Traffic Systems. Paper prepared for the Engineering Foundation Conference of "Traffic Monitoring and Control Systems" held in Henniker, New Hampshire during June 26-July 1, 1983 to be published in the Proceedings.

8. Adolf D. May, Wessel J. Pienaar, and Cecil A. Rose, The Use of the NCHRP Signalized Intersection Capacity Manual: A South African Experience. Presented at the 1984 session of the Transportation Research Board on January 17, 1984. 35 pp. To be published in the Transportation Research Board.

9. Suk June Kahng, Chawn-Yaw Jeng, James F. Campbell, and Adolf D. May, Developing Segmentwide Traffic Responsive Freeway Entry Control. Presented at the 1984 session of the Transportation Research Board on January 17, 1984. 34 pp. To be published in the Transportation Research Board.

10. Philip S. Babcock IV, David M. Auslander, Masayoshi Tomizuka, and Adolf D. May, The Role of Adaptive Discretization in a Freeway Simulation Model. Presented at the 1984 session of the Transportation Research Board on January 17, 1984. 54 pp. To be published in the Transportation Research Board.

11. Juan D. Sananez and Adolf D. May, Development and Application of a Macroscopic Model for Rural Highways. Presented at the 1984 session of the Transportation Research Board on January 17, 1984. 35 pp. To be published in the Transportation Research Board.

MICHAEL L. RUBINSTEIN

Mr. Rubinstein is a Senior Systems Consultant. His areas of expertise include real-time computer software, data communications, and digital logic systems. Mr. Rubinstein has over 18 years of computer systems experience.

During his association with JHK & Associates, Mr. Rubinstein had major responsibility on the following projects:

- A VME chassis based traffic communications control unit (CCU).
- An error-free serial communications protocol for minicomputers and personal computers.
- A real-time traffic graphics system.
- An ETHERNET based multi-computer, multi-task communications network.
- Enhancements to the City of Atlanta traffic system.
- A microprocessor based on-street master system. Work included an operating system, communication, logging, and report software.

Prior to his work with JHK & Associates, Mr. Rubinstein had major responsibility on the following projects:

- An automatic pouring system for ductile iron.
- A network system for intertask and intermachine communications.
- A computerize voice messaging system.
- A software driver for attachment of a vector auto-correlator image processor to a minicomputer.
- Microcode for a bit-slice communications controller.
- A software driver for a Perkin-Elmer minicomputer to IBM 370 mainframe channel interface.
- A timesharing monitor for a multicomputer network.
- Software drivers for floppy discs, printers, and virtual devices.
- A hardware minicomputer to mainframe channel interface.
- A real-time Fast Fourier Transform analysis system.

- Control software for an operant conditioning laboratory.
- An underwater sound transmission simulator.
- Graphics software for display of Spacecraft Guidance data.

Conrad L. Dudek

Dr. Dudek is President of Dudek & Associates and is Professor and Area Leader of the Transportation and Public Works Engineering Division of the Civil Engineering Department, Texas A&M University. He is also Director of the Southwestern Region University Transportation Center and Head of the Traffic Management and Information Systems Program of the Texas Transportation Institute, Texas A&M University. He received his Ph.D. Degree in Transportation Systems and Traffic Engineering at Texas A&M.

Dr. Dudek has an extensive background in real-time motorist information displays, human factors, traffic operations, and metropolitan traffic management. He has almost 30 years experience in the developmentment of freeway corridor traffic management and real-time motorist information systems.

Dr. Dudek was principal investigator for several federal and state research projects dealing with urban freeway corridor traffic management including "Human Factors Requirements for Real-Time Motorist Information Displays," and "Human Factors Design of Dynamic Visual and Auditory Displays for Metropolitan Traffic Management." He was also a Principal Researcher on the Dallas Freeway Corridor Project and the Gulf Freeway Surveillance and Control Project in Houston. He also served as a consultant to TRB and prepared "NCHRP Synthesis of Highway Practice 61 - Changeable Message Signs." He has done extensive research relating to real-time motorist information systems including the development and implementation of changeable message signs, highway advisory radio and telephone call-in systems for route diversion, incident management and highway construction and maintenance.

Dr. Dudek served as a consultant to the Los Angeles County Transportation Commission and the "Smart Corridor" Technical Committee and provided recommendations as to how real-time motorist information could be improved as part of the "Smart Corridor" project to encourage diversion around congestion. Specifically, he 1) analyzed conditions under which the motorists will divert from the freeway in the "Smart Corridor," 2) determined the placement displays and the information was needed to motivate motorists to divert, and 3) recommended message content to convey specific, consistent, and understandable information to all motorists via different communication modes.

He provided similar services to the City of Anaheim, California while working as a consultant with JHK & Associates, and to the Ontario Ministry of Transportation. He is currently working on a project to advise Caltrans on the use of changeable message signs for displaying travel time information during congestion. He is also serving as a consultant to TRB on freeway corridor management.

Dr. Dudek is currently preparing an Engineer's Guide on Changeable Message Signs. This work is sponsored by the Federal Highway Administration. He recently returned from Europe where he visited six countries and inspected the latest technology in changeable message signs.

Prior to joining Texas A&M University in 1967, Dr. Dudek was employed with the Michigan Department of Highways where he headed traffic research at the National Proving Ground for Freeway Surveillance, Control and Electronic Traffic Aids. The first full-scaled systems of electronic and television surveillance, ramp control and changeable message signs were installed and operated on the John C. Lodge Freeway in Detroit. He also served as highway research engineer for the Federal Highway Administration.

Dr. Dudek is considered an authority on real-time motorist information systems and his work is widely referenced. He has intimate knowledge of most systems in the United States and in foreign countries. He has personally visited 33 sites in North America and Europe where surveillance, control and real-time motorist information display systems were operating, and has discussed the problems of operations and human factors design with the hosts of these sites. He has also interviewed 16 users of highway advisory radio to discuss the problems with the operation and human factors design of messages, and met with several manufacturers of changeable message signs and highway advisory radio.

He is a member of numerous professional and technical societies. He is Chairman of the User Information Systems Committee of TRB; Chairman of the Institute of Transportation Engineers Committee 7S-3, "Work Zone Traffic Control"; Member of the National Committee on Uniform Traffic Control Devices, Construction and Maintenance Technical Committee; and is serving on the Freeway Operations Committee of TRB. He also served as a member of the ITE Technical Committee 4A-3, "Traffic Diversion Techniques."

He has authored over 160 significant reports, papers, and articles. He is Senior author on the widely used publications, "Human Factors Requirements for Real-Time Motorist Information Displays: Design Guide", and "Manual on Real-Time Motorist Information Displays". He received numerous honors including the Highway Research Board Award for a research paper of outstanding merit concerned with freeway operations. He is a registered engineer in Texas and Michigan.

KRISTER K. FAST

Ms. Fast is a Technical Specialist with Hughes Aircraft Company in the Ground Systems Group, and has been with the firm for more than 4 years.

Experience:

Ms. Fast is currently researching issues involved in the integration of knowledge-based expert systems into the command, control, communications and intelligence systems environment. One of her current project assignments includes expert systems design in conjunction with a nationwide commercial air traffic control system being built for the Canadian government.

Ms. Fasts' experience includes:

- o expert system development for DOD embedded computer environments
- o definition of system interface requirements for military expert systems and applications
- o developed an expert system application that serves as a tool for military planners
    - This system models a command and control communications network and performs analysis on that network to support "what if" scenarios, load analysis, and evaluation capabilities.

Ms. Fast has also developed an expert system which will aid air traffic controllers by detecting aircraft and air space conflicts and proposing a ranked set of resolutions to those conflicts to the controller.

Education:

MS	1988	Computer Science
BS	1985	Computer Science and Mathematics

BHADRA PATEL

Dr. Patel is a Senior Scientist with Hughes Aircraft Company in the Ground Systems Group, and has been with the firm for 10 years.

Experience:

Dr. Patel is currently the principal investigator for the C31 IR&D project on Systems Data Engineering Methodology.

He has had extensive experience on Command and Control system such as the Canadian Air Traffic Control Projects (CAATS) Technical Consultant in distributed processing, data bases and transaction processing; developed architectures and data engineering methodologies in a distributed environment; developed requirements for and a preliminary design for a real-time memory-based distributed data base system for managing real-time critical data; developed support toolset (integrated data dictionary, schema generators, MMU validation tools, stored query generators and configuration management tools) to create an effective integrated software/data base development environment for software and data base analysts.

Dr. Patel has been a data engineering consultant to the FAA's Advanced Automation System (AAS) Design Phase Program, developing data engineering guidelines for operational and data base analysts. He led a team of system analysts to develop distributed data base architecture to meet the response time requirements of the system.

Dr. Patel was the technical coordinator for the NEC CCIS (North European Command Command Control Information System) project with Hughes Information Systems in Irvine, responsible for developing a data base design methodology for a large complex data base and automated AI based tools.

Education:

PhD	1973	Electrical Engineering
MS	1969	Electrical Engineering
BA	1967	Electrical and Computer Sciences

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 100
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

RESUMES

Moses Katz, P.E.
Partner

B.S., Civil Engineering

Years Experience: 30

Reg. Traffic Engineer,
Cal. 1056

Signal Design: Worked for the City of Los Angeles, Dept. of Transportation for 17 years, including 13 years full-time experience in the Traffic Signal Design section. Performed traffic signal designs at a rate of 250 intersections per year. Creator of the flashing-red mid-block pedestrian signal concept, first implemented in Little Tokyo. As a consultant, responsible for preparation of traffic signal plans in the following jurisdictions: unincorporated Los Angeles County, unincorporated Orange County, El Toro, Irvine, Oxnard, Lancaster, Santa Monica, Beverly Hills, Oceanside, and Rancho Cucamonga.

Signal Timing: Four years full-time experience in signal operations for the City of Los Angeles. Set field settings for pretimed and actuated signal controllers for hundreds of City signals. Designed signal phase sequences. Designed the signal interconnect system for 200-signal coordinated systems.

Street and Highway Design: Totaled over 18 years experience in road design, working in the private sector and as a consultant. Produced road plans in the counties of Los Angeles, Orange, Riverside, Ventura, San Bernardino, Santa Barbara and San Diego, as well as the cities of Los Angeles, Oxnard, Irvine, Rancho Cucamonga, Lancaster, Palmdale, Alhambra, and others. Received Portland Concrete Cement's "Engineering Excellence Award for Intersection Design" (Lake Avenue and Walnut Street, Pasadena) in 1976. Designed over 317,000 feet of roads as a consultant in 1987. Developed AutoCAD software specifically tailored for design and drafting of road plans.

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 100
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

Walter Okitsu, P.E.
Partner

B.S., Mathematics-Computer Science
M.S., Transportation Engineering

Years Experience: 9

Reg. Traffic Engineer, Cal. 1406

Signal and Lighting Design: Prepared traffic signal and safety lighting plans for projects throughout Southern California, including unincorporated Orange County, unincorporated Los Angeles County, Oxnard, Compton, Long Beach, Alhambra, Pasadena, and Santa Monica.

Construction Management: Served as field traffic engineer for the construction of the Mid-Corridor segment of the Long Beach-Los Angeles Light Rail Project. Handled construction problems relating to traffic signals, striping, roadway geometrics, and railroad and light rail controls.

Signal Timing: Designed and installed optimal traffic signal timings at over 1,000 signals in Los Angeles, Manhattan Beach, El Segundo, Lawndale, Hawthorne, Redondo Beach, Long Beach, Pasadena and Los Angeles County. Provides expert witness testimony on legal cases involving traffic signal operations.

Traffic Impacts: Prepared impact study reports for office, residential, and commercial projects in the City of Los Angeles, Monterey Park, and unincorporated Los Angeles County. Analyzed the traffic impacts and construction feasibility of the Long Beach-Los Angeles, Torrance-Marina del Rey, San Fernando Valley, and Pasadena-Los Angeles light rail transit projects.

Katz, Okitsu & Associates
1200 Corporate Center Drive, Suite 100
Monterey Park, CA 91754
(213) 260-4703
Fax: (213) 260-4705

Kirby Leung, P.E.
Senior Engineer

B.S., Civil Engineering

Years Experience: 20

Reg. Civil Engineer,
Cal. 24850

Project Management: Since 1988, working in the private sector, has been responsible for traffic projects including the Los Angeles County Reception Center, El Segundo Light Rail and Pico Canyon/Interstate 5 interchange. Has headed the team doing the consultant plan checks for the Los Angeles County Department of Public Works.

Signal Design: 19 years with County of Los Angeles, Dept. of Public Works, including 6 years in traffic signal design. Prepared traffic plans for over 70 intersections throughout Los Angeles County. Designed the first signalized bike path in the U.S.A. in Marina Del Rey.

Road Design and Review: 11 years experience in road design and checking. Strong command of all phases of roads from initial conception, design, processing through agencies, and construction. Handled all types of rural and urban roads from local streets to mountain roads and highways. In 1987, approved/reviewed over 500,000 feet of roads. As assistant section head of the Road Section (38 total personnel), performed administrative and managerial duties. Met with citizen's groups, politicians, developers, and engineers to resolve road problems. Prepared the Department of Public Work's report to the Planning Commission defining Los Angeles County's *Road Requirement Guidelines* in all urban and rural developments--past, present and future.

Contract Administration: 1 year experience as contract administrator for checking all Los Angeles County development, maps and plans. Sole monitor and coordinator of over 500 plans in process with 6 consultants.

Huy Pham
Software Engineer

B.S., Computer Science & Chemical Engineering

Years Experience: 5

Computer Systems: IBM 370/158 OS/DOS/VSI, CMS, IBM AT/PC DOS, SUN-3/60, UNIX 4.2, PDP 11/44-PDP 11/70, RSTS/E, VAX 11/780, VMS, DCL, RT11, RSX-11.

Languages: C, Fortran, Basic, Macro-11, IBM 370/360 & 86020 Assembler, Pascal, Cobol, PL/1, LISP, IBM JCL.

Work Experience: Created and maintained application software in traffic and civil engineering design and research. Developed CAD systems to solve the following engineering problems:

- o Traffic/Transportation: signal control and traffic simulation
- o Earthwork: iso-contour mapping, 3-D view maps
- o Hydraulics: storm drain design
- o Hydrology: analysis, flood routing
- o Road Design: horizontal and vertical design

Doug Kien Yeh
Project Engineer

B.S. Optical Engineering

Years Experience: 2

Signal and Lighting Design: Project engineer for traffic signal and safety lighting designs at the following locations: Gayley Avenue and Le Conte Avenue, in Los Angeles (Westwood); Glendale Boulevard and Riverside Drive in Los Angeles (Silver Lake); Cloverfield Boulevard and Broadway in Santa Monica; and conduit-only plans along McBean Parkway in northern Los Angeles County.

Striping Plans: Project engineer for signing and striping plans for: Gayley Avenue in Los Angeles (Westwood); Lankershim Boulevard and Magnolia Boulevard in Los Angeles (North Hollywood); 20th Street East in Lancaster; Thousand Oaks Boulevard in western Los Angeles County (Agoura); and Alicia Parkway in Orange County (Mission Viejo). Provided conceptual design for an innovative reverse-flow left turning scheme on Tillary Avenue in Brooklyn, NY, and on Slauson Avenue in Culver City.

Computer-Aided Drafting (CAD): Expert user of AutoCAD software for traffic, street lighting, and highway design. Responsible for dozens of CAD-produced plans for the Long Beach-Los Angeles Rail Transit Project.

Bernard Li
Project Engineer

B.S., Electrical Engineering

Years Experience: 2

Signal and Lighting Design: Project engineer for traffic signal designs for three projects in unincorporated Orange County, one project in El Toro, two in unincorporated Los Angeles County, one on Rodeo Drive in Beverly Hills, one in Pasadena, one in Lancaster, one in Alhambra, one in Oceanside, one in Rancho Cucamonga, and two in Oxnard. Assisted in street lighting design for a project in Pasadena.

Striping Plans: Project engineer for signing and striping plans for Douglas Avenue in Oceanside, Archibald Avenue in Rancho Cucamonga, Rodeo Drive in Beverly Hills, and numerous projects in the City of Los Angeles.

Computer-Aided Drafting (CAD): Extensive experience in AutoCAD software for traffic, street lighting, and highway design, and in computer systems in general.

Road Design: Project Engineer for road plans located in the counties of Orange, Los Angeles and Riverside, as well as the cities of Palmdale, Lancaster and Irvine.

Viki Leung
CAD Supervisor

Years Experience: 1

Supervisor: Heads CAD unit(3 members) and is responsible for assignments, reviews and scheduling.

Computer-Aided Drafting(CAD): Experienced in AutoCAD software for traffic and road design. Responsible for dozens of CAD produced plans in Los Angeles, Orange, Riverside and Ventura Counties.

Tracy Moriya
Project Engineer

Years Experience: 1

Signal and Lighting Design: Project engineer for design of street lighting at various locations throughout Los Angeles. Prepared signal and safety lighting.

Computer-Aided Drafting(CAD): Experienced in preparation of traffic, lighting and road plans using AutoCAD.

Curt Freeman
Traffic Engineering Specialist

Years Experience: 23

Traffic Survey: 23 years with Los Angeles City Dept. of Transportation. Extensive experience in gathering traffic field data, interpretation and recording. Performed key survey during 1984 Olympics. Headed Record Unit for all city signs.

Striping Design: Prepared detour plans for projects in Montebello and Los Angeles

Signal Timing: Project engineering technician setting traffic signal coordination at over 700 intersections in Los Angeles.

Salvador Lopez
Civil Engineering Assistant

B.S.C.E., M.A.

Years Experience: 30

Reg. Civil Engineer
Puerto Rico 9249

Signal Design: 20 years with Nicaragua Urban Planning Offices, including 3 years in traffic signal and geometric design.

Traffic Impacts: 7 years preparing impact study reports on public transportation systems.

Highway Design: 10 years experience preparing and checking plans in both public and private sector.

Kamal Mouchantaf
Project Engineer

B.S., Civil Engineering

M.S. Structural Engineering

Years Experience: 3

Signal Design and Traffic Investigations: 1 year with State of New York Department of Transportation. Prepared traffic reports on safety, performed field investigations, inspections and Traffic Signal Plans. While at KOA, has become proficient at AutoCAD use in the design of Traffic Signal Plans.

Structural Engineering: Worked for 2 years in the private sector performing structural analysis on Nuclear Power Plants.

M. CONFLICT OF INTEREST

M. Conflict of Interest

SECTION M

CONFLICT OF INTEREST

This is to certify that neither JHK & Associates nor any of its subcontractors or its consultants have any conflict of interest with regard to this project.

Tom L. Stout, Senior Vice President

N. Cost Proposal

CONTRACT PRICING PROPOSAL (Professional Services)	LACTC "FORM 60"	PAGE 1 OF 2
Name of Proposer JHK & Associates	Service to be Furnished System Management Services (Prime Consultant)	
Home Office Address Bay Bridge Office Plaza 5801 Christie Avenue, Emeryville, CA 94608		
Division(s)/Location(s) Where Work is to be Performed JHK & Associates 205 S. Broadway, Suite 907, Los Angeles, CA 94608	Total Amount of Proposal	Contract No. TP017

DETAILED DESCRIPTION OF COST ELEMENTS

1. Direct Labor (Specify)	Estimated Hours	Rate/Hour	Est. Cost ($)	Total Est. Cost
Officer/Technical Specialist	2,352	$42.00	$ 98,784.00	
Project Director (Mr. Alan Clelland)	3,624	37.00	134,088.00	
Systems Associate	1,040	37.50	39,000.00	
Senior Engineer	14,626	30.00	438,780.00	
Engineer	8,082	26.00	210,132.00	
Support/Drafting	2,250	15.00	33,750.00	
Total Direct Labor				$954,534.00
2. Labor Overhead	**O H. Rate**	**x Base =**	**Est. Cost**	
	100%	$954,534.00	954,534.00	
Total Labor Overhead				$954,534.00
3. Travel*			**Est. Cost**	
a. Transportation			45,000.00	
b. Per Diem or Subsistence			38,000.00	
Total Travel				83,000.00
4. Subcontractors/Subconsultants **			**Est. Cost**	
Hughes Aircraft Company, Ground Systems Group			54,975.00	
Katz, Okitsu & Associates			360,488.00	
Total Subcontractors				$415,463.00
5. Other Direct Costs ***				727,750.00
TOTAL DIRECT COST AND OVERHEAD				
6. General & Admin. Expense (10 % of item nos. 3-7)				68,975.00
7. Fee (15% of burdened labor)				286,360.00
TOTAL ESTIMATED COST AND FEE				3,490,616.00

* Itemize on second page of "Form 60"
** Attach LACTC "Form 60" for all proposed subcontractors/subconsultants
*** Itemize on second page of "Form 60"

CONTRACT PRICING PROPOSAL (Professional Services)	LACTC "Form 60"	PAGE 2 OF 2

SUPPORTING SCHEDULE

ITEM NO.	ITEM DESCRIPTION	EST. COST ($)
1	Printing and Production Materials	$ 3,000.00
2	Communications (Phone, FAX, etc.)	5,000.00
	Equipment Items to be purchased for project:	
3	Smart Corridor Central Computer System	
	1 - DEC VAX 3400 System & Sybase DB Software	174,500.00
4	ATSAC & SATMS Node Processors	
	2 - DEC VAX 3100 System & Sybase DB Software	108,750.00
5	Expert Systems	
	3 - SUN 3/80 GX Workstations & G2 Expert Shell Software	215,500.00
6	PC Workstation Systems	
	6 - Compaq 386 VGA Workstation PC System	87,500.00
7	Network Communications Equipment	
	(Routers, Modems, Network Software, & Miscellaneous Cables	
	& Connectors)	103,500.00
8	CMS Design Workshop/Training	
	(Mr. Conrad Dudek - Transportation Consultant)	15,000.00
9	Traffic Simulation/Expert System Workshop/Training	
	(Dr. Adolf May - Transportation Consultant)	15,000.00

Type name and title	Signature
Tom L. Stout - Senior Vice President	
Name of firm	**Date of submission**
JHK & Associates	March 14, 1990

	Responsible Officer	Project Director	Technical Manager	Senior Engineer	Engineer	Systems Analyst	TE Associate	Technician	Drafting/ Secretarial	Consultant	
COS Rates	$42.00	$37.00	$42.00	$30.00	$26.00	$22.00	$30.00	$12.00	$15.00	$37.50	
Task	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Total Hours
Task A: Preliminary Design											
A1 Kick-Off Meeting	16	8	8	8	0						40
A2 Examine Existing Sys. Functionality		40			40				8		88
A3 Define Operation of Existing Sys.		40		40	40				8		128
A4 Define Smart Corridor Sys. Funct.	4	80		80	40				16		220
A5 Examine System Alternatives	4	80		80	40				16		220
A6 Perform System Analysis		60	80	160	160				80		540
A7 Revise/Expand Sys. Prelim. Design	4	80		80	40				40		244
A8 Define Field Equip. Requirements	4	40	0	60	20				8		132
A9 Update Technology Information	4	40	20	80	40				16		200
A10 Conduct Field Studies	4	80		120	40				16		260
A11 Assemble Prelim. Eng. Plan Data	4	20		24	40				16		104
A12 Identify/Analyze Alternative	4	40		120	40				16		220
A13 Define Field Components	4	40		80	20				16		160
A14 Prepare Prelim. Design	4	60		40	80				16		200
A15 Prepare Prelim. Design Report	20	80	20	40	80				60		300
Task B: Central Data Base & Expert Sys.											
B1 Develop Software Design		80	320	400	400				200		1400
B2 Prep. Test Software Design Spec.			8		80					120	208
B3 Prep. Data Base Server Design Spec		20	80	360	360						820
B4 Prep. Expert Sys. Design Spec.		40	160	360	240		400		80		1280
B5 Prep. ATSAC Interface Spec.		8	40	240	160						448
B6 Prep. SATMS Interface Spec.		8	40	240	240						528
B7 Prep. CHP Interface Spec.		40	20	160	160						380
B8 Prep. Field Equip. Interface Spec.		8	8	240	160						416
B9 Prep. Network Comm. Software Design Spec.		8	8	160						240	416
B10 Develop User Interface Prototype		8	20	240	360						628
B11 Prep. Procurement Spec.			8	160	160				160		488
B12.1 Smart Corridor Computer System				20	40				20		80
B12.2 Node Processor Computer System				20	40				20		80
B12.3 Expert System Computer System				20	40				20		80
B12.4 User Workstations				20	40				20		80
B12.5 Comm. & Support Hardware				80	80				40		200
B13 Dev./Test Sys. Simulation-Test Software			20	280	160					160	620
B14 Dev./Test Data Base Server Software			40	440	480					160	1120
B15 Dev./Test ATSAC-SATMS Expert Sys. S/W			80	320	240		360				1000
B16 Dev./Test Smart Corridor Expert Sys. S/W		40	80	320	240		360				1040
B17 Dev./Test ATSAC Data Base Interface Software			40	400	200						640
B18 Dev./Test SATMS Interface Software			40	400	200						640
B19 Test CHP Interface Software			20	120							140
B20 Dev./Test Field Equip. Interface Software			8	160	160						328

Exhibit N.1. Estimated Hours by Task

	Responsible Officer	Project Director	Technical Manager	Senior Engineer	Engineer	Systems Analyst	TE Associate	Technician	Drafting/ Secretarial	Consultant	
COS Rates	$42.00	$37.00	$42.00	$30.00	$26.00	$22.00	$30.00	$12.00	$15.00	$37.50	
Task	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Total Hours
B21 Dev./Test Network Comm. Software			8	240	80					320	648
B22 Dev./Test Workstation User Interface Sftwre.			80	360	360					40	840
B23 Perf. Simulated Sys. Test At Sys. Mgr's		80	80	160	160						480
B24 Relocate & Test Sys. Hardware in L.A.		8		80	80						168
B25 Conduct Subsystem Testing in L.A.		20		240	160						420
B26 Conduct Sys. Testing in L.A.		20		240	160						420
B27 Prep. Software Design Data Base Doc.		8	20	120	160				160		468
B28 Prep. Expert Sys. Doc.		8	40	200			160		160		568
B29 Prep. Graphical User Interface Doc.		8	20	200	80				240		548
B30 Prep. System Operations Doc.		80		80	80				160		400
B31 Prepare Hardware Configuration Doc.				80	80				80		240
B32 Provide Software/Data Base Training		20	40	160	80				16		316
B33 Provide Expert Systems Training			40	160			80		16		296
B34 Provide Graphical User Interface Training		20		120	80				16		236
B35 Provide System Operations Training		40		120					16		176
B36 Provide Hardware Configuration Training				30	16						46
Task C: Design CCTV Element											
C1 Assemble Base Plans		4		8	24				0		36
C2 Conduct Field Reviews	24	24		8	24				0		80
C3 Plan Prep. Process		8		40	8				0		56
C4 Finalize Display Features		24		40	0				16		80
C5 Finalize System Interface		8		40					4		52
C6 Perform System Design	16	40		160	40				24		280
C7 Prepare Specification		16		40	20				20		96
C8 Prepare Cost Estimates		16		40	10				8		74
C9 Assemble Bid Documents		16		24	40				20		100
Task D: Design HAR Element											
D1 Develop Test Criteria	16	24		40	0				4		84
D2 Design Pilot Test	0	40		80	40				8		168
D3 Conduct & Document Pilot Test	24	80		80	120				4		308
D4 Recommend Hwy. Advisory Radio Tech.	8	16		40					16		80
D5 Assemble Base Plans		8		16	40				0		64
D6 Conduct Field Reviews		24		80	40				0		144
D7 Plan Prep. Process	0	8		40	8				0		56
D8 Finalize System Interface	0	40	20	80	40				8		188
D9 Finalize Display Features	0	24	20	40	20				8		112
D10 Perform System Design	40	40		40	80				10		210
D11 Prepare Specification	0	40	20	80	20				40		200
D12 Prepare Cost Estimates	0	24		40	20				16		100

Exhibit N.1. Estimated Hours by Task Continued

	Responsible Officer	Project Director	Technical Manager	Senior Engineer	Engineer	Systems Analyst	TE Associate	Technician	Drafting/ Secretarial	Consultant	
CDS Rates	$42.00	$37.00	$42.00	$30.00	$26.00	$22.00	$30.00	$12.00	$15.00	$37.50	
Task	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Total Hours
D13 Assemble Bid Documents		24		24	40				40		128
Task E: Design CMS Element											
E1 CMS Design Workshop	16	40		0	40				0		96
E2 Prototype Trailblazer Design	16	40		80	0				8		144
E3 Evaluate Recommendations	8	24		40	0						72
E4 Assemble Base Plans		8		16	40						64
E5 Conduct Field Review		20		40	20				4		84
E6 Plan Preparation Process		8		40	8				4		60
E7 Finalize System Interface		24	20	40	0				8		92
E8 Finalize Display Features		24	20	40	0				4		88
E9 Perform System Design	40	80		80	40				16		256
E10 Prepare Specification		80	20	80	16				4		200
E11 Prepare Cost Estimates		24		40	20				4		88
E12 Assemble Bid Documents		24		40	40				8		112
E13 Design CMS Controller Software		20	20	80	20				4		144
E14 Develop CMS Controllers & Software		20	20	240	240				0		520
E15 Document CMS Controller Software		20		80	40				40		180
Task F: Motorist Information System											
F1 Develop Digital Broadcast RFP	20	80	20	80	0				40		240
F2 Evaluate Proposal		16	8	20	0				8		52
F3 Develop Evaluation Plan		8		8					4		20
F4 Dev. Smart Corr. Digital Broadcast Interface		8	16	40	20				4		88
F5 Document In-Vehicle Navigation	8	16	8	40	20				20		112
F6 Dev. Smart Corr. CHP Media Interface		16	8	40	20				8		92
F7 Dev. Smart Corr. Teletext Interface		16	8	40	20				8		92
F8 Develop Hwy. Advisory Telephone RFP	20	80	20	40	16				40		216
F9 Evaluate Proposal		16	8	20	8				4		56
F10 Develop Hwy. Advisory Telephone Interface		16	8	40	20				8		92
Task G: Control Center Linkages											
G1 Assemble Base Plans		20	0	20	8						48
G2 Conduct Field Review		20		20	8						48
G3 Plan Preparation Process		20		40	20						80
G4 Finalize System Interface		40	20	80	40						180
G5 Perform Design		20	40	120	120						300
G6 Prepare Specification	40	20		40	40						140
G7 Prepare Cost Estimate		8		20	8						36

Exhibit N.1. Estimated Hours by Task Continued

	Responsible Officer	Project Director	Technical Manager	Senior Engineer	Engineer	Systems Analyst	TE Associate	Technician	Drafting/ Secretarial	Consultant	
COS Rates	$42.00	$37.00	$42.00	$30.00	$26.00	$22.00	$30.00	$12.00	$15.00	$37.50	
Task	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Hours	Total Hours
G8 Assemble Bid Documents		16		40	20						76
Task H: Integrate Systems											
H1 Integrate Control System		20		160							180
H2 Test Control System		8		80							88
H3 Integrate Expert System		20		160							180
H4 Test Expert System		8		80							88
H5 Integrate CCTV		20		120							140
H6 Test CCTV		8		80							88
H7 Integrate Hwy. Advisory Radio		40		160							200
H8 Test Hwy. Advisory Radio		20		40							60
H9 Integrate Changeable Message Signs		20		80							100
H10 Test Changeable Message Signs		8		40							48
H11 Integrate Digital Broadcast		20		80							100
H12 Test Digital Broadcast		8		40							48
H13 Integrate Media Communications		20		80							100
H14 Test Media Communications		8		20							28
H15 Integrate Teletext		20		40							60
H16 Test Teletext		8		20							28
H17 Integrate Hwy. Advisory Telephone		20		40							60
H18 Test Hwy. Advisory Radio		8		20							28
H19 Integrate Data Base		20		120							140
H20 Documentation & Training		20		160							180
H21 System Test		20		120							140
Task I: Provide Technical Support Servic	160	480									640
Total Hours	532	3624	1820	13266	8082	0	1360	0	2250	1040	31974

Task	Labor Cost	Performed	Extension	Fee	Total	
Task A: Preliminary Design						211,103
A1 Kick-Off Meeting	1,544		3,088	463	3,551	
A2 Examine Existing Sys. Functionality	2,640		5,280	792	6,072	
A3 Define Operation of Existing Sys.	3,840		7,680	1,152	8,832	
A4 Define Smart Corridor Sys. Funct.	6,808		13,616	2,042	15,658	
A5 Examine System Alternatives	6,808		13,616	2,042	15,658	
A6 Perform System Analysis	15,740		31,480	4,722	36,202	
A7 Revise/Expand Sys. Prelim. Design	7,168		14,336	2,150	16,486	
A8 Define Field Equip. Requirements	4,088		8,176	1,226	9,402	
A9 Update Technology Information	6,168		12,336	1,850	14,186	
A10 Conduct Field Studies	8,008		16,016	2,402	18,418	
A11 Assemble Prelim. Eng. Plan Data	2,908		5,816	872	6,688	
A12 Identify/Analyze Alternative	6,528		13,056	1,958	15,014	
A13 Define Field Components	4,808		9,616	1,442	11,058	
A14 Prepare Prelim. Design	5,908		11,816	1,772	13,588	
A15 Prepare Prelim. Design Report	8,820		17,640	2,646	20,286	
Task B: Central Data Base & Expert Sys.						1,296,041
B1 Develop Software Design	41,800		83,600	12,540	96,140	
B2 Prep. Test Software Design Spec.	6,916		13,832	2,075	15,907	
B3 Prep. Data Base Server Design Spec	24,260		48,520	7,278	55,798	
B4 Prep. Expert Sys. Design Spec.	38,440		76,880	11,532	88,412	
B5 Prep. ATSAC Interface Spec.	13,336		26,672	4,001	30,673	
B6 Prep. SATMS Interface Spec.	15,416		30,832	4,625	35,457	
B7 Prep. CHP Interface Spec.	11,280		22,560	3,384	25,944	
B8 Prep. Field Equip. Interface Spec.	11,992		23,984	3,598	27,582	
B9 Prep. Network Comm. Software Desig	14,432		28,864	4,330	33,194	
B10 Develop User Interface Prototype	17,696		35,392	5,309	40,701	
B11 Prep. Procurement Spec.	11,696		23,392	3,509	26,901	
B12.1 Smart Corridor Computer System	1,940		3,880	582	4,462	
B12.2 Node Processor Computer System	1,940		3,880	582	4,462	
B12.3 Expert System Computer System	1,940		3,880	582	4,462	
B12.4 User Workstations	1,940		3,880	582	4,462	
B12.5 Comm. & Support Hardware	5,080		10,160	1,524	11,684	
B13 Dev./Test Sys. Simulation-Test Sof	19,400		38,800	5,820	44,620	
B14 Dev./Test Data Base Server Softwar	33,360		66,720	10,008	76,728	
B15 Dev./Test ATSAC-SATMS Expert Sys.	30,000		60,000	9,000	69,000	
B16 Dev./Test Smart Corridor Expert Sy	31,480		62,960	9,444	72,404	
B17 Dev./Test ATSAC Data Base Interfac	18,880		37,760	5,664	43,424	
B18 Dev./Test SATMS Interface Software	18,880		37,760	5,664	43,424	
B19 Test CHP Interface Software	4,440		8,880	1,332	10,212	
B20 Dev./Test Field Equip. Interface S	9,296		18,592	2,789	21,381	
B21 Dev./Test Network Comm. Software	21,616		43,232	6,485	49,717	
B22 Dev./Test Workstation User Interfa	25,020		50,040	7,506	57,546	
B23 Perf. Simulated Sys. Test At Sys.	15,280		30,560	4,584	35,144	
B24 Relocate & Test Sys. Hardware in L	4,776		9,552	1,433	10,985	
B25 Conduct Subsystem Testing in L.A.	12,100		24,200	3,630	27,830	
B26 Conduct Sys. Testing in L.A.	12,100		24,200	3,630	27,830	
B27 Prep. Software Design Data Base Do	11,296		22,592	3,389	25,981	
B28 Prep. Expert Sys. Doc.	15,176		30,352	4,553	34,905	

Exhibit N.2. Estimated Labor, Overhead, and Fee by Task

	Task	Labor Cost	Performed	Extension	Fee	Total	
B29	Prep. Graphical User Interface Doc	12,816		25,632	3,845	29,477	
B30	Prep. System Operations Doc.	9,840		19,680	2,952	22,632	
B31	Prepare Hardware Configuration Doc	5,680		11,360	1,704	13,064	
B32	Provide Software/Data Base Trainin	9,540		19,080	2,862	21,942	
B33	Provide Expert Systems Training	9,120		18,240	2,736	20,976	
B34	Provide Graphical User Interface T	6,660		13,320	1,998	15,318	
B35	Provide System Operations Training	5,320		10,640	1,596	12,236	
B36	Provide Hardware Configuration Tra	1,316		2,632	395	3,027	
Task C: Design CCTV Element							57,840
C1	Assemble Base Plans	1,012		2,024	304	2,328	
C2	Conduct Field Reviews	2,760		5,520	828	6,348	
C3	Plan Prep. Process	1,704		3,408	511	3,919	
C4	Finalize Display Features	2,328		4,656	698	5,354	
C5	Finalize System Interface	1,556		3,112	467	3,579	
C6	Perform System Design	8,352		16,704	2,506	19,210	
C7	Prepare Specification	2,612		5,224	784	6,008	
C8	Prepare Cost Estimates	2,172		4,344	652	4,996	
C9	Assemble Bid Documents	2,652		5,304	796	6,100	
Task D: Design HAR Element							127,875
D1	Develop Test Criteria	2,820		5,640	846	6,486	
D2	Design Pilot Test	5,040		10,080	1,512	11,592	
D3	Conduct & Document Pilot Test	9,548		19,096	2,864	21,960	
D4	Recommend Hwy. Advisory Radio Tech.	2,368		4,736	710	5,446	
D5	Assemble Base Plans	1,816		3,632	545	4,177	
D6	Conduct Field Reviews	4,328		8,656	1,298	9,954	
D7	Plan Prep. Process	1,704		3,408	511	3,919	
D8	Finalize System Interface	5,880		11,760	1,764	13,524	
D9	Finalize Display Features	3,568		7,136	1,070	8,206	
D10	Perform System Design	6,590		13,180	1,977	15,157	
D11	Prepare Specification	5,840		11,680	1,752	13,432	
D12	Prepare Cost Estimates	2,848		5,696	854	6,550	
D13	Assemble Bid Documents	3,248		6,496	974	7,470	
Task E: Design CMS Element							155,701
E1	CMS Design Workshop	3,192		6,384	958	7,342	
E2	Prototype Trailblazer Design	4,672		9,344	1,402	10,746	
E3	Evaluate Recommendations	2,424		4,848	727	5,575	
E4	Assemble Base Plans	1,816		3,632	545	4,177	
E5	Conduct Field Review	2,520		5,040	756	5,796	
E6	Plan Preparation Process	1,764		3,528	529	4,057	
E7	Finalize System Interface	3,048		6,096	914	7,010	
E8	Finalize Display Features	2,988		5,976	896	6,872	
E9	Perform System Design	8,320		16,640	2,496	19,136	
E10	Prepare Specification	6,676		13,352	2,003	15,355	
E11	Prepare Cost Estimates	2,668		5,336	800	6,136	
E12	Assemble Bid Documents	3,248		6,496	974	7,470	

Exhibit N.2. Estimated Labor, Overhead, and Fee by Task Continued

Task	Labor Cost	Performed	Extension	Fee	Total	
E13 Design CMS Controller Software	4,560		9,120	1,368	10,488	
E14 Develop CMS Controllers & Software	15,020		30,040	4,506	34,546	
E15 Document CMS Controller Software	4,780		9,560	1,434	10,994	
Task F: Motorist Information System						75,606
F1 Develop Digital Broadcast RFP	7,640		15,280	2,292	17,572	
F2 Evaluate Proposal	1,648		3,296	494	3,790	
F3 Develop Evaluation Plan	596		1,192	179	1,371	
F4 Dev. Smart Corr. Digital Broadcast I	2,748		5,496	824	6,320	
F5 Document In-Vehicle Navigation	3,284		6,568	985	7,553	
F6 Dev. Smart Corr. CHP Media Interface	2,768		5,536	830	6,366	
F7 Dev. Smart Corr. Teletext Interface	2,768		5,536	830	6,366	
F8 Develop Hwy. Advisory Telephone RFP	6,856		13,712	2,057	15,769	
F9 Evaluate Proposal	1,796		3,592	539	4,131	
F10 Develop Hwy. Advisory Telephone Inte	2,768		5,536	830	6,366	
Task G: Control Center Linkages						65,624
G1 Assemble Base Plans	1,548		3,096	464	3,560	
G2 Conduct Field Review	1,548		3,096	464	3,560	
G3 Plan Preparation Process	2,460		4,920	738	5,658	
G4 Finalize System Interface	5,760		11,520	1,728	13,248	
G5 Perform Design	9,140		18,280	2,742	21,022	
G6 Prepare Specification	4,660		9,320	1,398	10,718	
G7 Prepare Cost Estimate	1,104		2,208	331	2,539	
G8 Assemble Bid Documents	2,312		4,624	694	5,318	
Task H: Integrate Systems						149,334
H1 Integrate Control System	5,540		11,080	1,662	12,742	
H2 Test Control System	2,696		5,392	809	6,201	
H3 Integrate Expert System	5,540		11,080	1,662	12,742	
H4 Test Expert System	2,696		5,392	809	6,201	
H5 Integrate CCTV	4,340		8,680	1,302	9,982	
H6 Test CCTV	2,696		5,392	809	6,201	
H7 Integrate Hwy. Advisory Radio	6,280		12,560	1,884	14,444	
H8 Test Hwy. Advisory Radio	1,940		3,880	582	4,462	
H9 Integrate Changeable Message Signs	3,140		6,280	942	7,222	
H10 Test Changeable Message Signs	1,496		2,992	449	3,441	
H11 Integrate Digital Broadcast	3,140		6,280	942	7,222	
H12 Test Digital Broadcast	1,496		2,992	449	3,441	
H13 Integrate Media Communications	3,140		6,280	942	7,222	
H14 Test Media Communications	896		1,792	269	2,061	
H15 Integrate Teletext	1,940		3,880	582	4,462	
H16 Test Teletext	896		1,792	269	2,061	
H17 Integrate Hwy. Advisory Telephone	1,940		3,880	582	4,462	
H18 Test Hwy. Advisory Radio	896		1,792	269	2,061	
H19 Integrate Data Base	4,340		8,680	1,302	9,982	
H20 Documentation & Training	5,540		11,080	1,662	12,742	
H21 System Test	4,340		8,680	1,302	9,982	
Task	Labor Cost	Performed	Extension	Fee	Total	
Task I: Provide Technical Support Servic	24,480		48,960	7,344	56,304	56,304
	$954,534		$1,909,068	$286,360	$2,195,428	$2,195,428

Exhibit N.2. Estimated Labor, Overhead, and Fee by Task Continued

CONTRACT PRICING PROPOSAL (Professional Services) | LACTC "FORM 60" | PAGE 1 OF 2

Name of Proposer Hughes Aircraft Company, Ground Systems Group	**Service to be Furnished** Engineering Labor; Consulting in Expert Systems Jan. 1991 - June 1991
Home Office Address Box 3310, Fullerton, CA 92634-3310	
Division(s)/Location(s) Where Work is to be Performed JHK & Associates/Los Angeles, CA Hughes Aircraft/Fullerton, CA	**Total Amount of Proposal** $54,975
	Contract No. RFP No. TP017

DETAILED DESCRIPTION OF COST ELEMENTS

1. Direct Labor (Specify)	Estimated Hours	Rate/Hour	Est. Cost ($)	Total Est. Cost
Engineer - 0	147			
Engineer - 1	624			
Tech - 4 (Finance)	78			
Engineer-1 (Finance)	8			
Total Direct Labor				24,440
2. Labor Overhead + Fringe Benefits	O H. Rate	x Base =	Est. Cost	
Total Labor Overhead				16,293
3. [illegible]*			Est. Cost	
a. Transportation			1680	
b. Per Diem or Subsistence				
Total Travel				1,680
4. Subcontractors/Subconsultants **			Est. Cost	
Total Subcontractors				
5. Other Direct Costs *** Cost of Money				1,145
TOTAL DIRECT COST AND OVERHEAD				43,558
6. General & Admin. Expense (____% of item nos. _____)				5,649
7. Fee				5,768
T[illegible]. ESTIMATED COST AND FEE				54,975

* Itemize on second page of "Form 60"
** Attach LACTC "Form 60" for all proposed subcontractors/subconsultants
*** Itemize on second page of "Form 60"

CONTRACT PRICING PROPOSAL (Professional Services) | "Form 60" | ___v. ___

SUPPORTING SCHEDULE

ITEM NO.	ITEM DESCRIPTION	EST. COST ($)
a	Transportation: compensation to Hughes Aircraft	
	employee at 21¢/mile for commuting	
	to work in JHK offices in Los Angeles	$1,680

Name and title	Signature
Donald Savitt/Sr. Scientist	D. Savitt
Name of firm Hughes Aircraft	**Date of submission** 3/13/90

CONTRACT PRICING PROPOSAL (Professional Services)	LACTC "FORM 60"	PAGE 1 OF 2
Name of Proposer: Katz,Okitsu and Associates	Service to be Furnished: Plan Preparation,Field Installation, Specs., Cost Estimates	
Home Office Address: 1200 Corporate Center Drive #140 Monterey Park, CA 91754		
Division(s)/Location(s) Where Work is to be Performed: Monterey Park, California	Total Amount of Proposal: $360,488	Contract No.

DETAILED DESCRIPTION OF COST ELEMENTS

1. Direct Labor (Specify)	Estimated Hours	Rate/Hour	Est. Cost ($)	Total Est. Cost
Engineers	3140	$25.00	78,500	
Support	3030	16.00	48,480	
Clerical	320	11.00	3,520	
Total Direct Labor				130,500
2. Labor Overhead	**O H. Rate**	**x Base =**	**Est. Cost**	
	125%	130,500	163,125	
Total Labor Overhead				163,125
3. Travel*			**Est. Cost**	
a. Transportation			5,000	
b. Per Diem or Subsistence				
Total Travel				5,000
4. Subcontractors/Subconsultants **			**Est. Cost**	
Total Subcontractors				0
5. Other Direct Costs ***				32,500
TOTAL DIRECT COST AND OVERHEAD				331,125
6. General & Admin. Expense (____% of item nos._____)				
7. Fee (10% of burdened labor)				29,363
TOTAL ESTIMATED COST AND FEE				360,488

* Itemize on second page of "Form 60"
** Attach LACTC "Form 60" for all proposed subcontractors/subconsultants
*** Itemize on second page of "Form 60"

CONTRACT PRICING PROPOSAL (Professional Services)	LACTC "Form 60"	PAGE 2 OF 2

SUPPORTING SCHEDULE

ITEM NO.	ITEM DESCRIPTION	EST. COST ($)
5	Computer Charges (1500 hrs @ $18)	27,000
	Printing and Plans Production	3,000
	Communication (Phone, FAX, etc.)	2,500
	TOTAL	32,500

Type name and title	Signature
Walter Okitsu, Partner	Walter Okitsu
Name of firm	**Date of submission**
Katz, Okitsu and Associates	March 12, 1990

SMART Systems Manager
Prepared by Katz, Okitsu and Associates

Proj. M90023
March 12, 1990

		Task A: Prelim. Design		Task C: CCTV		Task D: MAR		Task E: CMS		Task G: Systems Comm.		TOTAL	
Category	Rate/ Hour	Hours	Cost	Hours	Cost	Hours	Cost	Hours	Cost	Hours	Cost	Hours	Cost
Engineer	$25.00	80	$2,000	700	$17,500	1370	$34,250	800	$20,000	190	$4,750	3140	$78,500
Support	$16.00	70	$1,120	680	$10,880	1320	$21,120	770	$12,320	190	$3,040	3030	$48,480
Clerical	$11.00	10	$110	70	$770	140	$1,540	80	$880	20	$220	320	$3,520
Total Direct Labor		160	$3,230	1450	$29,150	2830	$56,910	1650	$33,200	400	$8,010	6490	$130,500
Overhead (125%)			$4,038		$36,438		$71,138		$41,500		$10,013		$163,125
ODC			$2,000		$7,000		$17,000		$9,000		$2,500		$37,500
Fee (10%)			$727		$6,559		$12,805		$7,470		$1,802		$29,363
TOTAL COST			$9,994		$79,146		$157,852		$91,170		$22,325		$360,488

APPENDIX

Appendix

QUALITY CONTROL

The goal of the Quality Assurance Program is to assure JHK's high standards of quality are met prior to submitting project plans and contract documents to a client. The program is a set of procedures for reviewing every action that could affect the quality of the end product. The procedures are designed to:

1. Ensure that project documents meet project design criteria, are in accordance with good engineering design practice, and are complete and accurate.

2. Eliminate conflicting information, ambiguities, inaccuracies and deficiencies from project documents.

3. Ensure that project documents meet the project requirements and fulfill project goals.

4. Ensure that the plans can be readily used to construct the project.

PROJECT INITIATION

During Month 1 of the design project, the following actions shall be performed by the Project Manager.

1. Meets with key project staff to discuss agency specifications and guidelines to include, but are not limited to:

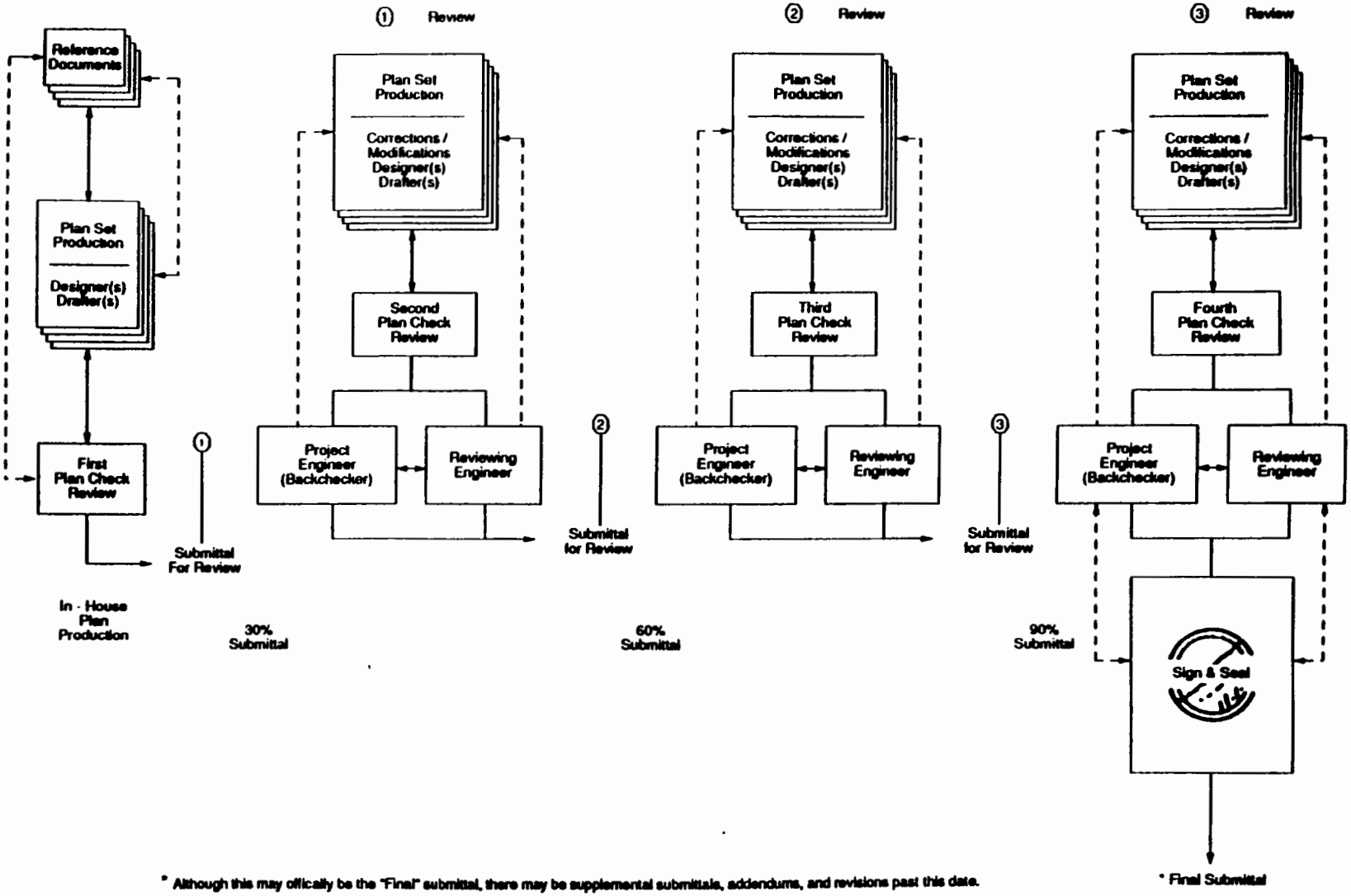
   - o Plan media (vellum, mylar, sepia, etc.)
   - o Scale
   - o Drafting specifications and guidelines (CAD or Manual)
   - o Geometrics

2. Review document checking procedures as shown in Exhibit 1.

3. Review Project Schedule to ensure adequacy of checking time prior to submittals.

4. Meets with agency to confirm that these procedures are being implemented.

Exhibit 1 Plan Design/Check/Review Process



DOCUMENT CHECKING PROCEDURES

The Quality Assurance Plan shall include as a minimum the following procedures:

1. Checking

   a. The Checker (someone other than the Originator/Designer) shall examine the checkprint prepared by the Originator/Designer for:

      - o project requirements
      - o technical adequacy
      - o compatibility with other project documents

   b. The Checker shall determine if the document is suitable and adequate to meet requirements.

   c. The following color codes shall be used for document checking:

      - o RED: Corrections or additions to be made
      - o GREEN: Deletion
      - o ORANGE: Backchecker's comments
      - o YELLOW HIGHLIGHT: Correction has been made

   d. The Checker shall mark in red, on the checkprint, the required corrections or deletions. Deletions shall be marked in green.

   e. The Checker shall sign and date the checkprint and the Quality Assurance control form and forward the checkprint to the Backchecker.

2. Backchecking

   a. The Backchecker (usually the Originator) shall review the Checker's marks on the checkprint.

   b. The Backchecker shall place a check mark in orange near each of the checker's changes if he/she agrees that the document original should be changed.

   c. The Backchecker shall consult with the Checker if he/she disagrees with the changes.

   d. If both the Checker and the Backchecker agree that the document original should not be changed, the Backchecker shall cross out in orange each of the Checker's changes.

e. The document original shall be updated to include the agreed to changes. The changes shall be highlighted in yellow upon completion.

f. The Backchecker shall compare the updated original with the checkprint to ensure that the document original has been properly updated and agrees with the checkprint.

g. The Backchecker shall sign and date the checkprint and Quality Assurance control form and forward the document original and the checkprint to the Reviewer.

3. Peer Review

Prior to submittal the project documents are reviewed by a Peer Review Team who have not been intimately involved with the design effort.

a. The Reviewer(s) shall review the checked documents for compatibility with the project requirements and for technical adequacy.

b. The Reviewer(s) shall review the checkprints for compliance with the established Quality Assurance program.

c. The Reviewer(s) shall resolve all review notations and comments with the Originator/Designer.

d. If necessary, the Reviewer(s) shall have the document originals updated and checked as necessary to include the Reviewer's comments.

e. The Reviewer(s) shall review the document originals to ensure that all of the agreed to changes have been accurately made.

f. The Reviewer(s) shall sign and date the checkprints.

g. The checkprints shall be filed in an independent quality assurance file so that they are available for verification with the final documents. Quality assurance control forms are filed in the project file.

4. Final Plans

a. The Project Manager shall review the final plans for technical adequacy. Comments shall be made in red.

b. The Reviewer shall resolve all review notations and comments by consulting with the Originator/Designator and Project Manager.

c. If necessary, the Reviewer shall have the document original updated and checked as necessary to include the Manager's comments.


jhk
& associates
Specializing in

James H. Kell
Chairman

Jack L. Kay
President

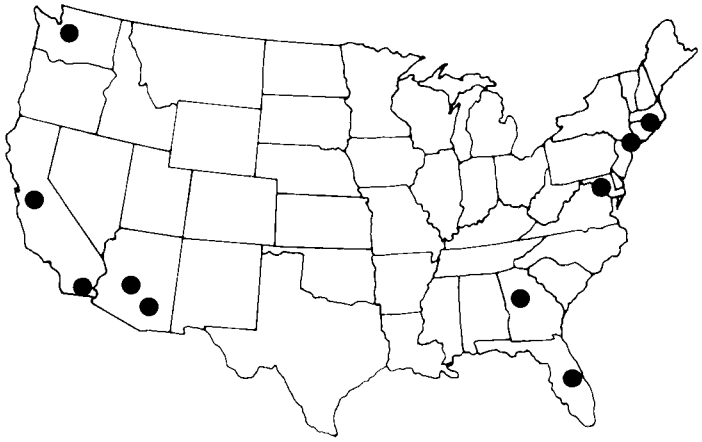
Morris J. Rothenberg
Chief Executive Officer
Mgr. Eastern Consulting

Tom L. Stout
Senior Vice President
Mgr. Systems Engineering

Barry S. Marrus
Vice President

Craig C. Gardner
Vice President

William R. Reilly
Vice President
Mgr. Western Consulting



● *Corporate Office*
5801 Christie Avenue
Emeryville, CA 94608
P.O. Box 3727
San Francisco, CA 94119

● *Washington, D.C. Office*
4660 Kenmore Avenue
Alexandria, VA 22304
(703) 370-2411

● *Atlanta Office*
3000 Northwoods Parkway
Norcross, GA 30071
(404) 447-6831

● *Tucson Office*
110 South Church Avenue
Tucson, AZ 85701
(602) 624-2306

● *New York Office*
118-35 Queens Boulevard
Forest Hills, N.Y. 11375
(718) 575-1580

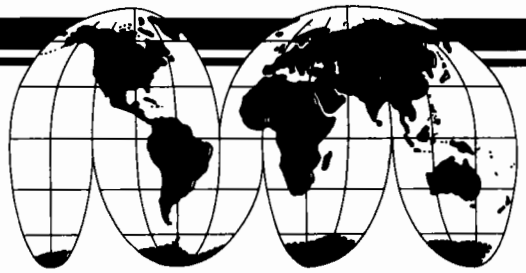
● *Phoenix Office*
2702 North 44th Street
Phoenix, AZ 85008
(602) 954-0383

● *Hartford Office*
410 Asylum Street
Hartford, CT 06103
(203) 522-3915

● *San Diego Office*
2831 Camino del Rio South
San Diego, CA 92108
(619) 295-2248

● *Seattle Office*
710 Second Avenue
Seattle, WA 98104
(206) 340-8850

● *Orlando Office*
7575 Dr. Phillips Blvd.
Orlando, FL 32819
(305) 345-1471



I would like to take this opportunity to acquaint you with JHK & Associates and our activities. Our Firm is a group of highly talented individuals whose combined skills and capabilities are addressing present day, as well as future, transportation problems. We have assumed a leadership role in developing new techniques and procedures that are sensitive and responsive to the social and political needs of our Nation's communities.

We believe that mobility is one of the driving forces that has structured our present society and will shape future directions. The convenient movement of people and material is essential to achieve and maintain a desirable quality of life. Toward this end JHK & Associates is continually involved in diverse projects and studies to direct the growth of urban areas more effectively; to operate and control existing transporation networks with greater efficiency and safety; to derive means and incentives for fuel conservation; to conceive the transportation methodologies of the future; and to transfer technological advances through research, education, and training.

The following pages summarize how JHK & Associates applies diversified skills, resources, and experience to assist both public and private agencies in meeting present and future challenges.

James H. Kell
Chairman of the Board

Range of Services

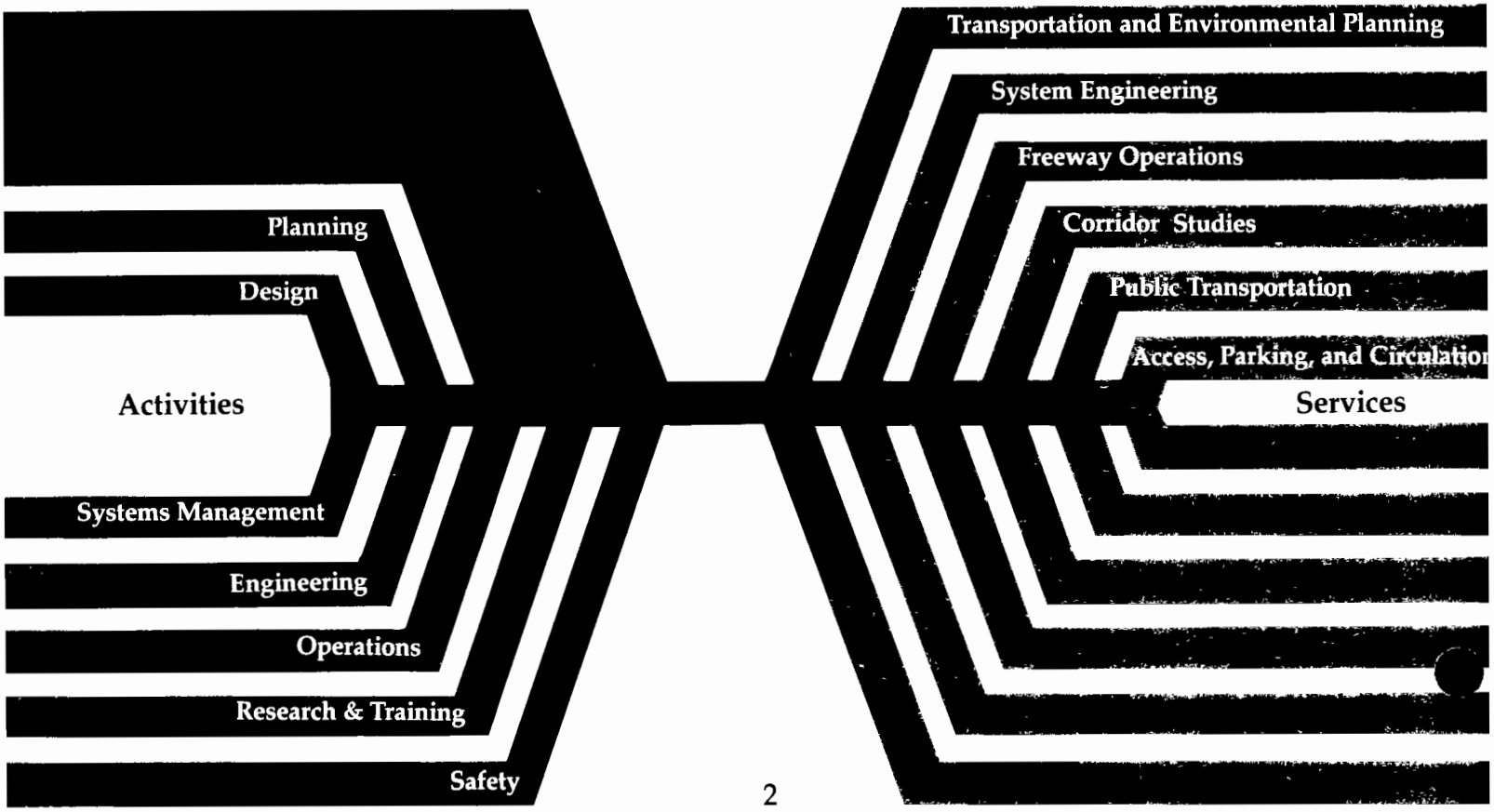
For a government or a private organization to thrive in an environment of continuing change, it must have the resiliency to adjust rapidly to new problems, new opportunities, and new technology. It must be responsive to changing needs and provide the means to meet those needs.

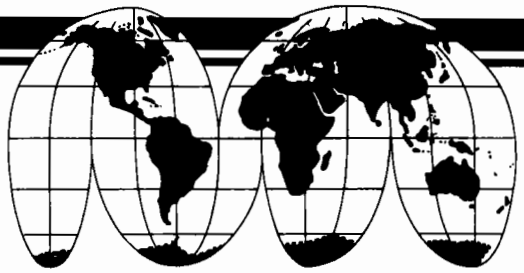
Since keeping pace with technology is a full-time activity, and since areas of specialization have narrowed, few governmental agencies or private organizations can afford to maintain a staff skilled in all the disciplines required to resolve diverse problems. Consequently, the services provided by JHK & Associates are designed to assist Federal, state, and local agencies as well as private organizations in solving their transportation-related problems.

Transportation problems do not recognize jurisdictional boundaries—nor can they be attributed solely to the public or private sector. JHK's professional role is to provide solutions which benefit the general public regardless of the source of the problem.

Historically, the functional aspects of transportation and associated activities have been structured under the broad categories of *Transportation Planning* and *Traffic Engineering*. Today, however, the distinction between these two categories is diminishing and the new techniques and methodologies are, in many cases, equally applicable.

Significantly, the systems approach traditionally used in comprehensive long range planning studies has become an essential framework for the shorter range traffic improvement programs. Emphasis in long range planning has shifted from a single focus on the development of new facilities to a concern for making better use of existing resources to meet future demands. Another evolving concept is to place greater emphasis on the movement of people





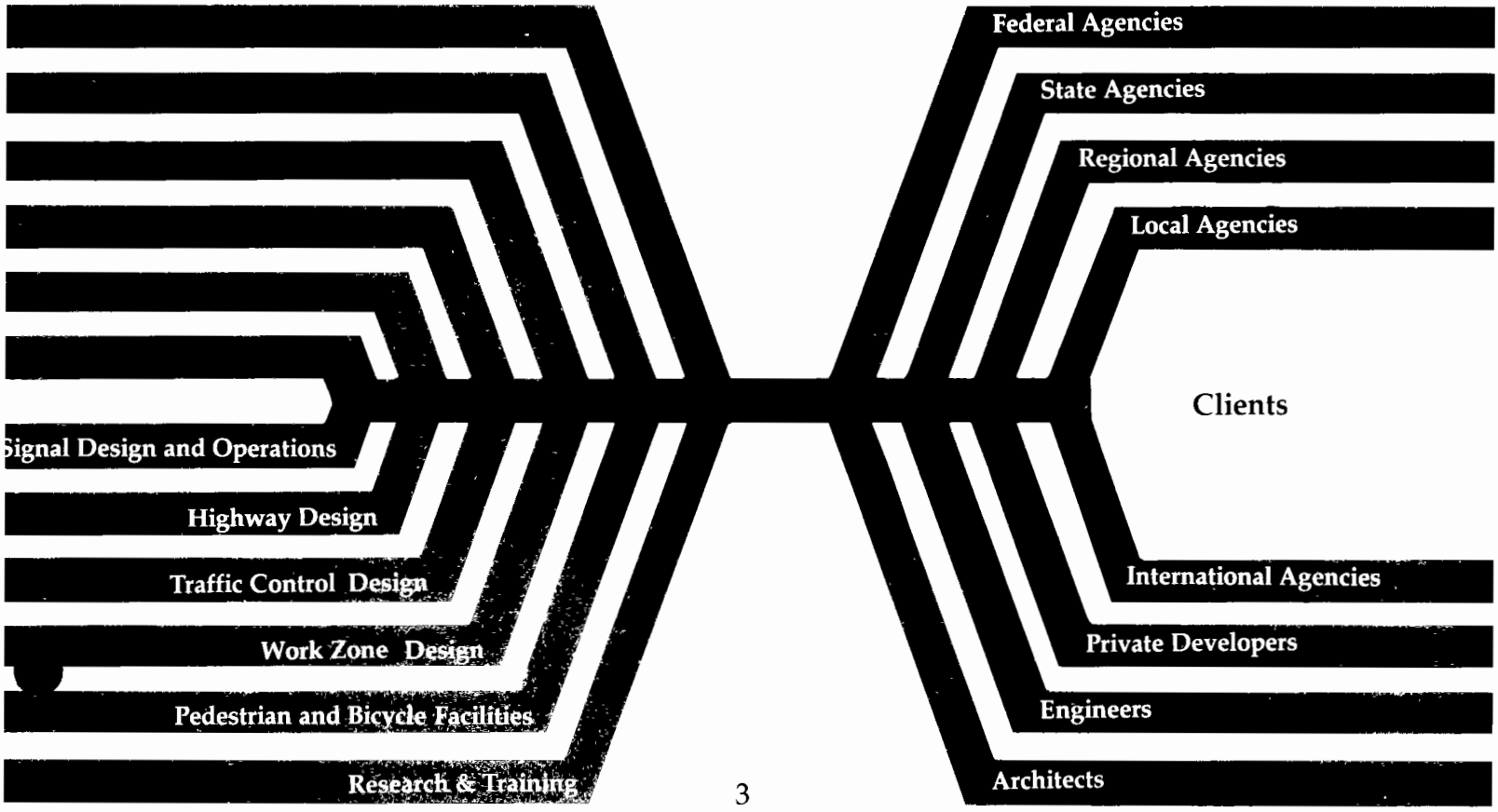
rather than on the singular movement of vehicles. Key areas of concern include maximizing the capacity of existing roads and intersections, reducing automobile usage, and increasing transit patronage.

Use of sophisticated computer-based control and surveillance technologies is receiving enhanced importance as a technique to improve the efficiency of existing facilities. JHK leads the industry in providing *System Engineering* services for areawide traffic control and freeway surveillance and control. The resources of the company are dedicated to the application of appropriate hardware and software technology to alleviate operational problems.

It is within this system framework that JHK has structured its transportation services. While the range of services provided covers all the traditional planning and engineering functions, it is recognized that these functional classifications are arbitrary and for the most part, interchangeable. This flexibility permits the Firm to apply its collective resources to emerging problems and changing conditions.

To augment JHK's extensive experience in planning and engineering, a major portion of the Firm's activity is involved in advancing the technological state-of-the-art through research projects. Combining practical experience with new technology and advanced research, JHK is also developing and conducting training courses to assist practicing engineers and planners in implementing changing transportation policies. While safety is an underlying presence in all JHK projects whether planning, engineering, or operational, many of JHK's research and training projects have specifically addressed safety concerns.

On the following pages, the fundamental characteristics of the services provided are briefly discussed vis-á-vis planning, engineering and operations, research, and training activities.

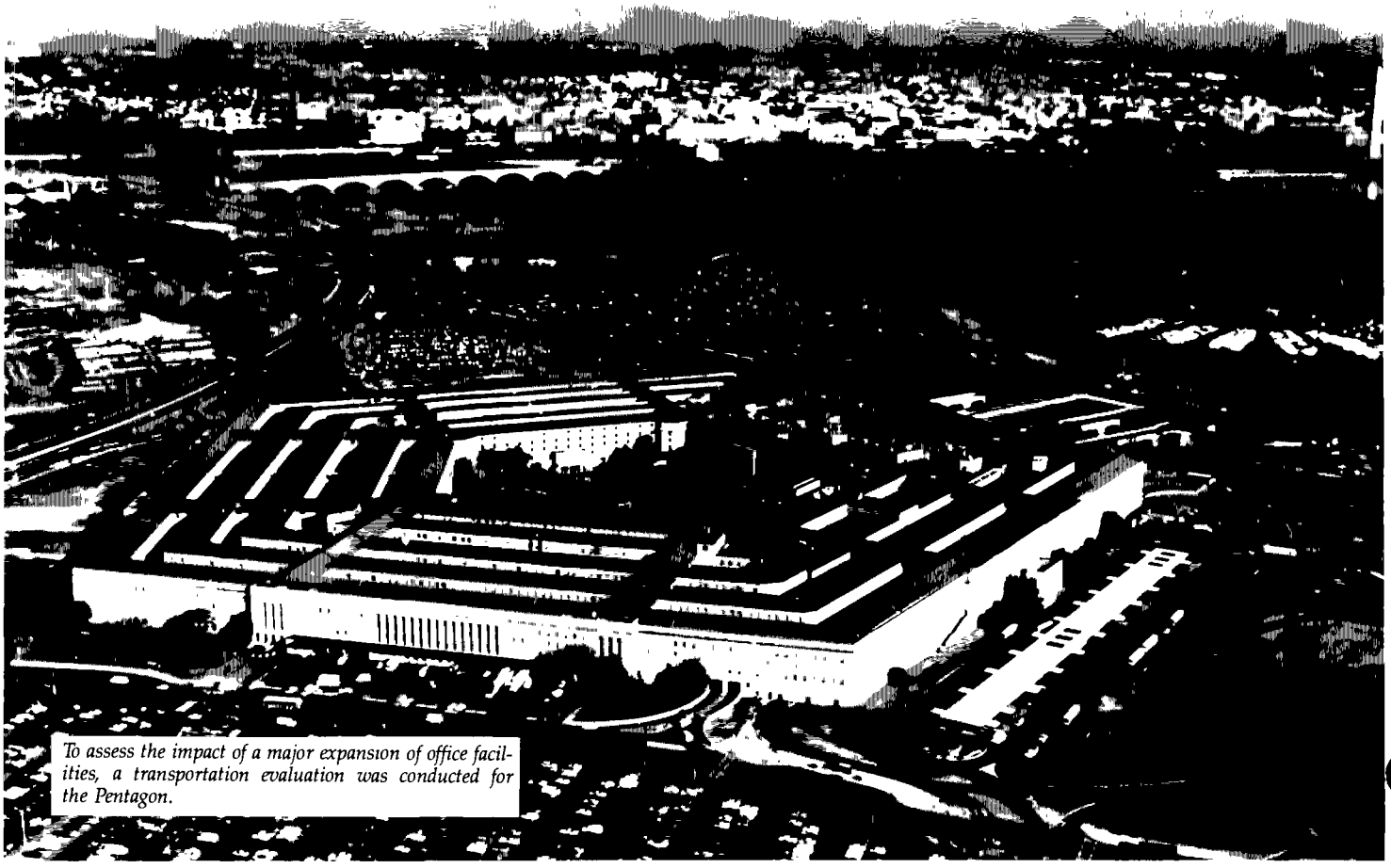


Transportation & Environmental Planning

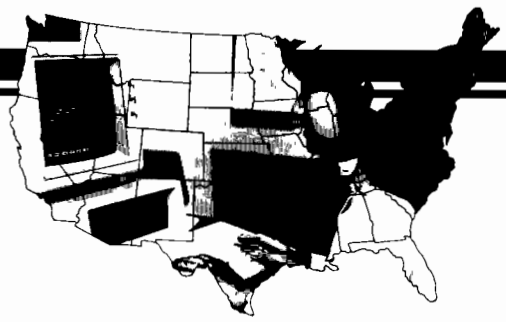
The nature of transportation planning is to look ahead and determine how to satisfy future needs. Today, this involves not only the traditional estimates of the type and amount of traffic which transportation systems must accommodate, but also requires a comprehensive understanding of the relationship between transportation modes, the environment, energy consumption, land-use, and the unique characteristics of each community.

It is expected that the growth of traffic during the final two decades of this century will focus largely on the suburbs and suburban activity centers. The emergence of such activity centers not only has a crucial impact on surrounding areas and roadway networks, but requires new approaches to the overall transportation planning process. To further the state of knowledge of mixed use suburban activity centers, JHK is developing a set of guidelines and procedures to better analyze these growing areas. Under contract to the National Cooperative Highway Research Program, this effort will examine six of the largest centers in the nation.

The mathematical simulation and forecasting techniques to describe travel behavior in relation to land use and environmental concerns have proliferated with the widespread availability of computer technology. The selection of a particular model should be based on its applicability to the specific decision process, and it's ability to accurately portray future directions.



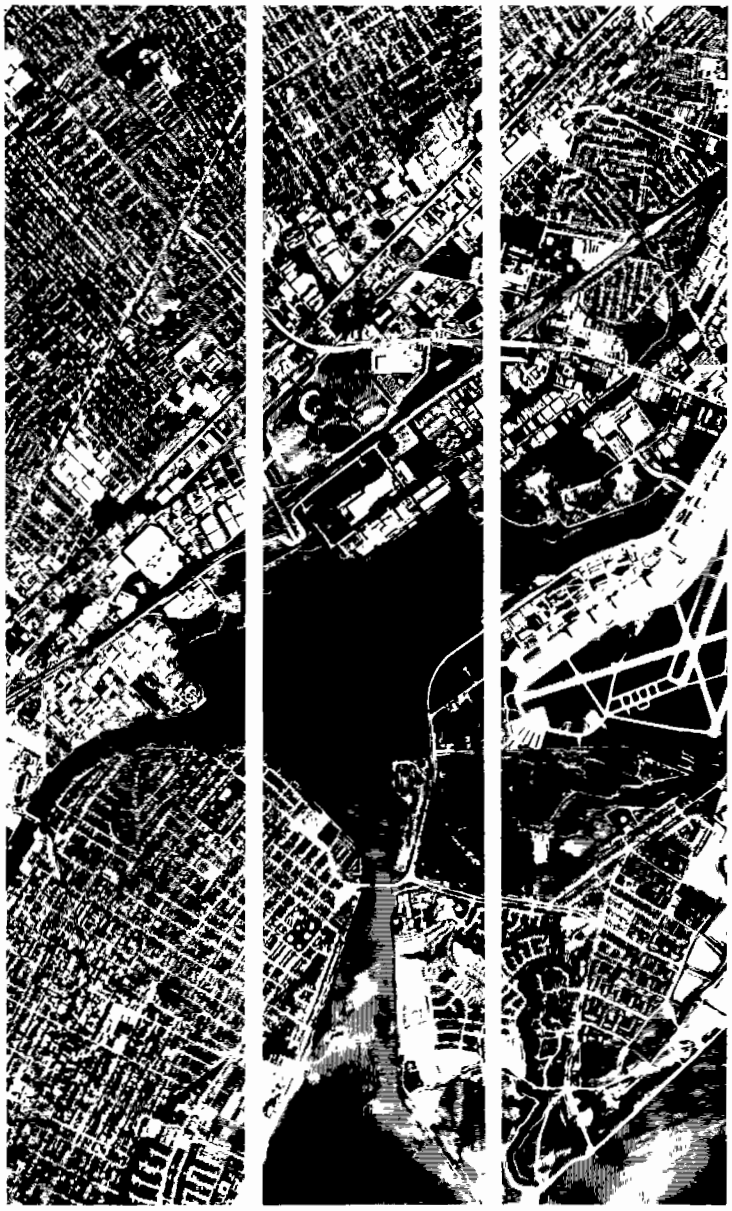
To assess the impact of a major expansion of office facilities, a transportation evaluation was conducted for the Pentagon.



JHK has extensive experience with a broad range of current transportation models such as T-Model, MINUTP, TRANPLAN, CATNAP, etc. To further accommodate JHK clients in the area of regional planning and subarea analysis, the JHK Modeling Process has been developed by the Firm. This model combines the functions of database management and transportation modeling with color graphic presentations.

The sophisticated, but easy to use, JHK Modeling Process provides the basics of path building, trip generation, trip distribution, mode choice, and trip assignment. The process also models travel by time of day and vehicle occupancy. Peak hour forecasts under a variety of HOV restrictions and detailed traffic impact analysis are simple processes with this model. The intersection-based capacity analysis features make the traffic assignment model sensitive to individual turning movement volumes.

Finally, innovative financing has become mandatory with the constraint of limited budgets. JHK's experience in financing transportation improvements include public/private partnerships, impact fees, transportation districts, developer contributions, and toll financing.



Development impact study site in Alexandria, Virginia (above). Continuing impact analyses of new development of Harbor Bay Isle, Alameda, California (right).

Systems Engineering

Traffic control technology has been greatly expanded in the past two decades and the proper application of this technology has become a critical element in the safe and efficient control of traffic. Realization of an effective traffic control system is a complex process requiring skill, experience, and expertise in many diverse disciplines and an indepth familiarity with the many hardware and software products available. Bringing together the best suited system concept and design with the appropriate hardware and traffic applications software—implemented and integrated into a fully-operational system that meets user expectations—is the primary goal of JHK's Systems Engineering Practice.

A typical traffic control system project undertaken by JHK begins with a system concept study to define an effective program to increase the efficiency of the transportation network. The study normally includes defining existing and future conditions, determining system requirements, evaluating alternatives and selecting the most cost effective approach, defining the system operations requirements, and developing a system implementation plan.

The project then proceeds to the system design stage. The tasks include the preparation of specifications, construction plans and estimates; and review of bidder qualifications and equipment submittal.

For a number of projects, JHK is serving as technical inspector and advisor during system construction. Acting as an extension of the agency staff or as the resident engineer, the work usually includes technical monitoring, software and hardware inspection, testing, developing signal timing and other system parameters, database development, training, and on-site problem solving. JHK's participation during

JHK's System Engineering Development & Test Facility, Atlanta, Georgia.

system implementation is tailored to meet the needs of clients. JHK may also provide additional service as systems manager and/or construction engineer. These services include computer hardware procurement and installation, software development, construction engineering, field hardware procurement and installation, system integration, training, documentation, and acceptance testing.

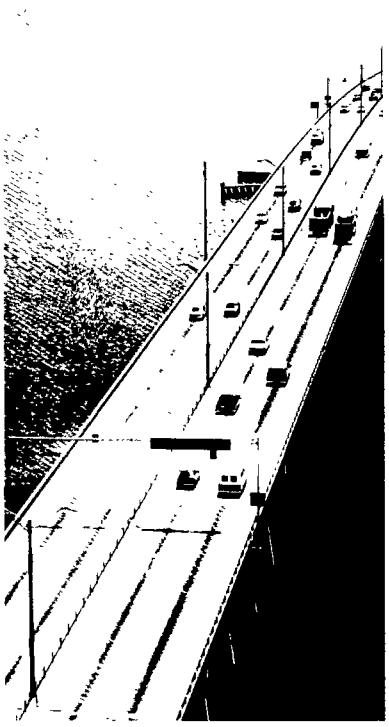
The final stage of a traffic control system project is to evaluate system effectiveness under varying traffic flow conditions.

In addition to the Firm's involvement in the design, implementation, and evaluation of traffic control systems, JHK provides assistance to users of operational systems. This includes performance hardware and software upgrades, developing procedures for relocating a computer center, assessing the impact of expanding system features, developing programs for system enhancement, updating timing and databases, and providing on-site operational support.

Location	No. of Intersections Initial	Expanded
Alexandria, VA	120	260
Atlanta, GA	200	350
Baltimore, MD	900	1200
Brooklyn-Bronx-Queens, NY	1400	5400
Casper, WY	60	255
Denver, CO	*	*
Durham, NC	170	260
Evansville, IN	170	260
Eugene-Springfield, OR	150	200
Grand Rapids, MI	270	400
Greensboro, NC	160	260
Hartford, CT	90	256
Howard Frankland Bridge, FL	*	*
Jacksonville, FL	143	256
Los Angeles, CA	200	2000
Mesa-Tempe, AZ	210	400
Minneapolis, MN	660	860
Ottawa-Carleton, Ontario	260	600
Phoenix, AZ	260	410
Portland, OR	200	600
Raleigh, NC	160	260
Salt Lake City, UT	120	260
Scottsdale, AZ	60	100
Seattle, WA	155	500
Sioux City, IO	70	160
Tampa, FL	119	750
Tucson, AZ	130	260
Washington, DC	1260	1600

* Freeway Surveillance & Control Systems

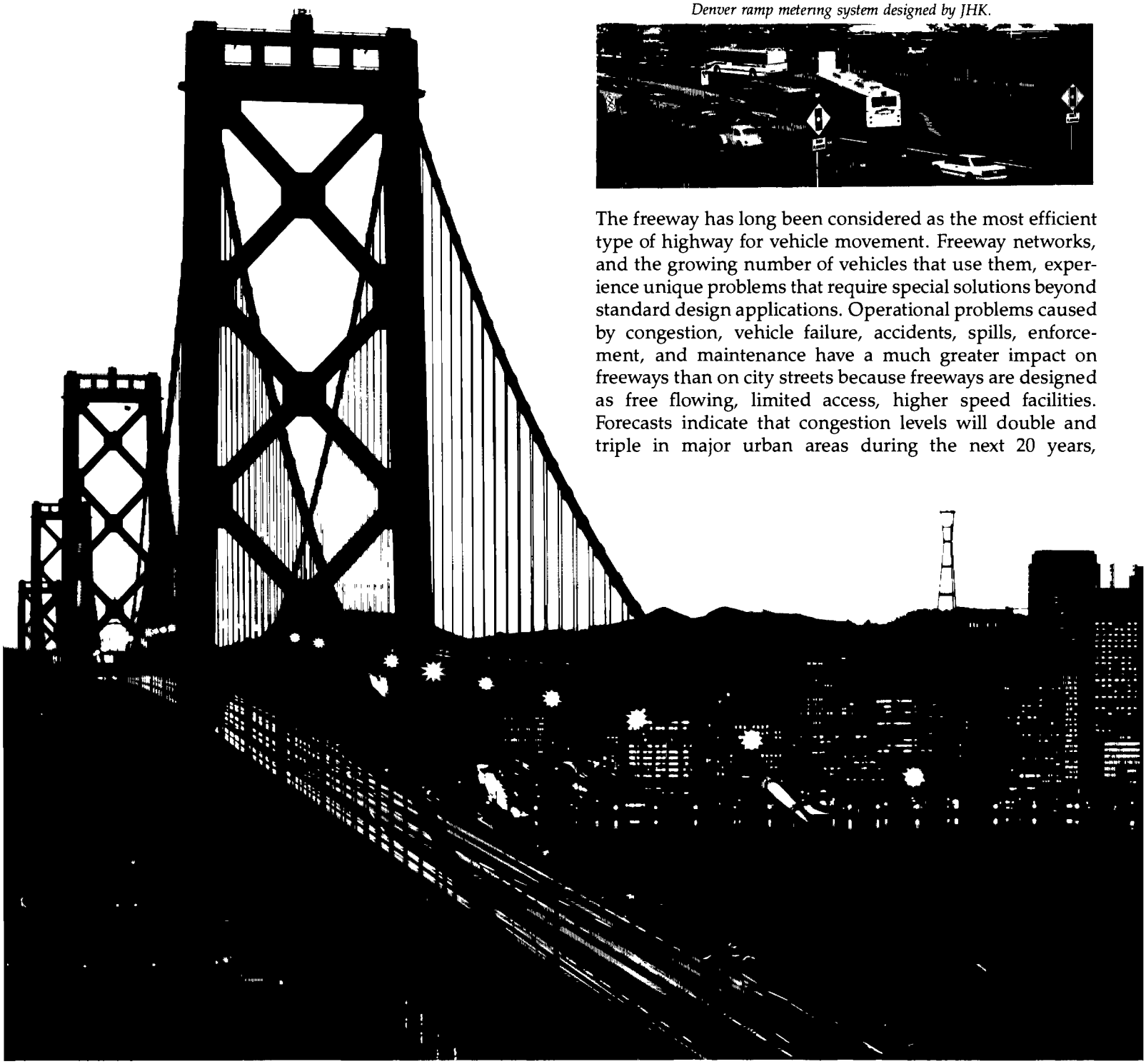
Los Angeles (top) and New York City (bottom) Traffic Control Centers. Howard Frankland Bridge Surveillance and Control System near Tampa, Florida (left).



Freeway Operations

Denver ramp metering system designed by JHK.

The freeway has long been considered as the most efficient type of highway for vehicle movement. Freeway networks, and the growing number of vehicles that use them, experience unique problems that require special solutions beyond standard design applications. Operational problems caused by congestion, vehicle failure, accidents, spills, enforcement, and maintenance have a much greater impact on freeways than on city streets because freeways are designed as free flowing, limited access, higher speed facilities. Forecasts indicate that congestion levels will double and triple in major urban areas during the next 20 years,



CONTROL CONCEPT • INCIDENT DETECTION • CHANGEABLE MESSAGE SIGNS • RAMP METERI[illegible] • C[illegible]

In confronting these problems, JHK has a demonstrated, pragmatic approach that produces viable solutions. The Firm provides the full range of services involved in developing and evaluating alternative concepts for improving freeway operations and safety, and in designing and implementing the improvements.

Typical projects may range in complexity from a study of operational strategies for priority vehicle lanes and the preparation of plans for managing incidents, to the development and operation of large, area-wide freeway surveillance and control systems. Elements of such projects may include entrance and exit ramp control; mainline control by such means as driver information systems, variable speed control, reversible lane use, etc; priority control to provide preferential treatment for buses, vanpools, and carpools; incident detection and management; and design and implementation of central traffic control facilities including the communication and computer subsystems, user interface, system software, and operator displays.

In addition to projects which focus on specific operational problems, JHK has been involved in a number of research projects addressing a wide range of existing and emerging freeway problems. These projects were undertaken by the Firm to expand the state-of-the-art in freeway operations and control, and to increase the understanding of the basic nature of operational problems.

Burlington Skyway, Ontario, Canada.

The San Francisco Bay area was the subject of a Traffic Operation Center Study.

BOXES • CLOSED CIRCUIT TELEVISION • HIGHWAY ADVISORY RADIO • SYSTEMS & COMMUNICATIONS IMPLEMENTATION

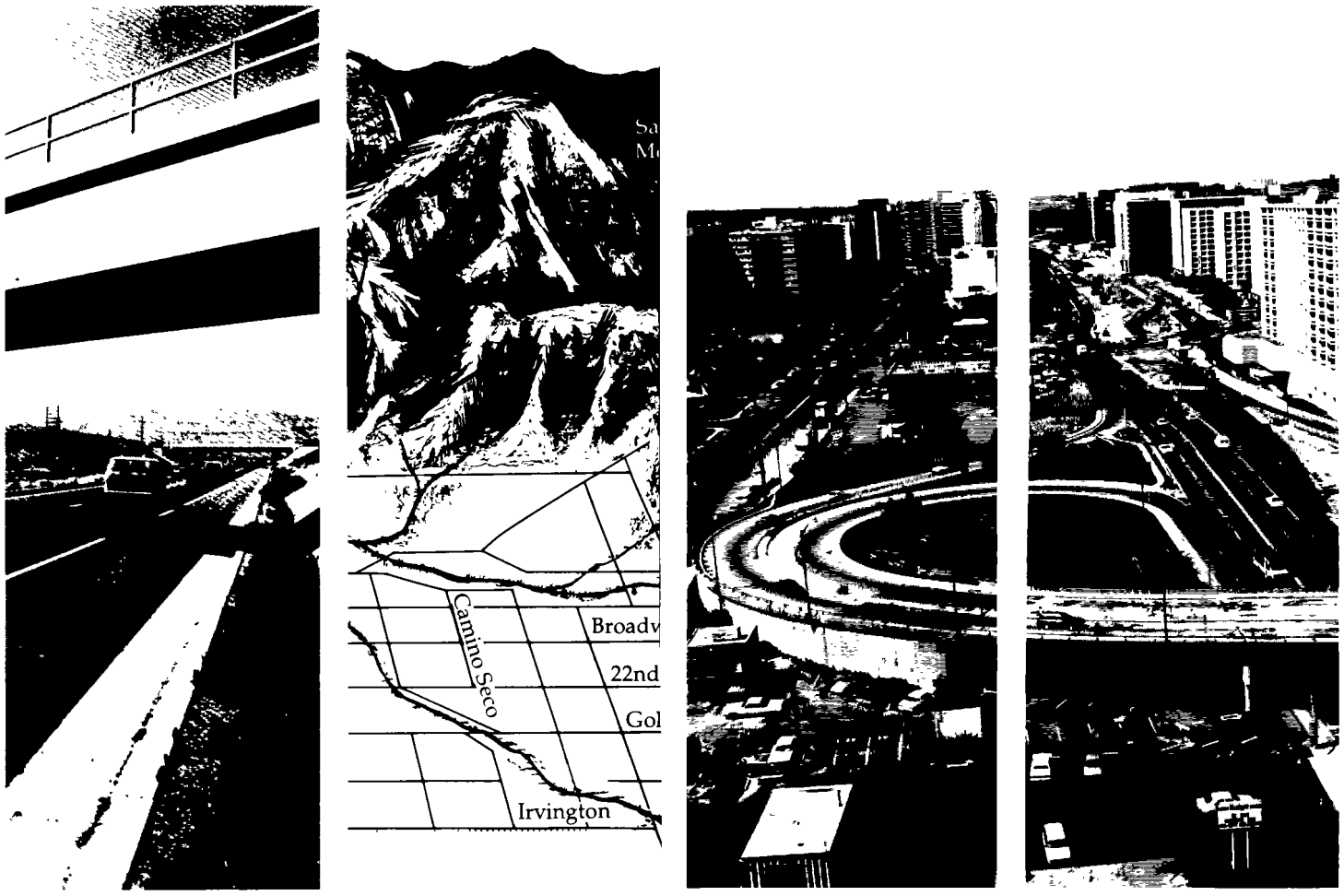
Corridor Studies

Urban areas across the nation are confronted with critical congestion, motorist delay, and safety problems. The congestion plaguing freeways and major urban streets is basically a function of excessive demand on the roadway system. When a primary traffic carrier in a corridor approaches or reaches capacity, it is critical to assure that all facilities in the corridor are utilized to maintain traffic flow at a reasonable level of service. A corridor may be described as comprising a freeway, major arterial, ramps, frontage roads or parallel arterial streets that can be used as alternative routes, and the cross-streets that link the major facility with the alternative routes. Thus, corridor studies integrate freeway or arterial operations with the adjacent elements of urban street circulation and traffic control.

The objective of a corridor project may be to define traffic improvements in an existing or proposed corridor. This process involves the identification and evaluation of existing and future traffic demands which leads to the development of plans to meet those demands. Generally, these studies principally consider automobile, truck, transit, and HOV demand.

JHK is well qualified to assist local communities, metropolitan planning organizations, and private enterprise in developing state-of-the-art operational strategies such as freeway interchange or roadway improvements, roadway extensions or new roadways, signal coordination on frontage roads and arterial cross streets or new roadways, and preferential treatments. Projects with unique characteristics and requirements represent a special challenge to JHK.

Corridor studies include the Kolb Corridor, Tucson, Arizona (left) and the I-595 Corridor, Arlington, Virginia.



Public Transit

Bay Area public transportation systems were analyzed for BART Impact Project (above). The New Carrollton Metro Station for the Washington Metropolitan Area Metrorail System was one of 23 studied.

In recent years considerable attention has been focused on the imbalance between the use of private automobiles and the use of public transit. In response, Federal and state agencies have earmarked significant portions of their transportation dollars to allow local jurisdictions to improve their public transit systems.

JHK conducts a variety of coventional transit studies varying in scope from designing an operational plan for small urban areas transit needs to the development of the transit element of comprehensive transportation planning projects and the evaluation of transit operations for TSM-type programs. The services provided cover all functional aspects, including:

- Patronage estimates and market analyses
- Financial analyses
- Operational modes (ownership policies and operational procedures)
- Scheduling, routing, and fare structuring
- Capital Improvement Programs

Paratransit studies cover a wide range of collective passenger movement strategies. Unlike the conventional common service carriers operating with fixed routes and schedules, paratransit systems have been developed to accommodate special groups of travelers. Types of paratransit alternatives that may be developed in a typical JHK public transit project include school buses, vanpools and carpools, share-the-ride programs, subscription buses, and demand-responsive (dial-a-ride) systems.

Another form of public transportation-oriented project involves transit access. The product of such studies incorporates recommendations on access mode policy; identification of community and environmental impacts; preliminary cost estimates for recommended access measures; benefit/cost analyses; and availability of funding sources.

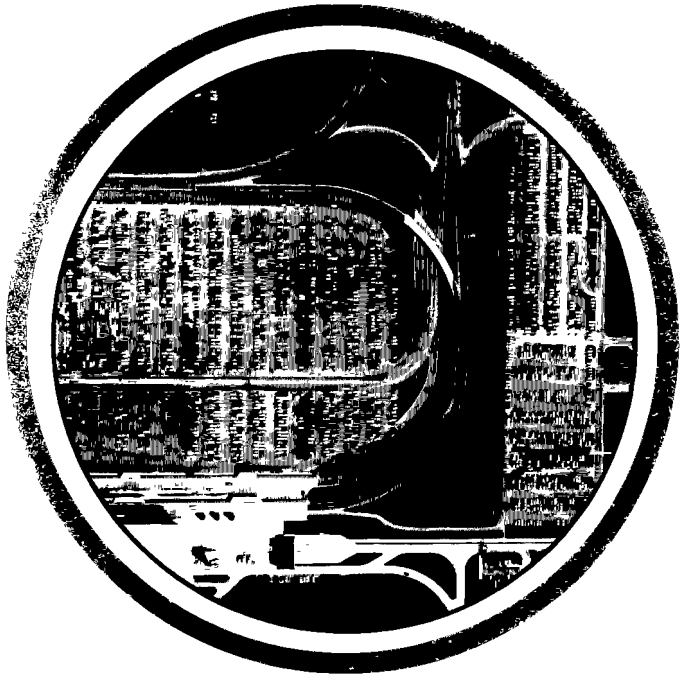
JHK's familiarity with planning, management, and operations of the various modes of transit in both large and small applications is augmented by research studies in public transportation. The results of such research coupled with the Firm's operational experience formed the basis for a public transportation training program developed by JHK as part of the Urban Transportation Operations Training program jointly sponsored by FHWA and UMTA.

Access, Parking, Circulation

The trend to centralize similar or complementary land uses into major suburban activity centers has created new challenges for the traffic engineering profession. For activity centers to prosper, both traditional and innovative techniques are required to achieve access to the center, vehicular and pedestrian circulation within the center, and convenient parking designs. Even greater challenges are created by the expansion of existing centers which result in traffic demands that far exceed original expectations.

Traditional transportation planning tools and techniques such as trip-generation analysis, parking demand analysis, and pedestrian demand analysis are used to develop safe and efficient designs. However, many situations are encountered which are not amenable to traditional approaches and require innovative techniques and designs. For example, there exists little sound data on the needs for internal circulation.

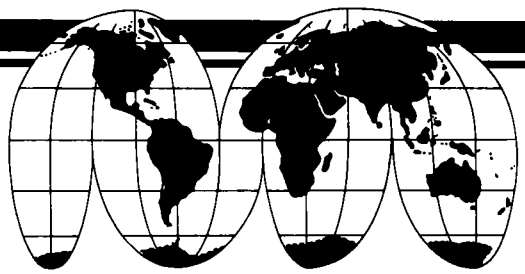
JHK has successfully dealt with these problems for a wide variety of typical and unique situations. Studies include access for commercial and residential developments, design or redesign of parking facilities, and planning and development of major activity centers such as transportation terminals, sports arenas, medical centers, or suburban mixed use centers. JHK prides itself on the number of planning and design studies that have been constructed and have subsequently enjoyed successful operations.



Dulles Airport Access, Parking & Circulation Project site (above). Underpass to Scottsdale, Arizona Civic Center Mall (below).

Similar studies are conducted for existing areas of a city, such as the central business district, or for major generators, such as airports or recreational facilities. Parking studies may include specific recommendations for new facilities, changes in types of usage, or improved parking regulations. Region-wide parking studies may concentrate on policy changes to encourage specific supply or demand control goals.

Signal Design & Operations



Delay and congestion at traffic signals have come to be viewed with increasing concern. Not only does vehicular delay result in inconvenience and wasted time, but the congestion adds to air and noise pollution, and results in needless consumption of fuel. The reduction of delay and congestion by increasing the efficiency of traffic signals has become critical.

The development of signal timing and the selection of overall control strategies is a continuing traffic engineering responsibility. Although great strides have been made in developing solid state components, microprocessors, centralized computer control, etc., there is a growing need to periodically update signal timing and operational plans in response to changing conditions.

JHK pioneered the development and use of signal timing analysis procedures to enable local agencies to keep pace with the flexibility afforded by new equipment. Signal timing programs such as SIGART, PASSER, and TRANSYT have been applied by JHK in numerous projects ranging from coordinating several signals along an arterial, to multiple signal timing strategies for computer-controlled grid systems.

Plans, specifications, and costs estimates for individual intersections, as well as for large systems and communications networks, have long been a traditional speciality of JHK's practice. Plans and specifications are prepared to reflect operational requirements, safety conditions, and local design standards.

An integral part in many of JHK's signal design and operations projects is the provision of tools, techniques, and training of agency staff. In addition to on-site training during a project, JHK has developed and conducted numerous training courses across the country focusing on traffic signal design, and intersection controller equipment.

Contemporary traffic signal design for downtown Tucson, Arizona.

HIGHWAY DESIGN

As public agencies are confronted with the need to design new facilities, or to redesign existing facilities to meet new demands, it becomes an important concern whether to staff up or to contract for the needed expertise. JHK is experienced in all aspects of highway design, from the predesign phase where the determination of design speed and other criteria is critical, to the actual design phase including reviewing specifications with contractors during construction.

Important considerations include the determination of horizontal, vertical, and cross-section characteristics to achieve operational safety and roadway aesthetics. In intersection design, the main objective is to reduce the number of conflicts among vehicle and pedestrian movements and improve capacity. Design elements are based on human factors, traffic considerations, physical elements, and economics.

JHK utilizes state-of-the-art tools in their designs, including the use of Computer-Aided Design (CAD) equipment. The CAD system affords maximum flexibility for creating and editing designs in a timely and efficient manner.

TRAFFIC CONTROL DESIGN

Uniformity in the use of traffic devices is a nationwide objective and is becoming increasingly important with the dramatic rise in traffic demand and the parallel increase in civil litigation against agencies resulting from accidents. The proper application of traffic control devices (signals, signs, markings, lighting) requires a thorough knowledge of local and national standards as well as awareness of local conditions and engineering judgment.

JHK & Associates has contributed significantly to current knowledge in traffic control design, both through research activities and challenging project designs. Many projects undertaken by JHK involve determining the need or warrants for specific devices and specifying location, type, size, support hardware. JHK develops final plans for control devices on such facilities as rural highways, urban streets, freeways, intersections, and parking lots and garages. Other projects involve developing or updating traffic control devices inventories.

Arizona Freeway Signing Project

JHK's Computer Assisted Design Equipment

Of note, JHK developed the "Traffic Control Devices Handbook" as a companion volume to the "Manual of Uniform Traffic Control Devices" for the Federal Highway Administration and also developed the "Manual of Traffic Signal Design" for the Institute of Transportation Engineers.

PEDESTRIAN AND BICYCLE FACILITIES

There is growing national concern over the safety and convenience of nonmotorized modes of travel. Conflicts between auto, pedestrian, and bicycle traffic are increasing and require consideration of how best to accommodate all modes of traffic. In assisting local and state agencies to respond to this need, JHK has developed a demonstrated expertise in planning, engineering, and designing pedestrian and bicycle facilities.

JHK's work in this field has ranged from designing and implementing intra-city bicycle systems to developing bicycle and pedestrian standards for local and state agencies. In all such projects, operational safety and education are stressed as major factors.

JHK is a leader in pedestrian research and planning. The firm has authored major works on the subject, including a report for the National Cooperative Highway Research Program entitled "Planning and Implementing Pedestrian Facilities in Suburban and Developing Rural Areas" *(NCHRP Report 294)*. Other research has been conducted by the firm to analyze pedestrian behavior at intersections and to develop alternative pedestrian control techniques, signal timing criteria, and guidelines for crosswalk markings. These techniques have since been incorporated into various national guidelines.

WORK ZONE DESIGN

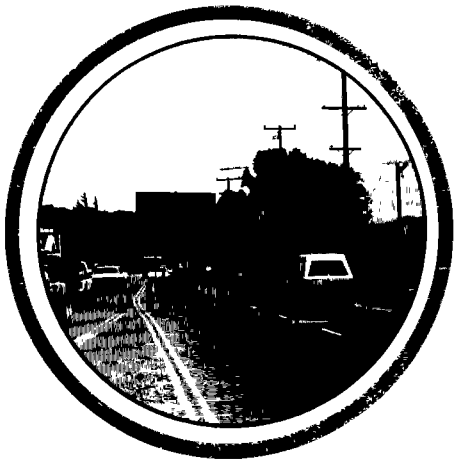
The provision of clear, understandable traffic controls through or around freeway or street construction is vital for the safe movement of traffic. Traffic flow must be maintained while separating vehicular traffic from construction hazards. It is also a critical element in protecting the agency from tort liability actions arising from accidents involving construction sites.

Primary considerations in work zone design are to minimize accident potential while maintaining traffic movements as close to the original level of operations as possible; thus, minimizing delay to drivers. This requires identifying and selecting the best strategy for diverting traffic. Other key concerns include designing detour routes to meet driver expectancies in terms of geometric consistencies with existing routes and visibility under night and poor weather conditions.

JHK is experienced in developing innovative solutions to unique traffic control situations. Work zone designs follow local standards and guidelines based on the standard reference, "Manual of Uniform Traffic Control Devices" and the supplementary "Traffic Control Devices Handbook."

Kino Boulevard & I-10 Interchange alignment, Tucson, Arizona

Typical Work Zone.

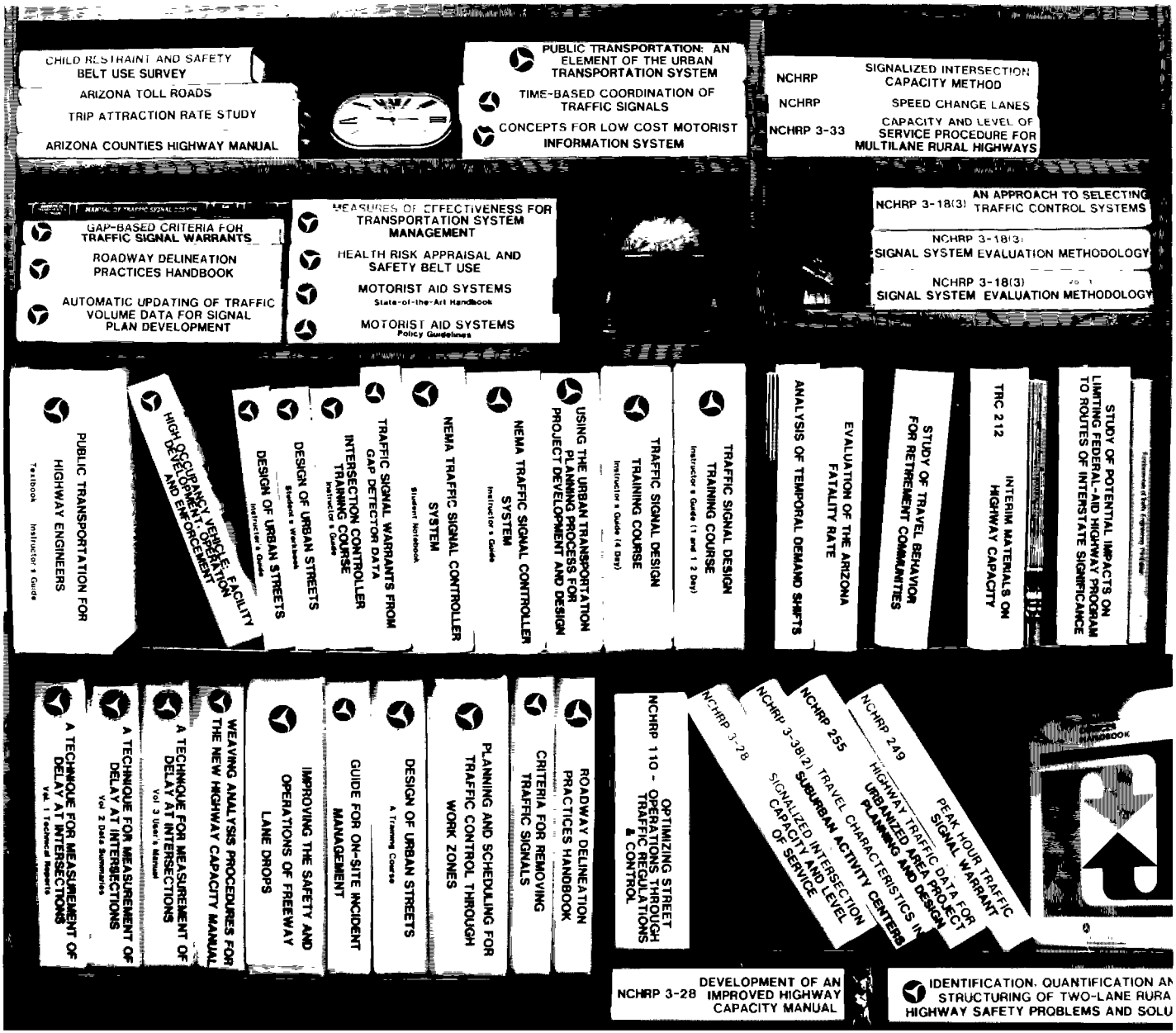


Research & Training

JHK & Associates' consulting services are characterized by close and diligent orientation toward client's needs and public responsibility. While many traditional policies and procedures—evolving over time—have adequately answered the need of the transportation profession, the field of transportation and traffic engineering is not static and must continually seek new solutions to respond to new problems and to better accommodate prevailing situations. Hence, a large segment of JHK's practice is focused on research in the various aspects of transportation and traffic engineering.

Not only is the pursuit of new knowledge to expand technical boundaries an objective of the Firm, so too is the upgrading of practitioner skills by the expeditious transfer of knowledge. To be of lasting value, the collective intelligence brought to bear through research must be accorded professional acceptance leading to timely application of research results. Toward this end, JHK is committed to the development and presentation of training courses for decision-makers, engineering staffs, and technicians.

The JHK library of research documents and training courses developed by the Firm in recent years is portrayed below.



Representative Clients . . .

FEDERAL

U.S. Army—Corps of Engineers
U.S. Air Force
U.S. Navy (NAVFAC)
Dept. of Defense—DCPA
Dept. of Interior
  National Park Service
U.S. General Services Admin.
Dept. of Transportation
  FAA
  FHWA
  NHI
  NHTSA
  UMTA

STATE

Alaska
Arizona
California
Colorado
Connecticut
Florida
Georgia
Hawaii
Illinois
Indiana
Louisiana
Maine
Maryland
Michigan
Minnesota
Nevada
New Jersey
New Mexico
New York
North Carolina
Oklahoma
Oregon
Rhode Island
Vermont
Virginia
West Virginia
Wisconsin

REGIONAL

AC Transit
Amador County Trans. Comm.
Atlanta Regional Commission
Bay Area Rapid Transit District
Golden Gate Bridge, Highway
  and Transportation District
Kern COG
Maricopa Assoc. of Govts.
Marin County Transit District
Metropolitan Transportation Comm.
Metropolitan Washington, COG
National Capital Planning Comm.
Oahu MPO
Orange County Transit District
Pennsylvania Turnpike Comm.
Piedmont Triad COG
Pima Assoc. of Govts.
SW Florida Regional Planning Comm.
San Bernardino Assoc. Govts.
Stanislaus Area Assoc. of Govts.
Tahoe Regional Planning Agency
Washington Metro Area Transit Auth.

COUNTY

Alameda County, CA
Anoka County, MN
Arlington County, VA
Baltimore County, MD
Brevard County, FL
Butte County, CA
Cochise County, AZ
Contra Costa County, CA
Douglas County, NV
El Dorado County, CA
Fairfax County, VA
Henrico County, VA
King County, WA
Los Angeles County, CA
Maricopa County, AZ
Marin County, CA
Montgomery County, MD
Orange County, CA
Pima County, AZ
Prince Georges County, MD
Riverside County, CA
Sacramento County, CA
San Diego County, CA
San Joaquin County, CA
San Luis Obispo County, CA
San Mateo County, CA
Santa Clara County, CA
Santa Cruz County, CA
Sonoma County, CA
Stanislaus County, CA
Volusia County, FL
York County, VA

CITY

Albuquerque, NM
Alexandria, VA
Anaheim, CA
Ann Arbor, MI
Annapolis, MD
Atlanta, GA
Baton Rouge, LA
Baltimore, MD
Berkeley, CA
Bountiful, UT
Burlington, VT
Carlsbad, CA
Charleston, WV
Charlottesville, VA
Chula Vista, CA
Cincinnati, OH
Columbus, GA
Compton, CA
Cupertino, CA
Denver, CO
Des Moines, IA
Detroit, MI
Durham, NC
El Cajon, CA
Escondido, CA
Eugene, OR
Evansville, IN
Fairfield, CA
Flint, MI
Fresno, CA
Fullerton, CA
Grand Island, NE
Grand Rapids, MI
Greensboro, NC
Hampton, VA
Hartford, CT
Hayward, CA
Honolulu, HI
Huntington, WV
Irvine, CA
Jackson, MS
Long Beach, CA
Los Angeles, CA
Mesa, AZ
Minneapolis, MN
Modesto, CA
New Orleans, LA
Newport Beach, CA
Newport News, VA
New York, NY
Norfolk, VA
Oceanside, CA
Oklahoma City, OK
Orlando, FL
Oswego, NY
Phoenix, AZ
Portland, OR
Raleigh, NC
Reno, NV
Richmond, VA
Riverside, CA
Rome, GA
Salt Lake City, UT
San Bernardino, CA
San Diego, CA
San Francisco, CA
San Jose, CA
San Juan Capistrano, CA
San Mateo, CA
Santa Ana, CA
Santa Barbara, CA
Santa Cruz, CA
Savannah, GA
Scottsdale, AZ
Seattle, WA
Sierra Vista, AZ
Sioux City, IA
South Jordan, UT
South Lake Tahoe, CA
Springfield, OR
Stamford, CT
Stockton, CA
Sunnyvale, CA
Syracuse, NY
Tempe, AZ
Tucson, AZ
Vacaville, CA
Washington, D.C.
Willcox, AZ
Winston-Salem, NC

UNIVERSITIES & COLLEGES

Antioch College of Law, D.C.
California State Polytechnic, CA
Chico State College, CA
Federal City College, VA
Fresno State College, CA
George Mason University, VA
John Hopkins University, MD
Mills College, CA
Montgomery College, MD
Stockton State College, NJ
Sonoma State College, CA
Univ. of Calif.—Berkeley
Univ. of Calif.—San Diego
Univ. of Calif.—Santa Cruz

INTERNATIONAL

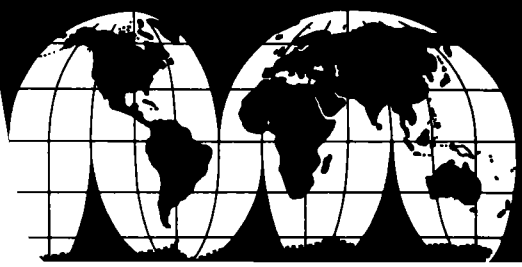
Australia
Canada
  Hull, Quebec
  Mississauga, Ontario
  Ontario Five Cities
  Ottawa-Carleton, Ontario
  Province of Ontario
  Regina, Saskatchewan
Philippines
  Cebu
  Manila
Mexico, D.F.
World Bank
  Abidjan, Ivory Coast
  Bangkok, Thailand
  Belo Horizonte, Brazil
  Bogotá, Colombia
  Bombay, India
  Kingston, Jamaica
  Kuala Lumpur, Malaysia
  Lima, Peru
  San José, Costa Rica

NATIONAL

American Public Works Assoc.
American Public Transit Assoc.
Institute of Transportation Engineers
National Cooperative Highway
  Research Program
Transportation Research Board

PRIVATE

Anderson DeBartolo Pan, Inc.
Architecture One
Atlantic Research Corp.
Arthur Young & Co.
Benson & Gerdin, Inc.
Bingham Engineering
Black & Veatch
Business Properties, Inc.
Cambridge Systematics, Inc.
Cella Barr Associates
Coe & Van Loo, Inc.
Coldwell, Banker
Comsis Corporation
Cornoyer-Hedrick, Inc.
Cutter Labs
Dames & Moore
DMJM
EDAW, Inc.
Environmental Resources Group
Environmental Science Assoc.
Ernst & Ernst
Greiner, Inc.
Gruen Associates
HDR Infrastructure, Inc.
Henningson, Durham &
  Richardson, Inc.
Johnson Brittain Associates
Kaiser Engineers
Keyes Condan & Florance
Leedshill-Herkenhoff, Inc.
Lendrum Design Group
Lichliter Jameson & Associates
Mobil Oil Co.
Parducci Winery
Peat Marwick Main & Co.
Philips Telecommunication Industries
Post Buckley Schuh & Jernigan
Raytheon Co.
Rouse Co.
RTKL, Inc.
Skidmore, Owings & Merrill
Standard Oil Co.
Stanford Research Institute
Stanley Engineers, Inc.
Sverdrup Corp.
SYDEC
Systems Applications, Inc.
The Planning Center
The Taubman Company
TAMS Consultants, Inc.
TRW Corporation
United Parcel Service
Utah Construction & Mining Co.
Winkler Development



Preliminary CPM For Project

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

entire contract in accordance with Paragraph 26, "Rights and Remedies of State for Default."

d. Unless otherwise provided in Rider D, software shall not be accepted by the State and no charges associated with such software shall be paid by the State until the software has satisfactorily completed the acceptance tests.

e. Immediately upon successful completion of the acceptance testing, the State shall notify the Contractor in writing of the acceptance of the software and authorize appropriate payment. The State shall maintain adequate records to satisfy the requirements of acceptance testing.

10. Purchase Prices and Payment Schedules

a. Purchase prices for equipment under this contract shall be shown in Rider B. The monthly cost to the State for installment payments, if applicable under this contract, shall be in accordance with the appropriate Payment Schedule(s) contained in Rider E. If the operating software is proprietary, the license for its use is contained in Rider G.

b. The consideration to be paid Contractor, as provided herein shall be in compensation for all of Contractor's expenses incurred in the performance hereof, including travel and per diem, unless otherwise expressly so provided.

11. Use of Software and Basis for Payment

All software, other than operating software to be delivered, with any charges for its use, are listed on Rider C. Each item of software which is proprietary in nature shall be licensed to the State for its use in accordance with the provisions of Rider G. Except as may be provided in Rider G, the State shall have unrestricted use of such software.

12. Maintenance of Equipment

If the Contractor is responsible under this contract to maintain the equipment covered under this contract, the Contractor shall keep the equipment in good operating condition and shall always be responsive to the maintenance requirements of the State. Equipment maintenance shall be provided in accordance with the provisions of Rider F, with the basic monthly maintenance charges, if any, listed in Rider B. Maintenance Services, other than those provided in accordance with Rider F, are outside the scope of this contract. The Contractor agrees, however, to make available for a minimum of 5 years after the installation date, adequate maintenance service.

13. Replacement Parts Availability

The Contractor shall indicate in Rider B, the number of years all replacement parts will be available beginning with the installation date. If replacement parts are not available after the expiration of the Rider B period, the Contractor, when requested by the State, will assist the State to arrange for its own support by providing the State with whatever documentation is available to Contractor, subject to the conditions and charges, if any, associated with such documentation.

14. Transportation and Installation

a. Transportation

RIDER G - SOFTWARE LICENSE

This Rider is intended to provide the State with a license to use those proprietary program products which are necessary (or advantageous) to the State in performing the work for which the equipment was acquired.

The following language was adapted from the State's model software contract and may be used as a model.

/// EXAMPLE ///
RIDER G - SOFTWARE LICENSE

1. License Grant

a. Contractor hereby grants to the State and the State hereby accepts from Contractor, subject to terms and conditions of this Rider, a nonexclusive, nontransferable license to use the Software Products listed in Rider B and C and further described in Contractor's technical specifications (hereinafter referred to as "Software Products").

b. The license granted above authorizes the State to use the Software Products in machine-readable form on the computer system located at (Installation address). Said computer system and its associated units (collectively referred to as "CPU") are designated as (Manufacturer name, model and serial number), provided that if the CPU is inoperative due to malfunction, the license herein granted shall be temporarily extended to authorize the State to use the Software Products, in machine-readable form, on any other State CPU until the designated CPU is returned to operation. By prior written notice, the State may redesignate the CPU on which the Software Products are to be used. The redesignation will be effective upon the date specified in the notice of redesignation.

c. The State may use the Software Products in the conduct of its own business, and any division thereof.

2. Maintenance

a. The correction of any residual errors in any Software Products which may be discovered by Contractor or by the State will be considered maintenance. Such maintenance will be performed by Contractor without additional charge for twelve (12) months after installation. Suspected errors discovered by the State in the Software Products will be handled by the following procedure:

(1) A listing of the output and a copy of the identical input data in machine-readable form will be submitted to the Contractor, along with a complete copy of the appropriate Contractor information form and a listing of the contents of pertinent portions of the main memory of the CPU at the time the error condition was noted.

(2) Errors in Software Products as verified by Contractor will be corrected by providing a new copy of said Software Products (or of the affected portions) in machine-readable form.

(3) The Contractor shall attempt to correct Software Product errors within a reasonable time.

b. Contractor will be available to assist the State in isolating and correcting error conditions caused by the State's particular hardware or operating system at rates listed in Attachment to Rider C.

c. If Contractor is called upon by the State to correct an error caused by State negligence, modification by State, State supplied data, machine or operator failure, or due to any other cause not inherent in the original Software Products, Contractor reserves the right to charge State for such services on a time and material basis at rates listed in Attachment to Rider C.

///EXAMPLE///
RIDER G - SOFTWARE LICENSE (Continued)

3. Right to Copy or Modify

a. Any Software Product provided by Contractor in machine readable form may be copied, in whole or in part, in printed or machine-readable form for use by the State with the designated CPU, for use by the State to perform one-time benchmark tests, for archival or emergency restart purposes, to replace a worn copy, to understand the content of such machine-readable material, or to modify the Software Product as provided below; provided, however, that no more than three printed copies and five machine-readable copies will be in existence under this Agreement at any one time without prior written consent from Contractor, such consent not to be unreasonably withheld. The original, and any copies of the Software Product, in whole or in part, which are made hereunder shall be the property of the Contractor.

b. The State agrees to keep any such copies and the original at a mutually designated State location, except that the State may transport or transmit a copy of the original of any Software Product to another State location for backup use when required by CPU malfunction, provided the copy or the original is destroyed or returned to the designated location when the malfunction is corrected.

c. The State may modify any Software Product, in machine-readable form, for its own use and merge it into other program material. Any portion of the Software Product included in any merged program material shall be used only on the designated CPUs and shall be subject to the terms and conditions of this Rider.

d. The State agrees to reproduce and include the Contractor's copyright or other proprietary notice on any copies, in whole or in part, in any form, including partial copies of modifications, or Software Products furnished under this contract.

4. Protection of Software Product

a. State agrees that all materials furnished hereunder, appropriately marked or identified as proprietary, are provided for the State's exclusive use and will be held in confidence. All proprietary data shall remain the property of the Contractor. The State will not provide or otherwise make available any program materials in any form without Contractor's prior written consent except to State employees, Contractor employees or other persons during the period they are on the State's premises for purposes specifically related to the State's use of the program.

b. The State will insure, prior to disposing of any media, that any licensed materials contained thereon have been erased or otherwise destroyed.

c. The State agrees that it will take appropriate action by instruction, agreement, or otherwise with its employees or other persons permitted access to licensed programs and/or optional materials to satisfy its obligations under this Rider with respect to use, copying, modification and protection and security of licensed programs and optional materials.

5. Termination

a. The State may terminate this Rider in its entirety, without penalty, upon thirty (30) days prior written notice to the Contractor.

/// EXAMPLE ///
RIDER G - SOFTWARE LICENSE (Continued)

b. Within fifteen (15) days after cancellation or termination of this Rider, for whatever cause, State agrees to certify to Contractor in writing that the original and all copies, in whole and in part, in any form including partial copies, and modifications of any Software Product subject to this Rider, have been destroyed. However, upon prior written notification to the Contractor, the State may retain a copy for archive purposes only.

c. If this Rider shall be terminated as to certain, but not all, Software Products, the State will certify to Contractor in writing that the original and all copies, in whole or in part, in any form, have been destroyed.

6. Future Releases

If improved versions of this Software Product are developed by the Contractor (other than those described in Contractor's technical specifications), and are made available to other licensees, they will be made available to the State at the State's option provided such versions are operable on the same computer configuration.

STATE OF CALIFORNIA—BUSINESS AND TRANSPORTATION AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF TRANSPORTATION
BOX 7310
SAN FRANCISCO 94120
(415) 557-1840

1/26/90

January 22, 1990

Contract No. 04D922-PC
Traffic Operations
System and Center
398-150010

By Fax

Consultants:
(See Attached List)

This is response to questions raised at and subsequent to the subject proposers conference. The information is provided to enhance your understanding of Caltrans needs for operating and maintaining the system, especially the software.

You (the consultants) are not expected to include a response in the proposal that is due January 26. You should be prepared to discuss the subject in your interview.

Caltrans will have the responsibility of operating and maintaining the system. Caltrans may have to correct bugs appearing after the warranty period. We also must be able to expand the system easily to solve future traffic-related problems or perform various system enhancements. As a consequence, Caltrans requires source code for sections we may have to add to or repair.

The following describes the type of software documentation we believe is required to maintain the software. It also reflects the ownership and licensing relationships needed. We realize you are expert in these matters, and invite you to offer solutions to our problem.

1) Documentation of Code

The CONTRACTOR shall supply well documented source code for any program which controls or allows an operator to directly or indirectly control traffic management devices and equipment, including application programs and device drivers. In addition, documented source code shall be supplied by the CONTRACTOR for any code he develops for this CONTRACT, including operating system and application source code if modifications to commercially available packages are made.

User documentation shall be supplied by the CONTRACTOR for all software supplied to the State in this CONTRACT.

Examples showing the type, level, and extent of documentation required will be supplied by the State for examination by the CONTRACTOR. The CONTRACTOR shall also provide examples of documented source code to the State prior to negotiations.

2) Ownership, Licensing, and Confidentiality of TOS Software

a. Software developed by the CONTRACTOR to fulfill CONTRACTUAL requirements shall become the non-exclusive property of the State.

b. Software supplied, but not developed by the CONTRACTOR under this CONTRACT shall be licensed by the State from the software's owner, but supported by the CONTRACTOR.

c. State workers and others exposed to confidential source code will be required to first sign nondisclosure agreements with the owners of the software.

d. Site or single licenses for additional installations by Caltrans in California of all TOS software supplied under the CONTRACT will be available from the CONTRACTOR.

3) Proposed partial list of unmodified third-party software for which source code and source documentation would not be required:

a. Databases and spreadsheets,

b. Utility programs

- Software development programs
- Word processing programs

c. Some device drivers

d. LAN software

e. Application generators

f. Graphics information system software

Sincerely yours,

BURCH C. BACHTOLD
District Director

by Lenka Culik-Caro

LENKA CULIK-CARO
Senior Transportation Engineer
District Consultant Coordinator
Project Development North Counties

Attachment:

Letter from JHK & Associate dated January 3, 1990

SMART CORRIDOR SYSTEM MANAGER PROPOSAL

The following summarizes the cost-effectiveness issues concerning the cost proposal submitted by JHK & Associates.

1. The estimate for the work scope included in the proposal was estimated at $3,789,100 in the Implementation Plan, Smart Corridor Demonstration Project (see attached exhibit). When the contingencies shown in the Implementation Plan are included, the project estimate for the scope of work is $4,357,465. The JHK proposal is in the amount of $3,490,616 is 8% less than the original estimate or 20% less than the original with contingency. The RFP estimate of $2,500,000 did not fully reflect the scope of work of the RFP.

2. The JHK staff has full knowledge of the project, with the assigned staff having worked on the conceptual design stage. No initial start-up or learning delays and associated costs will be incurred.

3. The subcontractor for preparation of field design plans (Katz and Okitsu) are preparing CAD based plans in the Smart Corridor area at this time. No hand-off or learning delay or associated costs will be incurred.

4. The JHK staff assigned to the project are intimately aware of the software for the ATSAC and SATMS systems. This will allow related software development and integration tasks to be undertaken with minimum risk to the base software and with minimum start-up delay and associated costs.

5. JHK is the only firm with the project management and field design staff capable of doing this type work and currently located in Los Angeles. This minimizes travel and per diem costs. The JHK cost proposal includes less than 2.5 % for travel and per diems.

6. JHK is a cognizant contractor for this type of work. The estimates prepared reflect direct experience with similiar development efforts. This minimizes the risk associated with an unfamiliar contractor that might greatly underestimate the original costs and require significant modification to the original estimate.

7. JHK receives significant discounts on the majority of the computer equipment to be provided under this contract (generally 15 to 25%) and these savings will be passed on to LACTC.

8. JHK has procedures in-place for developing equipment lists and procuring the equipment, reducing the cost for this work.

9. Final software coding and testing is done in Norcross, Georgia, which is a low salary cost environment. Well qualified staff are available at a cost that is approximately 20% lower than costs for comparable persons in the Los Angeles basin.

10. Overall, the staff of JHK and Katz/Okitsu are more familiar with the project and project area of any that could be proposed. This, in total, reduces project initiation costs and delays and insures greater accuracy of the total project estimate.

SMART CORRIDOR IMPLEMENTATION PLAN

ELEMENT	*ITEM*	*AMOUNT*
1.	*Central Smart Corridor System/Expert System*	
	a. Capital Cost	*$1,857,400*
	b. Design	*185,700*
	c. Interpretation	*185,700*
3.	*Caltrans/ATSAC Communications*	
	a. Design (Portion)	*25,000*
7.	*Freeway CCTV Interface*	
	a. SC Database Interface	*50,000*
	b. Control PS & E	*10,000*
8.	*Surface Street CCTV*	
	a. PS & E	*151,200*
	b. Interface SC Database	*50,000*
11.	*Digital Broadcast*	
	a. Design, SM Portion	*35,000*
	b. Monitoring and Evaluation	*60,000*
12.	*Highway Advisory Telephone*	
	a. Integration	*10,000*
	b. Design	*21,200*
21.	*Freeway CMS*	
	a. Integration (Portion of CE.)	*30,000*
22.	*Surface Street CMS*	
	a. PS & E	*410,500*
	b. Sign Software (170)	*50,000*
	c. ATSAC/CMS Software & Integration	*75,000*
23.	*Freeway HAR*	
	a. PS & E	*15,300*
24.	*Surface Street HAR*	
	a. PS & E	*59,100*
25.	*Operations Plan and Decision Matrix*	
	a. System Manager Support	*508,000*
	TOTAL	*$3,789,100*
	Contingency at 15%	*$ 568,365*
	Total with Contingency	*$4,357,465*

B & C

SMART CORRIDOR SYSTEMS MANAGER RFP

Answers to Questions and

Clarifications to RFP

February 16, 1990

REVISED SCHEDULE - The schedule has been revised. See attached revision. Twenty-five copies of the Proposal are due to LACTC on Wednesday, March 14 at 2:00 p.m.

OTHER INTERESTED CONSULTANTS - An attendance list from the pre-proposal conference is attached.

OVERHEAD RATE - The overhead rate in the Proposal shall not exceed 125%. Consultants may increase this overhead rate to a maximum of 150%.

CAN A CONSULTANT WHO CONTRIBUTED TO THE RFP CONTENTS BID ON THE CONTRACT? - The RFP document was prepared by LACTC, Caltrans and LADOT staff based on the findings of the Conceptual Design Contract and without consultant contribution. Excerpts from the conceptual design contract reports, which have been made available to bidders, are included in the Scope of Work for reference purposes (Work Schedules, maps, and Attachment A pages 35-118.) According to LACTC Contracts Section and Legal Counsel, there is no legal prohibition against hiring, or reviewing proposals by, a consultant who contributed to the conceptual design report.

COORDINATION - The consultant must be able to work with all of the agencies involved in the cooperative Smart Corridor project.

SOFTWARE OWNERSHIP - According to Section 5262 of the State Administrative Manual, software developed using public funds allocated by the State, shall become property of the State of California.

STAFF SUBSTITUTION - Addition to ITP-4, item 8.10. Key personnel will not be substituted without written approval from LACTC.

CHANGE TO LIABILITY SECTION OF GENERAL CONDITIONS - As requested by the City of Los Angeles and LACTC's insurance consultant, the liability section of the RFP is changed as follows:

1. Section GC-7.0, Page GC-6: Delete the last sentence of this section.

2. Section GC-9.0, Page GC-7: Subsection A, Replace the entire first paragraph with the following:

   A. "The CONSULTANT shall carry Comprehensive General Liability insurance, including automobile coverage, for bodily injury, property damage and personal injury with

limits not less than $500,000 per occurrence. CONSULTANT'S Automobile Liability shall provide coverage for any hired, non-owned or owned vehicles used in performance of the Services or entering any portion of the project site and for all work performed under this Contract. Such insurance shall name the COMMISSION."

Delete numbered item 3 on page GC-7.

D. Replace the first sentence in Section D. on Page GC-8 with the following: "CONSULTANT's Professional Liability Insurance shall be carried in the amount of at least $1,000,000 covering claims concerning acts, errors or omissions whenever committed for services performed under this contract."

EVALUATION CRITERIA - Replace the evaluation criteria on page ITP-4 with the following. The major changes are to make the DBE performance goals, or reasonable efforts, mandatory, and not part of the evaluation criteria.

8.9.1. Proposal and Presentation (25%)
Adequacy of the proposed method of accomplishing the project work including planning and design approach, activity coordination and sequencing.

8.9.2. Staff Assigned to the Project (35%)
Technical competence of the assigned staff to perform the work including an evaluation of the project's technical, professional and managerial personnel assignments, and the time dedicated to the project. Identification of which key personnel will be committed to the project unless the firm is given a written waiver from the Commission will also be considered.

8.9.3. Related Experience and Ability (15%)
Past record of performance of firm as determined by proposal and former clients regarding cost control, work quality and completing work on schedule.

8.9.4. Cost and Schedule (25%)
Proposals will be judged to ensure that the proposed work is commensurate with the scope of work proposed. The software ownership issue (see previous) will also be considered as a factor of cost. Capability of the consultant to accomplish the project expeditiously will also be considered.

8.9.5. Disadvantaged Business Enterprises (0%, but mandatory that the firm either meet the goal, or have LACTC approved good faith efforts to meet the goal.)

ATTENDANCE

SMART CORRIDOR SYSTEMS MANAGER
PRE-PROPOSAL CONFERENCE
FEBRUARY 13, 1990

Name	Agency	Phone/FAX
Tom Wetmore	Edwards & Kelcey	714/634-9212 714/634-9258
P. Morris Burgess	Kaiser Engineers	213/612-7161 213/612-7130
Duane Kenagy	DeLeuw, Cather & Co.	818/440-7583 818/440-2630
Dennis Foderberg	National Engineering Technology Corp. (NET)	708/394-8287 708/293-0289
Fong-Ping Lee	FPL	714/964-2778 714/964-6999
Robert M. Haynes	FPL & Associates	714/681-3357 714/964-6999
Ali Caylr	Transtech	714/595-8599 714/595-8863
Alistair Baillie	IBI Group	714/760-3188 714/760-3970
Scott Stewart	IBI Group	714/760-3188 714/760-3970
Robert Larson	Boyle Engineers	714/680-0884 714/721-7142
John Itagaki	BI Tran Systems	916/441-0260
Abbas Mohaddes	DKS Associates	714/543-9601 714/648-0402
Alan Clelland	JHK	213/625-1522 213/625-1158
John Grant	JHK	213/625-1522 213/625-1158
Leo Lee	DKS	213/627-0419 213/627-9761
Kirby Leung	Katz, Okitsu & Associates	213/260-4703 213/260-4705
Linda Miller	The Nettleship Group	213/392-8585
Hon Yow	BSI Consultants	714/558-1952
Gregory Damico	Caltrans District 07	213/620-5467
Diane Perrine	LACTC	213/626-0370
Verej Janoyan	LADOT	213/485-8754
Anson Nordby	LADOT	213/485-4271
Scott Varanesh	LACTC	213/626-0370
Jan Walls	LACTC	213/626-0370

The interview panel will consist of representatives from the major agencies serving on the inter-agency Smart Corridor Committee such as Caltrans, the City of Los Angeles, LACTC and CHP.

WRITTEN QUESTIONS SUBMITTED BY JHK & ASSOCIATES

1. It is stated on page LOI-2 that "the budgeted amount of the work performed ... is approximately $2.5 million. This is repeated on the Pre-Proposal Meeting invitation notice. The Implementation Plan estimates the following:

Element 1: Central System	$2.5 million
Design and Support Services corresponding to other work items defined in the consultant's responsibilities	$0.9 million

   Should the contract budget therefore be $3.4 million?

   No. The proposal should address a work effort within the $2.5 million project budget. Should a proposer feel that there is additional work to be performed that will significantly enhance the effectiveness of this project, the proposer may include a description and estimate of this work for consideration should additional funds become available.

2. The payment schedule of page PR-7 conflicts with the contract payment clause of page GC-10. Is payment to be by task or by month?

   The payment will be by task per the General Conditions (page GC-10).

3. If the payment schedule of page PR-7 is to be followed, then the 10% withhold appears to be excessive. Can the withhold be reduced to 5% which is more customary for this type of project?

   The withholding will remain at 10% for the first 50% of the work. LACTC has the option of reducing the withholding to 5% after the 50% level if satisfactory performance has been performed.

WHEN WILL THE CONSULTANT BE EXPECTED TO DO THE WORK? - The current schedule calls for the consultant to start work on April 2. See the matrix of responsibilities on pages 6 through 11 of the scope of work, and the overall schedule on pages 31 through 34 for additional information. Additional pages, showing the overall work schedule for LADOT and LACTC are attached.

WILL THE CONSULTANT ASSUME CONSTRUCTION ENGINEERING AND INSTALLATION RESPONSIBILITIES? - No, the City of Los Angeles and Caltrans will do these tasks.

WHAT IS MEANT BY THE CONSULTANT HEADING ON PAGE 6? - This means that the Systems Manager will work with other consultants. For

example, under item #3, Caltrans Communication Systems, the work design and contract administration will be done by consultants.

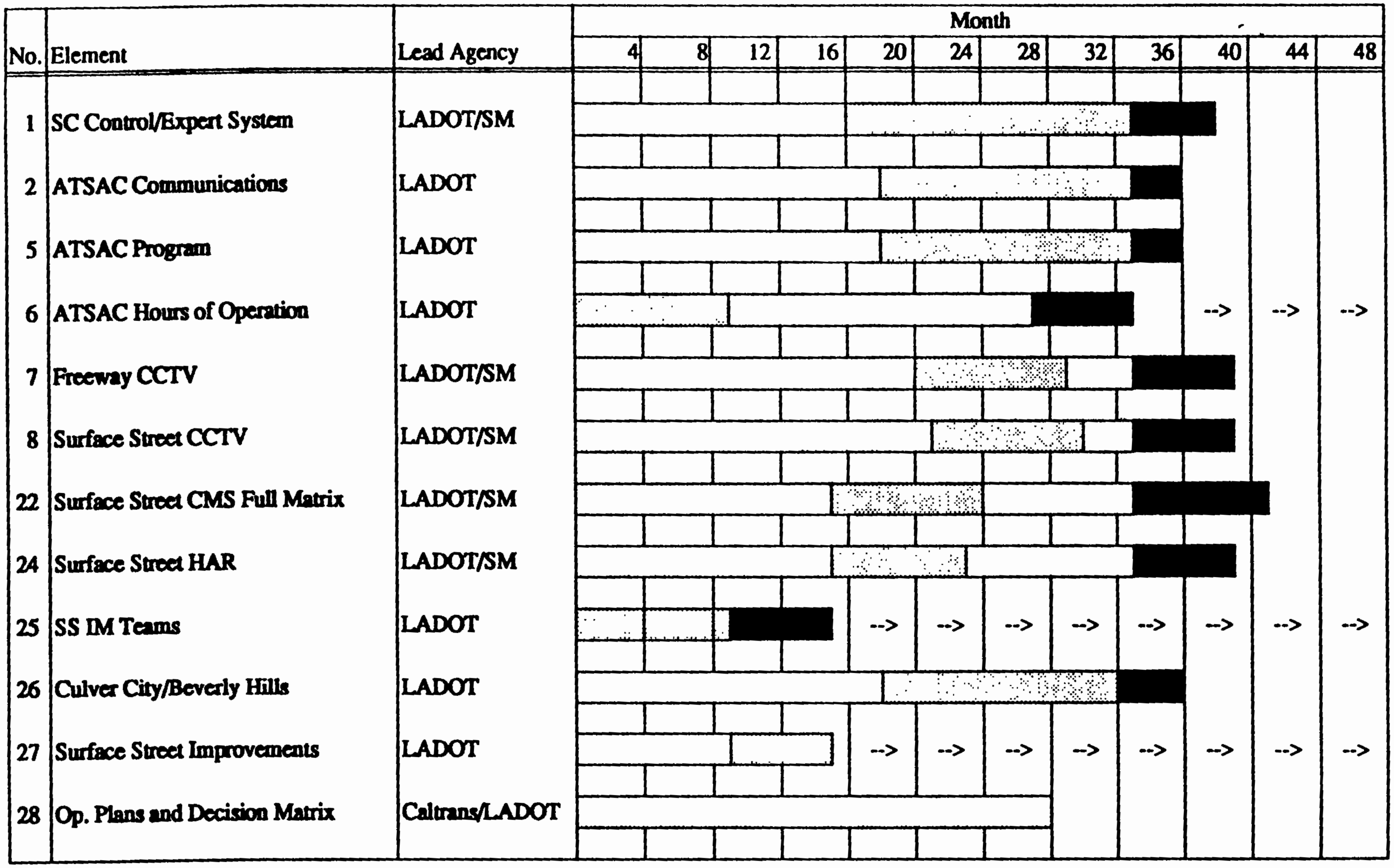
DOES THE $2.5 MILLION BUDGET FOR THE SMART CORRIDOR PROJECT INCLUDE COMPUTER HARDWARE AND ASSOCIATED SOFTWARE? - Yes, for additional detail refer to the Conceptual Design report.

DOES THE BUDGET INCLUDE ANY ALLOWANCE FOR CONSTRUCTION ENGINEERING DURING THE IMPLEMENTATION OF THE ELECTRONIC EQUIPMENT? - No, Caltrans and LADOT will perform construction engineering as part of their functions.

DISTRIBUTION OF RESPONSES - Responses to the questions will be faxed to consultants attending the pre-proposal conference, and mailed to the rest of the proposal mailing list.

DP:me
propmin
smart#6

S-5. Implementation Program LADOT Schedule



No.	Element	Lead Agency	4	8	12	16	20	24	28	32	36	40	44	48
1	SC Control/Expert System	LADOT/SM												
2	ATSAC Communications	LADOT												
5	ATSAC Program	LADOT												
6	ATSAC Hours of Operation	LADOT										-->	-->	-->
7	Freeway CCTV	LADOT/SM												
8	Surface Street CCTV	LADOT/SM												
22	Surface Street CMS Full Matrix	LADOT/SM												
24	Surface Street HAR	LADOT/SM												
25	SS IM Teams	LADOT					-->	-->	-->	-->	-->	-->	-->	-->
26	Culver City/Beverly Hills	LADOT												
27	Surface Street Improvements	LADOT					-->	-->	-->	-->	-->	-->	-->	-->
28	Op. Plans and Decision Matrix	Caltrans/LADOT												

S-4. Implementation Program LACTC Schedule

No.	Element	Lead Agency	Month 4	8	12	16	20	24	28	32	36	40	44	48
29	Public Information & Education	LACTC												
31	Evaluation	LACTC												

SMART STREET RFP SCHEDULE

REVISED FEBRUARY 13, 1990

Issue RFP	2/5
Pre-Proposal Conference	Tuesday, 2/13 -8:00 a.m. LACTC
Issue RFP Clarifications	2/16
Proposals Due	Wednesday 3/14 - 2:00 p.m. LACTC
Short Interview List (Smart Interagency Subcommittee)	Tuesday 3/20 - Noon LACTC
Consultant Interviews (Smart Committee) & Recommendation	Thursday 3/22 LACTC (to be scheduled)
Consultant Confirmed by Streets and Highways Committee	Friday, 3/23 12:30 pm
Draft Contract made available to recommended consultant	Friday, 3/23 2:00 pm
Consultant Confirmed by LACTC	Wednesday, 3/28 1:00 pm
Consultant Starts Work	Monday, 4/2

DP:lhm

RFPSched/Smart#6

STATE OF CALIFORNIA

OFFICE MEMO DATE: March 9, 1990
Std. 100

To: DIANE PERRINE
LA CTC

From: SUZANNE HOLMES Suzanne Holmes
OFFICE OF DEPARTMENTAL GRANTS
DOTP
Phone: 4-7099

Subject: SMART CORRIDOR/ PROPRIETARY INFO

THERE ARE NO FEDERAL RESTRICTIONS AS FAR AS THE PVEA (EXXON) MONEY IS CONCERNED ON SPECIFIC PROPRIETARY & LICENSING REQUIREMENTS.

THE STATES USE THEIR OWN REGULATIONS AND IN THIS CASE IT IS THE STATE ADMINISTRATIVE MANUAL SECTION 5262. THIS SHOULD CONTAIN THE LANGUAGE INFORMATION YOU NEED. ATTACHED IS A COPY OF THE SAMPLE RIDER LANGUAGE ON THIS SUBJECT THAT YOU SHOULD CONSIDER USING.

WHILE THE DOCUMENT YOU PROVIDED FROM THE TOC IN SAN FRANCISCO CONTAINS PROPRIETARY & LICENSING INSTRUCTIONS, WE ARE NOT ABLE TO CONFIRM THAT IT COVERS ALL THE ASPECTS OF YOUR PARTICULAR PROJECT.

CALL ME IF YOU NEED ANYTHING ELSE. 916 324 7099

CC GORO ENDO DISTRICT 07

RIDER G - SOFTWARE LICENSE

This Rider is intended to provide the State with a license to use those proprietary program products which are necessary (or advantageous) to the State in performing the work for which the equipment was acquired.

The following language was adapted from the State's model software contract and may be used as a model.

/// EXAMPLE ///
RIDER G - SOFTWARE LICENSE

1. License Grant

a. Contractor hereby grants to the State and the State hereby accepts from Contractor, subject to terms and conditions of this Rider, a nonexclusive, nontransferable license to use the Software Products listed in Rider B and C and further described in Contractor's technical specifications (hereinafter referred to as "Software Products").

b. The license granted above authorizes the State to use the Software Products in machine-readable form on the computer system located at (Installation address). Said computer system and its associated units (collectively referred to as "CPU") are designated as (Manufacturer name, model and serial number), provided that if the CPU is inoperative due to malfunction, the license herein granted shall be temporarily extended to authorize the State to use the Software Products, in machine-readable form, on any other State CPU until the designated CPU is returned to operation. By prior written notice, the State may redesignate the CPU on which the Software Products are to be used. The redesignation will be effective upon the date specified in the notice of redesignation.

c. The State may use the Software Products in the conduct of its own business, and any division thereof.

2. Maintenance

a. The correction of any residual errors in any Software Products which may be discovered by Contractor or by the State will be considered maintenance. Such maintenance will be performed by Contractor without additional charge for twelve (12) months after installation. Suspected errors discovered by the State in the Software Products will be handled by the following procedure:

(1) A listing of the output and a copy of the identical input data in machine-readable form will be submitted to the Contractor, along with a complete copy of the appropriate Contractor information form and a listing of the contents of pertinent portions of the main memory of the CPU at the time the error condition was noted.

(2) Errors in Software Products as verified by Contractor will be corrected by providing a new copy of said Software Products (or of the affected portions) in machine-readable form.

(3) The Contractor shall attempt to correct Software Product errors within a reasonable time.

b. Contractor will be available to assist the State in isolating and correcting error conditions caused by the State's particular hardware or operating system at rates listed in Attachment to Rider C.

c. If Contractor is called upon by the State to correct an error caused by State negligence, modification by State, State supplied data, machine or operator failure, or due to any other cause not inherent in the original Software Products, Contractor reserves the right to charge State for such services on a time and material basis at rates listed in Attachment to Rider C.

///EXAMPLE///
RIDER G - SOFTWARE LICENSE (Continued)

3. Right to Copy or Modify

a. Any Software Product provided by Contractor in machine readable form may be copied, in whole or in part, in printed or machine-readable form for use by the State with the designated CPU, for use by the State to perform one-time benchmark tests, for archival or emergency restart purposes, to replace a worn copy, to understand the content of such machine-readable material, or to modify the Software Product as provided below; provided, however, that no more than three printed copies and five machine-readable copies will be in existence under this Agreement at any one time without prior written consent from Contractor, such consent not to be unreasonably withheld. The original, and any copies of the Software Product, in whole or in part, which are made hereunder shall be the property of the Contractor.

b. The State agrees to keep any such copies and the original at a mutually designated State location, except that the State may transport or transmit a copy of the original of any Software Product to another State location for backup use when required by CPU malfunction, provided the copy or the original is destroyed or returned to the designated location when the malfunction is corrected.

c. The State may modify any Software Product, in machine-readable form, for its own use and merge it into other program material. Any portion of the Software Product included in any merged program material shall be used only on the designated CPUs and shall be subject to the terms and conditions of this Rider.

d. The State agrees to reproduce and include the Contractor's copyright or other proprietary notice on any copies, in whole or in part, in any form, including partial copies of modifications, or Software Products furnished under this contract.

4. Protection of Software Product

a. State agrees that all materials furnished hereunder, appropriately marked or identified as proprietary, are provided for the State's exclusive use and will be held in confidence. All proprietary data shall remain the property of the Contractor. The State will not provide or otherwise make available any program materials in any form without Contractor's prior written consent except to State employees, Contractor employees or other persons during the period they are on the State's premises for purposes specifically related to the State's use of the program.

b. The State will insure, prior to disposing of any media, that any licensed materials contained thereon have been erased or otherwise destroyed.

c. The State agrees that it will take appropriate action by instruction, agreement, or otherwise with its employees or other persons permitted access to licensed programs and/or optional materials to satisfy its obligations under this Rider with respect to use, copying, modification and protection and security of licensed programs and optional materials.

5. Termination

a. The State may terminate this Rider in its entirety, without penalty, upon thirty (30) days prior written notice to the Contractor.

STATE MODEL PURCHASE CONTRACT

THE FOLLOWING TEXT WILL BE INCLUDED ON THE FACE OF THE STATE'S INVITATION FOR BID AND PURCHASE ORDER FORMS OR STANDARD AGREEMENT FORM

Contractor agrees to furnish and install at a site designated by the State, in the vicinity of _____ and to sell to the State, and the State hereby intends to purchase from the Contractor, in accordance with the General Terms and Conditions below, all those electronic data processing machines and special features listed on Rider B. In addition, Contractor agrees to provide to the State all those products and services specified in all Riders attached to this contract, and in accordance with any provisions contained therein. The maximum amount of this contract shall not exceed _____. The term of this contract shall be from _____ to _____.

The following Riders and Addendum are hereby incorporated by reference and made a part hereof:

Rider A - Special Provisions
Rider B - Equipment List, Prices, Installation Dates and Allied Information
Rider C - Software List, Prices, Delivery Dates and Allied Information
Rider D - Acceptance Testing
Rider E - Installment Purchase Payment Schedules
Rider F - Maintenance Provisions
Rider G - Software License
Rider H - Training
Rider I - Personal Services
Rider J - Additional Contractor Commitments
Rider K - Non-Applicability
Form 17A - Nondiscrimination Clause

IFB/RFP (Correct #) and Contractor's responding bid are hereby incorporated and made a part of this contract.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS

1. Term and Amount of Contract

The term of this contract if applicable shall be as stated on the face of the State's Invitation for Bid and Purchase Order Forms, or Standard Agreement Form, subject to the availability of funds, unless terminated earlier by the State in accordance with the termination provisions contained in Paragraph 37. The maximum amount of this contract shall not exceed that amount stated on the face of the State's Purchase Order or Standard Agreement Form, payable solely from funds appropriated for the purpose of this contract. This amount may be changed during the term of this contract only by amendment to this contract. This contract is effective on the State's Purchase Order Date, or if a Standard Agreement Form is used, after signing by the Contractor and the contracting State agency, on the date of its last approval or certification of exemption from approval by or on behalf of the Director of Finance and the Director of General Services.

2. Amendments

Unless specifically prohibited by the solicitation document which was the basis for this contract, this contract may be amended by mutual consent of the parties. An amendment shall not be effective until approved by the Director of General Services, or until a certification of exemption from such approval has been signed by the contracting agency. No alteration or variation of the terms of this contract shall be valid unless made in writing and signed by the parties hereto, and no oral understanding or agreement not incorporated herein shall be binding on any of the parties hereto.

3. Definitions

a. Data Processing System (System) - The total complement of Contractor-furnished machines, including one or more central processors (or instruction processors) and operating software, which are acquired to operate as an integrated group.

b. Data Processing Subsystem - A complement of Contractor-furnished individual machines, including the necessary controlling elements (or the functional equivalent) and operating software, if any, which are acquired to operate as an integrated group, and which are interconnected entirely by Contractor-supplied power and/or signal cables; e.g., direct access controller and drives, a cluster of terminals with their controller, etc.

c. Machine - An individual unit of a data processing system or subsystem, separately identified by a type and/or model number, comprised of but not limited to mechanical, electro-mechanical, and electronic parts, microcode, and special features installed thereon and including any necessary software; e.g., central processing unit, memory module, tape unit, card reader, etc.

d. Equipment - An all-inclusive term which refers either to individual machines or to a complete data processing system or subsystem, including its operating software (if any).

e. Equipment Failure - A malfunction in the equipment, excluding all external factors, which prevents the accomplishment of the equipment's intended function(s). If microcode or operating software, residing in the equipment, is necessary for the proper operation of the equipment, a failure of such microcode or operating software which prevents the accomplishment of the equipment's intended functions shall be deemed to be an equipment failure.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

f. Operational Use Time - For performance measurement purposes, that time during which equipment is in actual operation by the State.

g. Preventive Maintenance - That maintenance, performed on a scheduled basis by the Contractor, which is designed to keep the equipment in proper operating condition.

h. Remedial Maintenance - That maintenance performed by the Contractor which results from equipment (including operating software) failure, and which is performed as required; i.e., on an unscheduled basis.

i. Principal Period of Maintenance - Any nine consecutive hours per day (usually between the hours of 7:00 a.m. and 6:00 p.m.) as selected by the State, including an official meal period not to exceed one hour, Monday through Friday, excluding holidays observed at the installation.

j. Period of Maintenance Coverage - The period of time, as selected by the State, during which maintenance services are provided by the Contractor for a fixed monthly charge, as opposed to an hourly charge for services rendered. The Period of Maintenance Coverage consists of the Principal Period of Maintenance and any additional hours of coverage per day, and/or increased coverage for weekends and holidays.

k. Maintenance Diagnostic Routines - The diagnostic programs customarily used by the Contractor to test equipment for proper functioning and reliability.

l. Facility Readiness Date - The date specified in the contract by which the State must have the site prepared and available for equipment delivery and installation.

m. Installation Date - The date specified in the contract by which the Contractor must have the ordered equipment ready (certified) for use by the State.

n. Performance Period - A period of time during which the State, by appropriate tests and production runs, evaluates the performance of newly installed equipment and software prior to its acceptance by the State.

o. Acceptance Tests - Those tests performed during the Performance Period as provided by Paragraph 8 and 9, and by Rider D, which are intended to determine compliance of equipment and software with Contractor's published specifications and to determine the reliability of the equipment.

p. Machine Alteration - Any change to a Contractor-supplied machine which is not made by the Contractor, and which results in the machine deviating from its physical, mechanical, electrical, or electronic (including microcode) design, whether or not additional devices or parts are employed in making such change.

q. Attachment - The mechanical, electrical, or electronic interconnection to the Contractor-supplied machine or system of equipment manufactured by other than the original equipment manufacturer and which is not connected by the Contractor.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

r. Software - An all-inclusive term which refers to any computer programs, routines, or subroutines supplied by the Contractor, including operating software, programming aids, application programs, and program products.

s. Operating Software - Those routines, whether or not identified as program products, that reside in the equipment and are required for the equipment to perform its intended function(s), and which interface the operator, other Contractor-supplied programs, and user programs to the equipment.

t. Programming Aids - Contractor-supplied programs and routines executable on the Contractor's equipment which assists a programmer in the development of applications including language processors, sorts, communications modules, data base management systems, and utility routines, (tape-to-disk routines, disk-to-print routines, etc.).

u. Application Program - A computer program which is intended to be executed on the Contractor's equipment for the purpose of performing useful work for the user of the information being processed. Application programs are usually developed or otherwise acquired by the user of the hardware/software system, but they may be supplied by the Contractor.

v. Program Product - Programs, routines, subroutines, and related items which are proprietary to the Contractor and which are licensed to the State for its use, usually on the basis of separately stated charges and appropriate contractual provisions.

w. Software Failure - A malfunction in the Contractor-supplied software, other than operating software, which prevents the accomplishment of work, even though the equipment (including its operating software) may still be capable of operating properly. For operating software failure, see definition of equipment failure.

4. Contractor Written Commitments

Any written commitment by the Contractor within the scope of this contract shall be binding upon the Contractor. Failure of the Contractor to fulfill any such commitment shall render the Contractor liable for liquidated or other damages due to the State. Such written commitments include (1) any warranty or representation made by the Contractor in the bid or proposal as to equipment or software performance, total system performance, or other physical design or functioning characteristics of a machine or software system; (2) any warranty or representation made by the Contractor concerning the characteristics of the items described in (1) above, made in any publication, drawings, or specifications accompanying or referred to in the bid or proposal which pertains to the responsiveness of the bid or proposal to the solicitation document, and (3) any written notification of or affirmation or representation as to the above which is made by the Contractor in or during the course of negotiations and which is incorporated into a formal amendment to the proposal.

5. Site Preparation

a. If the equipment to be installed requires special environmental considerations, Contractor shall provide site preparation specifications for equipment listed on Rider B within a reasonable time upon request by the State, unless such specifications have been included in the Contractor's bid or proposal. These specifications shall be in such detail as to ensure that

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

equipment, if installed according to these specifications, shall operate efficiently, from an environmental point of view and properly from a functional point of view.

b. The State may prepare a site plan showing the location of each item of equipment listed in Rider B and detailing the associated electrical power and environmental control facilities. If requested, the Contractor will review and comment on the adequacy of the State's plan, and shall be permitted free access to the site for this purpose. Alternatively, the Contractor may prepare the site plan, and will be permitted free access to the site for this purpose.

c. The State shall cause the site to be prepared in accordance with the Contractor's written minimum site and environmental specifications, unless the Contractor has agreed to be responsible for such site preparation, on or before the Facility Readiness Date specified in Rider B.

d. Any subsequent alterations or modifications to the site which are directly attributable to incomplete or erroneous specifications provided by the Contractor and which involve additional expense shall be made at the expense of the Contractor, to the extent that such costs would not have been incurred had the complete and/or correct specifications been initially provided.

e. If any such site alterations as discussed in Paragraph 5d above cause a delay in the installation, the provisions of Paragraph 7b shall apply.

f. Unless mutually agreed to otherwise, arrangements for procurement, installation, and maintenance of noncontractor's communication media (telephone lines, modems, etc.) necessary for the remote transmission of data are the responsibility of the State. In addition, if requested by the Contractor, the State shall provide one telephone, with appropriate coupling devices for the transmission of data, for the Contractor's use in installation and maintenance of the equipment. Any toll charges resulting from the use of this instrument by the Contractor in the installation and maintenance of the equipment will be borne by the Contractor.

6. Installation and Delivery Dates

a. Equipment (Hardware and Operating Software)

(1) Except as otherwise provided in Paragraph 6a(7), the Contractor shall install equipment listed in Rider B ready for use on or before the Installation Dates specified in Rider B. Time is the essence of this agreement.

(2) Installation Dates may be changed by mutual consent of the Contractor and the State by amendment to Rider B; however, consent of the Contractor is not required if, at least 90 days prior to the Installation Date, the State defers the installation of any machine, but a new Installation Date will be established by mutual agreement. Such unilateral deferment shall not exceed 180 days, except by mutual agreement.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

(3) The State shall provide the Contractor access to the site for the purpose of installing the equipment prior to the Installation Date. The Contractor shall specify in writing the time required to install the equipment.

(4) Except as otherwise provided in Paragraph 6a(7), the Contractor shall determine that the equipment is ready for use, and operates in conformance with the Contractor's published specifications. The Contractor shall then certify in writing to the State that the equipment is installed and ready to be turned over to the operational control of the State. The Contractor shall also provide to the State appropriate documentation to support the above certification, at which time the State will accept control of the equipment for the purpose of validating its installation and performance.

(5) Notwithstanding certification by the Contractor that the equipment has been installed and is ready for use, the equipment shall not be deemed installed within the terms of this Contract until such installation is confirmed by the State through testing prescribed by the solicitation document or by performance of other suitable tests mutually agreed to by both parties as being adequate for this purpose. If the test is successfully completed, the equipment shall be deemed installed and ready for use as of the date of the Contractor's certification. The State shall immediately begin acceptance testing of the equipment in accordance with the provisions of Paragraph 8, and shall notify the Contractor in writing, within five (5) working days, that the State concurs that the equipment was installed. If the equipment fails to successfully complete the test, the Contractor shall be notified immediately of the failure, with written confirmation to be provided in not more than five (5) working days. Control of the equipment shall immediately be given to the Contractor. The equipment shall not be deemed to be installed until the Contractor re-certifies such installation and the above-described test is successfully completed.

(6) Except as otherwise provided in Paragraph 6a(7), in the event the Contractor fails to install the equipment by the Installation Date, liquidated damages as prescribed in Paragraph 7 shall apply.

(7) If the nature of the equipment is such that the services of the Contractor are not required for its installation, and the Contractor so states in writing and the State agrees in writing that such Contractor services are not necessary, the Contractor may ship the equipment to the State site. If the equipment arrives not later than five (5) working days prior to the Installation Date, the equipment shall be deemed to have been installed on or before the Installation Date and no liquidated damages shall be paid, irrespective to whether or not the State is successful in installing the equipment without Contractor assistance. If this procedure is used, the State shall make every reasonable effort to install the equipment prior to the Installation Date, and shall confirm such installation in accordance with the procedures set forth in Paragraph 6a(5) above, without requiring a certification of installation as set forth in Paragraph 6a(4) above by the Contractor. If, however, the State is unable to install the equipment, it shall notify the Contractor that Contractor assistance is required. The Contractor shall then assist in the equipment installation and certification that such installation has been accomplished.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

b. Software (other than Operating Software)

(1) The Contractor shall provide those programming aids, program products, and applications listed on Rider C, on or before the Delivery Dates specified in Rider C, and shall certify to the State that such software has been delivered and is ready for State use. For purposes of this Paragraph, "delivered" also means received by the State, if such software is mailed by the Contractor.

(2) If, in the opinion of the Contractor, the services of the Contractor are required to install the software on State equipment, "delivery" of the software, for the purposes of this contract, shall be deemed to include such installation services.

(3) In the event the Contractor fails to deliver the agreed-upon software by the dates specified, liquidated damages as prescribed in Paragraph 7 will apply.

(4) During the period of this contract, when requested by the State, the Contractor shall furnish any additional software which it has developed or may develop at a future date for general use with the type of equipment listed on Rider B and which it furnishes to its customers generally, at the charges generally in effect at that time.

7. Liquidated Damages

a. General

The Installation Dates of the equipment set forth in Rider B and the Delivery Dates for software set forth in Rider B and C have been fixed so that the utilization of the equipment and software is consistent with the timing schedules of the State's programs. If any of the units of equipment, with all required operating software, are not installed within the times specified in Rider B, and/or if any of the other software is not delivered to the State within the time limits specified in Rider C, the delay will interfere with the proper implementation of the State's programs, to the loss and damage of the State. From the nature of the case, it would be impracticable and extremely difficult to fix the actual damages sustained in the event of any such delay. The State and the Contractor, therefore, presume that in the event of any such delay the amount of damage which will be sustained from a delay will be the amounts set forth in Riders B and C, and the State and the Contractor agree that in the event of any such delay, the Contractor shall pay such amounts as liquidated damages and not as a penalty. Similarly, a unilateral deferment by the State of equipment installation without appropriate notice or a delay in readying the facility interferes with the installation schedule under which the Contractor is operating, thus resulting in damages to the Contractor. The State and Contractor presume that in the event of such delay, the amount of damage which will be sustained will be the amount set forth in Rider B, and they agree that in the event of such a delay, the State will pay such amount as liquidated damages and not as a penalty. Amounts due the State as liquidated damages may be deducted by the State from any money payable to the Contractor. The State shall notify the Contractor in writing of any claim for liquidated damages pursuant to this paragraph on or before the date State deducts such sums from money payable to the Contractor.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

b. Equipment Installation Delays Caused by the Contractor

(1) If the Contractor does not install the equipment, (designated by the Contractor's type and model number), and special features included with the equipment (or suitable substitutes acceptable to the State), ready for use with all appropriate operating software, all as listed in Rider B, on or before the Installation Date(s) specified in Rider B, or in the case of the equipment described in Paragraph 6a(7) deliver to the State in time for State installation, the Contractor shall be liable for fixed liquidated damages specified in Rider B, in lieu of all other damages for such noninstallation. Liquidated damages shall accrue for each calendar day between the Installation Date specified in Rider B and the date the equipment is certified ready for use or 180 calendar days, whichever occurs first.

(2) If some, but not all of the machines are installed, ready for use, during a period of time when liquidated damages are applicable, and the State uses any such installed machines, liquidated damages shall not accrue against the machines used for any calendar day the machines are so used.

(3) If the delay is more than thirty (30) calendar days, then by written notice to the Contractor, the State may terminate the right of the Contractor to install, and may obtain substitute equipment, in accordance with the provision of Paragraph 26, "Rights and Remedies of the State for Default". In this event, the Contractor shall also be liable for liquidated damages, in the amounts specified above until substitute equipment is installed, ready for use, or for 180 days from the installation date, whichever occurs first.

c. Other Delivery Delays Caused by the Contractor

(1) If the Contractor does not deliver all the programming aids, program products, and applications listed on Rider C ready for use in substantial accordance with the Contractor's specifications, on or before the Delivery Dates specified in Rider C, the Contractor shall be liable for liquidated damages in the amounts specified in Rider C, in lieu of all other damages for such nondelivery. Liquidated damages shall accrue for each calendar day between the Delivery Date specified and the actual date of the delivery of such software or for 180 days, whichever occurs first. If the Contractor fails to provide the software listed in Rider C by the specified Delivery Date, but provides suitable substitution of software acceptable to the State, liquidated damages shall not apply to listed software for which substituted software is provided.

(2) If the State is unable to use the equipment on the installation date because Contractor failed to deliver the software listed in Rider C by the delivery date specified in Rider C, and Contractor does not furnish suitable substitute software acceptable to the State, liquidated damages for equipment noninstallation as specified in Paragraph 7b(1) shall be paid to the State in lieu of damages for software nondelivery as specified in Paragraph 7c(1). Such liquidated damages shall apply until the State uses the equipment or until Contractor provides the programming aids or

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

applications which which would render the equipment usable, whichever occurs first, but not for more than 180 calendar days.

d. Installation or Delivery Delays Caused by the State

(1) In the event the equipment cannot be installed because the State has failed to prepare the facility by the Facility Readiness Date specified, the State shall be liable for fixed liquidated damages specified in Rider B for each day between the Facility Readiness Date specified in Rider B and the actual readiness date, but not to exceed 180 calendar days, in lieu of all other damages for such delay.

(2) In the event a change directed by the State requires a later installation date of certain equipment and the State has failed to notify the Contractor of the delay at least 90 days prior to the original Installation Date, the State shall be liable, in lieu of all other damages, for liquidated damages as specified in Paragraph 7d(1) for each day between the original Installation Date and the new Installation Date, but not to exceed 180 calendar days.

(3) The State shall not be liable for liquidated damages under both Paragraphs 7d(1) and 7d(2) during the same period of time with respect to the same equipment.

8. Acceptance Testing for Equipment (including Operating Software)

a. Acceptance testing is intended to ensure that the equipment acquired operates in substantial accord with the Contractor's technical specifications, is adequate to perform as warranted by Contractor's response to the requirements of the State's solicitation document, and evidences a satisfactory level of performance reliability, prior to its acceptance by the State. If the equipment to be installed includes operating software as listed in Rider B, such operating software shall be present for the acceptance test unless substitute operating software acceptable to the State is provided. Acceptance testing is required for all newly installed EDP systems, subsystems, and individual machines, and machines which are added or field modified (modification of a machine from one model to another) after a successful performance period.

b. In accordance with Paragraph 6a(4), the Contractor shall certify in writing to the State when equipment is installed and ready for use, at which time operational control becomes the responsibility of the State. Acceptance testing shall commence on the first State workday following certification, and shall end when the equipment has met the standard of performance (performance criteria) as provided in Rider D for a period of 30 consecutive days. Operation of the equipment to confirm its installation, as provided in Paragraph 6a(5), shall be considered to be a part of the acceptance test.

c. In the event the equipment does not meet the standard of performance during the initial 30 consecutive days, the acceptance tests shall continue on a day-to-day basis until the standards of performance are met for 30 consecutive days.

d. If the equipment does not meet the standards of performance within ninety (90) consecutive days after the start of the acceptance testing,

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

the State shall have the option to request replacement equipment, extend the performance period or terminate the order (or portions thereof) and seek relief as provided by Paragraph 26, "Rights and Remedies of State for Default". The State's option shall remain in effect until such time as the equipment meets the performance criteria, or 180 consecutive days after the start of the acceptance testing, whichever occurs first. If the equipment has not met the standards of performance by 180 days after installation, the contract shall be canceled or the defective equipment deleted from the contract and Paragraph 26 shall apply.

e. At the request of the Contractor, the State shall make available not only the failed equipment, but also those machines which must be utilized by the Contractor to identify the cause of failure and to accomplish the repair.

f. Equipment shall not be accepted by the State and no charges associated with such equipment shall be paid by the State until the equipment has satisfactorily completed the acceptance tests. In addition, if required by Rider D, no charges shall be paid until specified Contractor-supplied software has been accepted by the State.

g. Immediately upon successful completion of the acceptance tests, the State shall notify the Contractor in writing of acceptance of the equipment and authorize appropriate payment. The State shall maintain adequate daily records to satisfy the requirements of acceptance testing. Increments of time shall be measured in hours and whole minutes.

9. Acceptance Testing for Software (other than Operating Software)

a. Acceptance testing is required for all contractor-supplied software supplied under this contract and listed on Rider C, including all software initially installed, improved versions (new releases) of this software, any such software which has been altered (modified) by the Contractor to satisfy State requirements, and any substitute software provided by the Contractor in lieu thereof, unless Rider D provides otherwise. The purpose of the acceptance test is to ensure that the software operates in substantial accord with the Contractor's technical specifications and meets the State's performance specifications. The specific procedures for the accomplishment of such tests are contained in Rider D.

b. When software has been provided and certified in accordance with Paragraph 6b(1), the State shall begin acceptance testing on the first State workday following such certification, as provided in Rider D.

c. If successful completion of the acceptance test is not attained within ninety (90) days after the start of the acceptance testing, the State shall have the option to request substitute software, cancel that portion of the contract which relates to the unaccepted software, or continue the acceptance tests. The State's option shall remain in effect until such time as the tests are successfully performed, or 180 days after certification, whichever occurs first. If the acceptance tests have not been successfully performed prior to the expiration of 180 days, that portion of the contract which relates to the unaccepted software shall be canceled, unless both parties agree to the continuation of the tests or to the delivery of substitute software. If the unaccepted software (or its functional equivalent) is crucial to the accomplishment of the work for which the equipment was acquired, and is so identified in Rider D, the State shall have the option of terminating the

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

entire contract in accordance with Paragraph 26, "Rights and Remedies of State for Default."

d. Unless otherwise provided in Rider D, software shall not be accepted by the State and no charges associated with such software shall be paid by the State until the software has satisfactorily completed the acceptance tests.

e. Immediately upon successful completion of the acceptance testing, the State shall notify the Contractor in writing of the acceptance of the software and authorize appropriate payment. The State shall maintain adequate records to satisfy the requirements of acceptance testing.

10. Purchase Prices and Payment Schedules

a. Purchase prices for equipment under this contract shall be shown in Rider B. The monthly cost to the State for installment payments, if applicable under this contract, shall be in accordance with the appropriate Payment Schedule(s) contained in Rider E. If the operating software is proprietary, the license for its use is contained in Rider G.

b. The consideration to be paid Contractor, as provided herein shall be in compensation for all of Contractor's expenses incurred in the performance hereof, including travel and per diem, unless otherwise expressly so provided.

11. Use of Software and Basis for Payment

All software, other than operating software to be delivered, with any charges for its use, are listed on Rider C. Each item of software which is proprietary in nature shall be licensed to the State for its use in accordance with the provisions of Rider G. Except as may be provided in Rider G, the State shall have unrestricted use of such software.

12. Maintenance of Equipment

If the Contractor is responsible under this contract to maintain the equipment covered under this contract, the Contractor shall keep the equipment in good operating condition and shall always be responsive to the maintenance requirements of the State. Equipment maintenance shall be provided in accordance with the provisions of Rider F, with the basic monthly maintenance charges, if any, listed in Rider B. Maintenance Services, other than those provided in accordance with Rider F, are outside the scope of this contract. The Contractor agrees, however, to make available for a minimum of 5 years after the installation date, adequate maintenance service.

13. Replacement Parts Availability

The Contractor shall indicate in Rider B, the number of years all replacement parts will be available beginning with the installation date. If replacement parts are not available after the expiration of the Rider B period, the Contractor, when requested by the State, will assist the State to arrange for its own support by providing the State with whatever documentation is available to Contractor, subject to the conditions and charges, if any, associated with such documentation.

14. Transportation and Installation

a. Transportation

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

(1) Shipments to the installation site shall be the responsibility of the Contractor and shall be made by commercial carrier and by padded van or air freight in consideration for payment of the equipment destination (in) charges shown in Rider B. These charges are exclusive of rigging. If air shipment by commercial carrier is not specified by the State, shipment shall be made by padded van, or Contractor may, at its option, use a premium method of transportation (e.g., air freight), but the State shall pay only equipment destination charges shown in Rider B. Machines shall be preserved, packed and marked in accordance with Contractor's standard practice.

(2) When the State elects to specify air shipment by commercial carrier, written authorization for such method shall be furnished to the Contractor at least 30 days prior to the scheduled shipping date and the State shall pay the air freight charges in lieu of the equipment destination (in) charges shown in Rider B. The Contractor shall furnish copies of the freight bills to substantiate transportation charges billed by the Contractor to the State.

(3) Transportation charges for the shipment of empty packing cases shall be paid by the Contractor except when equipment is moved from one State location to another.

(4) Prior to acceptance of the equipment, the contractor shall bear the cost of transportation, rigging, and/or drayage whenever equipment is shipped or moved for mechanical replacement purposes unless the replacement was due to fault or negligence by the State.

(5) The State shall pay only those rigging costs incurred at the State's location unless otherwise agreed to between the State and the Contractor.

b. Installation

(1) The State shall furnish such labor as may be necessary for unpacking and placement of equipment when in possession of the State.

(2) Supervision of unpacking and placement of equipment shall be furnished by the Contractor during the Contractor's normal working hours without additional charge to the State.

15. Training and Technical Services

a. Training

The Contractor agrees to provide informal, "hands-on" instruction for experienced personnel in operation of the equipment, at no additional charge to the State, at mutually agreeable times prior to, or subsequent to, equipment installation, for purposes of familiarization. Any additional training to be provided will be as stated in Rider H.

b. Technical and Other Personal Services

Personal services to be provided by the Contractor to the State, if any, will be as stated in Rider I.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

16. Invoices and Payments

a. Submission of Invoices

The Contractor shall render invoices in triplicate to the name and address listed on Rider A. Invoices for purchases and software fees are not due and payable until successful completion of any applicable acceptance testing. Invoices for services are not due and payable, and do not constitute an obligation of the State, until the month following the month for which charges accrue. Installment payments, if any, shall be in accordance with Rider E payment schedules.

b. Additional Charges

If additional charges for maintenance outside the Period of Maintenance Coverage are applicable, the State shall furnish the Contractor an Authorization to Bill, which shall contain sufficient information for the Contractor to compute appropriate charges. Such Authorization to Bill shall be submitted promptly following the end of the month covered by the authorization, and shall be based on appropriate records subject to joint review by the State and the Contractor at the request of either party.

c. Payment

The State shall make every reasonable effort to pay invoices as promptly as regular State fiscal procedures permit.

d. Required Payment Date

If the Contractor is a nonprofit organization and contract value is less than $500,000, or if the Contractor is a small business, payment is due thirty (30) days from the date the equipment, software or services are received and accepted by the State or thirty (30) days from the date a correct invoice is received in the office specified by the State, whichever is later. Payment is due to any other Contractor sixty (60) days from the date the equipment, software or services are received and accepted by the State or sixty (60) days from the date a correct invoice is received in the office specified by the State, whichever is later. When provision is made for a testing period preceding acceptance by the State, date of acceptance shall mean the date the equipment or software is accepted by the State during the specified testing period.

17. Taxes

The State of California is exempt from Federal excise taxes and no payment shall be made for any personal property taxes levied on the Contractor or on any taxes levied on employee wages. The State will only pay for any State or local sales or use taxes on the services rendered or equipment, parts or software supplied to the State pursuant to this contract.

18. Documentation

The Contractor agrees to provide to the State, at charges no more than those made by the Contractor to its other customers for similar publications, a reasonable number of all nonproprietary manuals and other printed materials, and updated versions thereof, which are necessary or useful to the State in its use of the equipment or software provided hereunder. The Contractor agrees to provide

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

additional documentation at prices not in excess of charges made by the Contractor to its other customers for similar documentation.

If the Contractor is unable to perform maintenance or the State desires to perform its own maintenance on equipment purchased under this contract, then upon written notice by the State the Contractor will provide at Contractor's then current rates and fees adequate and reasonable assistance including relevant documentation to allow the State to maintain the equipment based on Contractor's methodology. The Contractor agrees that the State may reproduce such documentation for its own use in maintaining the equipment. If the Contractor is unable to perform maintenance, the Contractor agrees to License to use the above noted documentation, any other Contractor that the State may have hired to maintain the equipment. The State agrees to include the Contractor's copyright notice on any such documentation reproduced, in accordance with copyright instructions to be provided by the Contractor.

19. Confidentiality of Data

All financial, statistical, personal, technical and other data and information relating to the State's operation which are designated confidential by the State and made available to the Contractor in order to carry out this agreement, or which become available to the Contractor in carrying out this agreement, shall be protected by the Contractor from unauthorized use and disclosure through the observance of the same or more effective procedural requirements as are applicable to the State. The identification of all such confidential data and information as well as the State's procedural requirements for protection of such data and information from unauthorized use and disclosure shall be provided by the State in writing to the Contractor. If the methods and procedures employed by the Contractor for the protection of the Contractor's data and information are deemed by the State to be adequate for the protection of the State's confidential information, such methods and procedures may be used, with the written consent of the State, to carry out the intent of this paragraph. The Contractor shall not be required under the provisions of this paragraph to keep confidential any data or information which is or becomes publicly available, is already rightfully in the Contractor's possession, is independently developed by the Contractor outside the scope of this agreement, or is rightfully obtained from third parties.

20. Major Field Modifications

If the Contractor is responsible, under this contract, for the maintenance of equipment under this contract, the Contractor shall provide for on-site field modification of the equipment under the provisions of Rider F.

21. General Indemnity

The Contractor agrees to indemnify, defend and save harmless the State, its officers, agents and employees from any and all claims and losses, with the exception of consequential damages, accruing or resulting to any other person, firm, or corporation furnishing or supplying work, services, materials or supplies in connection with the performance of this contract, and from any and all claims and losses accruing or resulting to any person, firm or corporation which may be injured or damaged by the Contractor in the performance of this contract which are attributable to the negligence or intentionally tortuous acts of the Contractor provided that the Contractor is notified in writing within 30 days that the State has knowledge of such claims.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

22. Patent, Copyright, and Trade Secret Protection

a. The Contractor, at its own expense, shall defend any action brought against the State to the extent that such action is based upon a claim that the equipment or software supplied by the Contractor, or the operation of such equipment pursuant to a current version of Contractor-supplied operating software, infringes a United States patent, or copyright or violates a trade secret. The Contractor shall pay those costs and damages finally awarded against the State in any such action. Such defense and payment shall be conditioned on the following:

(1) That the Contractor shall be notified within a reasonable time in writing by the State of any notice of such claim; and,

(2) That the Contractor shall have the sole control of the defense of any action on such claim and all negotiations for its settlement or compromise, provided, however, that when principles of government or public law are involved, the State shall have the option to participate in such action at its own expense.

b. Should the machines or software, or the operation thereof, become, or in the Contractors's opinion are likely to become, the subject of a claim of infringement of a United States patent, copyright or a trade secret, the State shall permit the Contractor at its option and expense either to procure for the State the right to continue using the machines or software, or to replace or modify the same so that they become noninfringing. If neither of these options can reasonably be taken, or if the use of such equipment or software by the State shall be prevented by injunction, the Contractor agrees to take back such equipment or software, and refund any sums the State has paid Contractor less any reasonable amount for use or damage and make every reasonable effort to assist the State in procuring substitute equipment or software. If, in the sole opinion of the State, the return of such infringing equipment or software makes the retention of other items of equipment or software acquired from the Contractor under this contract impractical, the State shall then have the option of terminating the contract, or applicable portions thereof, without penalty or termination charge. The Contractor agrees to take back such equipment or software and refund any sums the State has paid Contractor less any reasonable amount for use or damage.

c. The Contractor shall have no liability to the State under any provision of this Paragraph 22 with respect to any claim of patent, copyright, or trade secret infringement which is based upon:

(1) The combination or utilization of machines furnished hereunder with machines or devices not made or furnished by the Contractor.

(2) The operation of machines furnished by the Contractor under the control of any operating software other than, or in addition to, the aforementioned current version of Contractor-supplied operating software.

(3) The modification by the State of the machines furnished hereunder or of the aforementioned software.

(4) The combination or utilization of software furnished hereunder with noncontractor's supplied software.

d. The foregoing states the entire liability of the Contractor with respect to infringement of patents, copyrights and trade secrets.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

23. Risk of Loss or Damage

The State shall be relieved from all risks of loss or damage to the equipment under this contract prior to installation as defined in Paragraph 6, "Installation and Delivery Dates," except when such loss or damage is due to fault or negligence of the State.

24. Contractor's Liability for Injury to Persons or Damage to Property

a. The Contractor shall be liable for damages arising out of injury to the person and/or damage to the property of the State, employees of the State, persons designated by the State for training, or any other person(s) other than agents or employees of the Contractor, designated by the State for any purpose, prior to, during, or subsequent to delivery, installation, acceptance, and use of the equipment either at the Contractor's site or at the State's place of business, provided that the injury or damage was caused by the fault or negligence of the Contractor.

b. Contractor shall not be liable for damages arising out of or caused by an alteration or an attachment not made or installed by the Contractor, or for damage to alterations or attachments that may result from the normal operation and maintenance of the Contractor's equipment.

25. Warranty

The Contractor warrants that all machines purchased under this contract when installed will be in good working order and will conform to the Contractor's published specifications. If the Contractor is responsible under this contract to maintain the equipment under this contract, the Contractor will make all adjustments, repairs, and parts replacements necessary to maintain the machines in this condition. Specific warranty provisions are as detailed in Rider A. All machines are supplied subject to these warranties.

26. Rights and Remedies of State for Default

a. In the event any equipment, software, or service furnished by the Contractor in the performance of this contract should fail to conform to the specifications therefore, the State may reject the same, and it shall thereupon become the duty of the Contractor to reclaim and remove the same forthwith, without expense to the State, and immediately to replace all such rejected equipment, software, or service with others conforming to such specifications; provided that should the Contractor fail, neglect or refuse to do so the State shall thereupon have the right to purchase in the open market,in lieu thereof, a corresponding quantity of any such equipment, software. or service and to deduct from any moneys due or that may thereafter become due to the Contractor the difference between the price named in this contract and the actual cost thereof to the State.

b. In the event the Contractor shall fail to make prompt delivery as specified of any equipment, software, or service, the same conditions as to the rights of the State to purchase in the open market and to reimbursement set forth above shall apply, except as otherwise provided in Paragraph 31, "Force Majeure".

c. In the event of the cancellation of this contract either in whole or in part, by reason of the default or breach thereof by the Contractor, any loss or damage sustained by the State in procuring any equipment, software or service which the Contractor therein agreed to supply shall be borne and paid for by the Contractor.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

d. The rights and remedies of the State provided above shall not be exclusive and are in addition to any other rights and remedies provided by law or under the contract.

27. Limitation of Liability

a. The equipment shall be under State's exclusive management and control. The State agrees that the Contractor shall not be liable for any damages caused by the State's failure to fulfill any State responsibilities of assuring the proper use, management, and supervision of the machines and programs, audit controls, operating methods, and office procedures, and for establishing all proper checkpoints necessary for the State's intended use of the machines.

b. Contractor's liability for damages to the State for any cause whatsoever, and regardless of the form of action, whether in contract or in tort including negligence, shall be limited to the greater of $200,000 or the purchase price stated herein for the specific machines that caused the damages or that are the subject matter of or are directly related to the cause of action. In those instances where Contractor has failed to deliver machines as called for by the Contract, or machines have been returned to Contractor for failure to pass an Applicable Acceptance Test, the Limitation of Liability provided above shall not limit any right to recover the 'Cost to Cover.' 'Cost to Cover' means the cost of procuring a machine or machines of equivalent (not greater) capability, function, and performance, less the Contractor's bid price.

The foregoing limitation of liability shall not apply to the payment of costs and damage awards referred to in Paragraph 22, entitled "Patent, Copyright, and Trade Secret Protection", to claims covered by other specific provisions calling for liquidated damages or specifying a different limit of liability, or to claims for injury to persons or damage to property caused by Contractor's negligence. This limitation of liability does not apply to the receipt of court costs or attorney's fees that might be awarded by a court in addition to damages after litigation based on this contract.

c. In no event will either the Contractor or the State be liable for consequential damages even if notification has been given as to the possibility of such damages.

28. Disputes

a. Any dispute concerning a question of fact arising under the terms of this agreement which is not disposed of within a reasonable period of time by the Contractor and State employees normally responsible for the administration of this contract shall be brought to the attention of the Chief Executive Officer (or designated representative) of each organization for joint resolution. At the request of either party, the State shall provide a forum for discussion of the disputed item(s), at which time the State Chief of Procurement, or his representative, shall be available to assist in the resolution by providing advice to both parties as to the State of California EDP policies and procedures. If agreement cannot be reached through the application of high level management attention, either party may assert its other rights and remedies within this contract or within a court of competent jurisdiction.

b. The State and the Contractor agree that, the existence of a dispute notwithstanding, they will continue without delay to carry out all their responsibilities under this contract which are not affected by the dispute.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

29. Contractor's Power and Authority

The Contractor warrants that it has full power and authority to grant the rights herein granted and will hold the State hereunder harmless from and against any loss, cost, liability, and expense (including reasonable attorney fees) arising out of any breach of this warranty. Further, Contractor avers that it will not enter into any arrangement with any third party which might abridge any rights of the State under this contract.

30. Title to Equipment

Unless otherwise specified in Rider A, title to the equipment shall remain in the Contractor and assigns, if any, until such time as the full purchase price, applicable taxes and interest charges, if any, are paid to the Contractor. Title to each machine will be transferred to the State when its purchase price, taxes, and associated interest charges, if any, are paid. Title to a special feature installed on a machine and for which only a single installation charge was paid shall pass to the State at no additional charge, together with title to the machine on which it is installed.

31. Force Majeure

Except for defaults of subcontractors, neither party shall be responsible for delays or failures in performance resulting from acts beyond the control of the offending party. Such acts shall include but shall not be limited to acts of God, fire, flood, earthquake, other natural disasters, nuclear accident, strike, lockout, riot, freight embargo, public regulated utility, or governmental statutes or regulations superimposed after the fact. If a delay or failure in performance by the Contractor arises out of a default of its subcontractor, and if such default arises out of causes beyond the control of both the Contractor and subcontractor, and without the fault or negligence of either of them, the Contractor shall not be liable for damages of such delay or failure, unless the supplies or services to be furnished by the subcontractor were obtainable from other sources in sufficient time to permit the Contractor to meet the required performance schedule.

32. Waiver of Breach

No term or provision of this contract shall be deemed waived and no breach excused, unless such waiver or consent shall be in writing and signed by an individual authorized to so waive or consent. Any consent by either party to, or waiver of, a breach by the other, whether express or implied, shall not constitute a consent to, waiver of, or excuse for, any other breach or subsequent breach, except as may be expressly provided in the waiver or consent.

33. Conflict With Existing Law

The Contractor and the State agree that if any provision of this contract is found to be illegal or unenforceable, such term or provision shall be deemed stricken and the remainder of the contract shall remain in full force and effect. Either party having knowledge of such term or provision shall promptly inform the other of the presumed non-applicability of such provision. Should the offending provision go to the heart of the contract, the contract shall be terminated in a manner commensurate with the interests of both parties, to the maximum extent reasonable.

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

34. Assignment

This contract shall not be assignable in whole or in part without written consent of the State. It is the policy of the State of California to withhold consent from proposed assignments, subcontracts, or novations when such transfer of responsibility would operate to decrease the State's likelihood of receiving performance on the contract. The State does not normally object to the granting of assignments for financial purposes, provided that the original Contractor retains all of its responsibilities and obligations under the contract. In the event of any assignment hereunder to which the State has consented, each such assignment shall contain a provision that further assignments shall not be made to any third or subsequent party without additional written consent of the State.

35. Governing Law

This contract shall be governed by and construed in accordance with the laws of the State of California.

36. Limitation of Actions

No action, regardless of form, arising out of this contract may be brought by either party more than two years after the cause of action has arisen, or in the case of nonpayment, more than two years from the date of the last payment, except where either party (within two years after a cause of action has arisen) provides the other party in writing a notice of a potential cause of action, disclosing all material facts then known by the notifying party concerning such cause of action, then the notifying party may bring an action based on the matter so disclosed at any time prior to the expiration of four years from the time the cause of action arose.

37. Termination of Contract

a. Upon termination or other expiration of this contract, each party will assist the other party in orderly termination of the contract and the transfer of all assets, tangible and intangible, as may facilitate the orderly, nondisrupted business continuation of each party.

b. Prior to the expiration of this contract, this contract may be terminated for the convenience of both parties by mutual consent.

c. If the term of this contract extends into fiscal years subsequent to that in which it is approved, such continuation of the contract is subject to the appropriation of funds for such purpose by the Legislature. If funds to effect such continued payment are not appropriated, Contractor agrees to take back any affected equipment and software furnished under this contract, terminate any services supplied to the State under this contract, and relieve the State of any further obligation therefore.

d. State agrees that if the provisions of Paragraph 37c above are invoked, equipment shall be returned to Contractor in substantially the same condition in which it was delivered to the State, subject to normal wear and tear. State further agrees to pay for packing, crating, transportation to Contractor's nearest facility and for reimbursement to the Contractor for his expenses incurred in assisting in such packing and crating.

e. The State may terminate this agreement under the provisions of Paragraph 26, "Rights and Remedies of State for Default".

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

38. Contractor Evaluation

In accordance with the California Government Code, contractor performance evaluation will be completed within the guidelines of the State Administrative Manual, Section 1218. The State contracting agency, upon contract completion, will complete and forward the contractor evaluation to the Department of General Services.

39. Assignment of Antitrust Actions

The following provision of Government Code Section 4552 4553, and 4554 (Statutes of 1978, Ch. 414) shall be applicable to the Contractor.

"In submitting a bid to a public purchasing body, the bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title, and interest in and to all causes of action it may have under section 4 of the Clayton Act (15 U.S.C. sec. 15) or under the Cartwright Act [Chapter 2 (commencing with section 16700) of part 2 of division 7 of the Business and Professions Code], arising from purchases of goods, materials, or services by the bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the bidder."

"If an awarding body or public purchasing body receives, either through judgment or settlement, a monetary recovery for a cause of action assigned under this chapter, the assignor shall be entitled to receive reimbursement for actual legal costs incurred and may, upon demand, recover from the public body any portion of the recovery, including treble damages, attributable to overcharges that were paid by the assignor but were not paid by the public body as part of the bid price, less the expenses incurred in obtaining that portion of the recovery."

"Upon demand in writing by the assignor, the assignee shall, within one year from such demand, reassign the cause of action assigned under this part if the assignor has been or may have been injured by the violation of law for which the cause of action arose and (a) the assignee has not been injured thereby, or (b) the assignee declines to file a court action for the cause of action."

40. Covenant Against Gratuities

The Contractor warrants by signing hereon that no gratuities (in the form of entertainment, gifts, or otherwise) were offered or given by the Contractor or any agent or representative of the Contractor, to any officer or employee of the State with a view toward securing the contract or securing favorable treatment with respect to any determinations concerning the performance of the contract. For breach or violation of this warranty, the State shall have the right to terminate the contract, either in whole or in part, and any loss or damage sustained by the State in procuring on the open market any items which Contractor agreed to supply shall be borne and paid for by the Contractor. The rights and remedies of the State provided in the clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under the contract.

41. National Labor Relations Board Certification

By signing hereon the Contractor swears under penalty of perjury that no more than one final, unappealable finding of contempt of court by a federal court has been issued against the Contractor within the immediately preceding two-year period because of the Contractor's failure to comply with an order of the National Labor

STATE MODEL PURCHASE CONTRACT
GENERAL TERMS AND CONDITIONS (Continued)

Relations Board. This provision is required by, and shall be construed in accordance with, Public Contract Code Section 10296.

42. Statement of Compliance

The Contractor's signature affixed hereon and dated shall constitute a certification under the penalty of perjury under the laws of the State of California that the Contractor has, unless exempted, complied with the nondiscrimination program requirements of Government Code Section 12990 and Title 2, California Administrative Code, Section 8103.

43. Examination and Audit

The contracting parties shall be subject to the examination and audit of the State Auditor General for a period of three (3) years after final payment under the contract in accordance with the Government Code Section 10532. The examination and audit shall be confined to those matters connected with the performance of the contract, including, but not limited to the costs of administering the contract.

RIDER A - SPECIAL PROVISIONS

This Rider is used to provide the address for invoicing purposes, to provide warranty provisions, to establish price decline protection, and to provide any other items of a contractual nature required by the solicitation document which are not provided for in other sections of the contract. It is unique to each procurement. The specific language will normally be prescribed by the State, but it may be modified through negotiation during the procurement process.

The following example is for illustrative purposes only.

///EXAMPLE///
RIDER A - SPECIAL PROVISIONS

1. INVOICES

Invoices shall be submitted to:

_____

_____

_____

2. WARRANTY

a. Contractor will furnish all maintenance service and parts for a period of 90 days beginning on the first day of the successful performance period, provided that such maintenance service or parts are not required because of accident, neglect, misuse, failure of electrical power or air conditioning, humidity control, or causes other than ordinary use. Any such service required as a result of erroneous site preparation specifications furnished by the Contractor (See General Terms and Conditions, Paragraph 5) or otherwise required due to the fault or negligence of the Contractor, shall be provided by the Contractor at no additional charge. All replaced parts shall become the property of the Contractor. Prior to the expiration of the warranty period, whenever equipment is shipped for mechanical replacement purposes, the Contractor, shall bear all costs of such shipment including, but not limited to, costs of packing, transportation, rigging, drayage, and insurance. The warranty shall apply to the replacement machine beginning on the first day of the successful performance period for the replacement machine.

b. For one year, beginning on the first day of the successful performance period, the Contractor warrants to the State that the machines are free from defects in material and workmanship. Machines designated as newly manufactured may contain some used parts which are warranted equivalent to new in performance when used in these machines. Contractor's obligation with respect to defects in material and workmanship is limited to furnishing, on an exchange basis, replacements for machine or parts which have been properly reported by the State as having been, in its opinion, defective and are so found by the Contractor upon inspection.

c. Service pursuant to this warranty will be furnished by the Contractor's nearest service location. The Contractor shall have prompt access to the machine to perform this service. There shall be no charge for travel expense associated with services for which the Contractor is responsible under this warranty provision.

d. The Contractor shall not be responsible for failure to render service due to causes beyond its control. When a noncontractor's control program is used and as a result the Contractor's Maintenance Diagnostic routines do not pinpoint the failure, the State shall pay for the time spent by the Contractor in diagnosing the failure at the applicable per-call rate per man-hour then in effect.

///EXAMPLE///
RIDER A - SPECIAL PROVISIONS (Continued)

e. When Contractor is called to perform remedial maintenance service on the equipment and by mutual agreement it is determined that either no failure existed or that the service was outside the scope of the warranty as set forth in this Paragraph 2, the State shall pay for the travel expense and the time spent by the Contractor at the applicable per-call rate per man-hour then in effect.

f. Unless otherwise mutually agreed, the Contractor shall not be required to adjust or repair any machine or part if it would be impractical for Contractor personnel to do so because of alterations made by or on behalf of the State in the machine, or because its connection by mechanical or electrical means to another machine or device not furnished by the Contractor. Increased service pursuant to this warranty caused by any alteration or attachment shall be paid for by the State at the applicable per-call rate per man-hour then in effect, unless the Contractor elects not to apply such charge on an individual instance basis.

3. PRICE DECLINE (Applicable to Third Party Contractors)

Prices quoted shall be the maximum for the contract period subject to any price escalation provisions. However, should a price decline be announced by the manufacturer after contract award, but prior to a third party contractor taking title to the equipment; and should the third party contractor be the recipient of this manufacturer's price decline; it shall be passed on in total to the State of California by the third party contractor. Any interest, finance, or other charges based on the contract price will be recomputed using the original bid rates and the differences will also be passed to the State in total.

4. PRICE DECLINE (Applicable to Manufacturers)

Prices quoted shall be maximum for the contract period subject to any price escalation provisions. However, should a price decline be announced by the manufacture after contract award, but prior to the State taking title to the equipment, it shall be passed on in total to the State of California by the manufacturer. Any interest, finance, or other charges based on the contract price will be recomputed using the original bid rates and the differences will also be passed to the State in total.

5. CONNECTION POINTS FOR CENTRAL PROCESSOR EVALUATION EQUIPMENT

If requested by the State, the Contractor agrees to identify, on all items of equipment supplied under this contract, all appropriate test points for connecting one of the commercially available hardware monitors designed to measure system activity.

RIDER B TABLE 1

EQUIPMENT LIST, PRICES, INSTALLATION AND ALLIED INFORMATION

Line No.	Quantity	Description, Type and/or Features	Model	Date Facility to be Ready	Date to be Installed	Unit Purchase Price	Total Purchase Price

Liquidated Damages Per Day _____
(To be completed by State)

RIDER B TABLE 2

EQUIPMENT LIST, PRICES, INSTALLATION AND ALLIED INFORMATION

Line No.	Quantity	Description, Type and/or Features	Model			Unit Basic Monthly Maint.	Total Basic Monthly Maintenance

Annual Escalation Rate _____% (May not exceed 10%. Insert "0" if rates are fixed. A blank will be interpreted as 10%)

Replacement Parts Available _____ Years.

RIDER B

TABLE 3

EQUIPMENT LIST, PRICES, INSTALLATION AND ALLIED INFORMATION

Line No.	Quantity	Description, Type and/or Features	Model	Unit Destin. (in) Charge	Total Destin. (in) Charge	Unit Install. Charge	Total Install. Charge

ATTACHMENT TO RIDER B
OPERATING SOFTWARE PROGRAMS

TABLE 4

Line No.	Quantity	Operating Software Identification	Machine Cross Ref.	Install Date		Per Copy Initial Charge	Total Initial Charge

Annual Escalation Rate _____% (May not exceed 10%. Insert "0" if rates are fixed. A blank will be interpreted as 10%)

ATTACHMENT TO RIDER B
OPERATING SOFTWARE PROGRAMS

TABLE 5

Line No.	Quantity	Operating Software Identification	Technical Specs. Reference & Date	Support Catagory	Per Copy Basic Monthly [] Yearly [] Charge	Total Basic Monthly [] Yearly [] Charge

Annual Escalation Rate _____% (May not exceed 10%. Insert "0" if rates are fixed. A blank will be interpreted as 10%)

RIDER C

TABLE 1

SOFTWARE LIST, PRICES, DELIVERY DATES AND ALLIED INFORMATION

Line No.	Quantity	Software Identification		Delivery Date		Per Copy Initial Charge	Total Initial Charge

Liquidated Damages Per Day _____
(To be completed by State)

RIDER C

TABLE 2

SOFTWARE LIST, PRICES, DELIVERY DATES AND ALLIED INFORMATION

Line No.	Quantity	Operating Software Identification	Document Containing Technical Specs. Reverence & Date	Support Category	Per Copy Basic Monthly [] Yearly [] Charge	Total Basic Monthly [] Yearly [] Charge

Annual Escalation Rate _____% (May not exceed 10%. Insert "0" if rates are fixed. A blank will be interpreted as 10%.)

ATTACHMENT TO RIDER C
CONTRACTOR RATES

1. Minimum monthly and extended maintenance services.

	Extended Maintenance Service* (Consecutive hours per day)				
	9**	12	16	20	24
Monday through Friday (Excluding holidays)	+___%	+___%	+___%	+___%	+___%
Saturdays	+___%	+___%	+___%	+___%	+___%
Sundays and Holidays	+___%	+___%	+___%	+___%	+___%

* Percentage increase of the minimum monthly rate shown in Rider B.

**Nine consecutive hours any part of which is outside the hours of 7:00 a.m. to 6:00 p.m.

2. Additional travel and mileage rates for service calls at dispersed geographical locations. In no case will the Contractor be paid more than the rates paid State employees.

Identification of Facility	Travel Time Allowed (1 way)	Rate Per Man-Hour	Rate Per Mile***
Monday through Friday (Excluding holidays)		$XX.XX	$.205
Saturdays		XX.XX	.205
Sundays and Holidays		XX.XX	.205

3. Maintenance service outside the covered maintenance period -- minimum two hour charge per service call.

	Rate Per Man-Hour
Monday through Friday (Excluding holidays)	$XX.XX
Saturdays	XX.XX
Sundays and Holidays	XX.XX

***Rates may not exceed current State rate.

RIDER D - ACCEPTANCE TESTING

This Rider is normally prepared by the State agency acquiring the equipment and associated services. Acceptance testing of equipment being acquired is intended to ensure that the hardware and operating software (if any) operate in substantial accord with the Contractor's published technical specifications, that they are adequate to accomplish the tasks for which they are being acquired (meet performance specifications). and that they evidence a satisfactory level of performance reliability, prior to their acceptance by the State. Acceptance testing for other Contractor-supplied software is intended merely to ensure that the software performs in accordance with the Contractor's published specifications or, if custom written, to the State specifications.

The following example is for illustrative purposes only and is based upon a computer system providing the following:

- *On-line inquiry, during hours of 0800-1700, from 18 remote sites (average of 3 CRT terminals at each site) into master file at central site.*
- *File update transactions from remote sites logged to tape during 0800-1700 and used to update master file during 1700-0100.*
- *General batch processing during 0800-0100.*
- *Program development from 2 Programmer Work Stations during 0800-1700.*

Workload data are as follows:

- *25,000 (-20% to +40%) inquiries per day, with a two (2) second response time desired, and a maximum of five (5) seconds response time required. 0800-1700*
- *90 (+/-10%) batch jobs. 0800-1700*
- *150 (-15% to +20%) batch jobs. 1700-0100*
- *24 (-20% to +30%) twenty-minute program development sessions. 0800-1700*
- *16 various management reports during 0100-0800 on the first three work days of each month.*
- *8 various management reports during 0100-0800 on the fourth and fifth work day of each quarter.*

Equipment at Central Site:

A. *Two loosely coupled processors with one CPU used during the prime shift for communications handling and file access, and the other CPU used for program development. If the on-line inquiry computer goes down, the other CPU will assume its workloads, and program development will be deferred. In addition, both are used for batch processing on two shifts.*

RIDER D - ACCEPTANCE TESTING (Continued)

B. Five removable pack direct access storage devices, three of which are used for data base, one of which is used for system software, and one of which is used for program development and backup.

C. Four magnetic tape drives, one of which is used to log all data inquiries and file up-date transactions, and three of which are used for batch processing. Any unused drive may also be used for spooling, if the printer is inoperative.

D. One line printer, used primarily for generation of periodic reports and program listings.

E. Two local CRT Programmer Work Stations.

Equipment at Each Remote Site:

A. Two to five CRT terminals (depending on the number of inquiries).

B. One character printer.

C. One tape drive.

D. Associated communications facilities.

/// EXAMPLE ///
RIDER D - ACCEPTANCE TESTING

1. General

The purpose of this Rider is to set forth specific procedures and performance criteria to implement the testing required by Paragraphs 8 and 9 of the General Terms and Conditions. Because of the on-line programmatic aspects of the equipment and software, system reliability is of paramount importance, both at the host computer site and at the various remote operating locations.

2. Acceptance Testing of Host Computer System

a. Immediately upon certification by the Contractor that the host central processing units, together with all cable-connected peripheral equipment (including programmer work stations) and operating software scheduled for installation at the central site (herein collectively called the computer system), are installed, the State will confirm its installation by running Part A of the benchmark tests required by the IFB/RFP _____, as described in the benchmark manual accompanying the IFB/RFP. Upon confirmation by the State that the computer system is installed, the State shall put the computer system to full operational use for acceptance testing purposes.

b. The minimum acceptable computer system configuration, for the purposes of acceptance testing, is defined as one (1) central processing unit, one (1) operator's console, one (1) megabyte of main memory, four (4) direct access storage devices, three (3) magnetic tape drives, one (1) line printer, one (1) local Programmer Work Station, and all of the channels, controllers, etc., necessary to operate these machines. If the computer system is operable, in at least the minimum acceptable computer system configuration, at an average level of availability of 95% or more during a thirty (30) day period, it shall be deemed to have met the State's standard for acceptance and shall be accepted by the State. In addition, each of the machines which collectively constitute the computer system must operate in at least the minimum compliance with the Contractor's published specifications and must attain an average level of availability of 90%.

c. The average level of availability is a percentage figure computed by dividing the total operational use time during the Period of Maintenance Coverage by the sum of that time and associated downtime during the Period of Maintenance Coverage. All preventive maintenance time shall be excluded from the performance period hours.

d. Machine downtime shall begin from the time the State makes a valid effort to contact the Contractor (or its answering service) to report an equipment failure and shall end when the Contractor has returned the machine to the State in operable condition. Computer system downtime shall begin from the time the State makes a valid effort to contact the Contractor to report that equipment failure has caused the computer system to be inoperable, or operable at less than the minimum acceptable configuration, and shall end when the minimum acceptable computer system configuration has been returned to the State in operable condition. If the State is unable to contact the Contractor or its answering service, the State shall continue to make frequent attempts to notify Contractor until such contact is made. If the State fails to make available to the Contractor the machines necessary to test and repair the failed equipment, downtime shall not accrue during the period the State fails to make such machines available to the Contractor.

/// EXAMPLE ///
RIDER D - ACCEPTANCE TESTING (Continued)

e. During the successful performance period, a minimum of 100 hours of operation use time shall be required as a basis for computation of the average availability level. However, in computing the availability level, the actual number of operational use hours shall be used when in excess of the minimum stated above. When it is obvious that the actual operational hours that will be accumulated during the performance period will be less than 100 hours, the operational hours shall be supplemented using Contractor's diagnostic routines or simulated production operations, so as to provide a total of 100 hours. In addition, the State shall, during the acceptance period, use its best efforts to distribute workloads between and among various machines so that each of them is appropriately exercised. For example, the function being performed by each computer shall be transposed daily between them, so that each computer will perform the on-line inquiry functions every other day.

3. Acceptance Testing of Remote Equipment

a. Immediately upon certification by the Contractor that all equipment and operating software scheduled for the first installation at a remote site (herein collectively called remote subsystem) is installed, the State will confirm its installation by running Part B of the benchmark tests required by IFB/RFP _____, as prescribed in the benchmark manual accompanying the IFB/RFP. Upon State confirmation that the remote subsystem is installed, the State shall put it to full operational use for acceptance testing purposes. When remote subsystems are subsequently installed at the remaining remote locations, such benchmark testing shall be waived, and acceptance testing shall begin immediately.

b. The minimum acceptable remote subsystem configuration, for acceptance testing purposes, is defined as one (1) to four (4) CRT terminals (one terminal may be down), either the character printer or one tape drive (temporarily spooling data for the printer), and all Contractor-supplied communications facilities. If the remote subsystem is operable, in at least the minimum acceptable remote subsystem configuration, at an average level of availability of 95% or more during a thirty (30) day period, it shall be deemed to have met the State's standard of acceptance and shall be accepted by the State. In addition, each of the machines which collectively constitute the remote subsystem must operate in at least minimum compliance with the Contractor's published specifications and must obtain an average level of availability of 90%.

c. The average level of availability for the subsystem and for the machines shall be computed substantially in accordance with the procedures outlined in Paragraph 2c above.

d. Machine and remote subsystem downtime shall be computed substantially in accordance with the procedures outlined in Paragraph 2d above.

e. During the successful performance period, a minimum of fifty (50) hours of operational use time for each remote subsystem, including at least twenty-five (25) hours of operational use time for each CRT terminal, shall be required as a basis for computation of the average availability level. If necessary, the operational hours shall be supplemented using simulated productive work.

/// EXAMPLE ///
RIDER D - ACCEPTANCE TESTING (Continued)

4. Acceptance Testing of Additional Items of Equipment

Individual machines subsequently added to the contract, or machines substituted or field modified by the Contractor, shall undergo acceptance testing substantially in accordance with the procedures set forth in Paragraphs 2b, 2c, and 2d as they relate to the testing of individual machines. A minimum of twenty-five (25) hours of operational use time shall be required as a basis for computation of the average availability level. If necessary, the operational hours shall be supplemented using simulated productive work.

5. Acceptance Testing of Software (other than Operating Software)

a. Immediately upon certification by the Contractor that a programming aid or program product has been delivered ready for State use, in accordance with the provisions of Paragraph 6b(1) of the General Terms and Conditions, the State shall test such programming aid or program product, in accordance with the procedures outlined below.

b. For software which is provided at no charge, no performance tests are required. The State shall ensure, however, that such software has actually been delivered, corresponds to the listing in Rider C, is complete, and can be read into the equipment for use.

c. For software which is provided at a charge, the State shall thoroughly test such software to be assured that the software performs in accordance with the Contractor's published specifications. Said acceptance tests shall be mutually agreed to by both parties and shall be substantially in accordance with the proposed test plan contained in the Contractor's response to IFB/RFP _____.

d. For the custom program, JCLTEST, written especially for this procurement by the Contractor and further described in Rider A, the acceptance test shall be substantially as set forth below:

(1) The Contractor shall prepare a variety of run streams to be analyzed by JCLTEST, with varied job control language with known errors, as well as "clean" run streams with no errors. The State may also, if it desires, add additional input.

(2) JCLTEST shall be executed, using the above input.

(3) Error reports produced by JCLTEST shall be compared to ensure the error listings are in consonance with the known errors in the input and to ensure that "clean" runs are passed without error. All erroneous control cards must be identified and run streams with no errors must be allowed to execute.

RIDER E - PAYMENT SCHEDULES

This Rider is used for term purchase payment schedules. The State agency should indicate in this Rider the term in number of months acceptable to the State. The Contractor should provide the payment schedule.

/// EXAMPLE ///
RIDER E - PAYMENT SCHEDULES

The method of payment by the State for the following items will be by monthly installments for a period starting upon delivery and acceptance of the equipment and ending with the _____ payment at which time title will pass to the State. The award of the bid will be predicated on the total cost of all installment payments including any interest charges or by one initial total payment, whichever is in the State's best interest.

The State may elect to prepay any remaining balances prior to the beginning of any payment period. No prepayment penalties will be assessed against the State for such prepayments (such as, but not limited to, interest and service charges).

The Contractor must complete this Rider indicating the payment schedule for equal monthly payments and the amount to be paid at each installment period should the State elect to execute the prepayment option. Monthly payments are to include principal, interest and California sales tax.

RIDER F - MAINTENANCE PROVISIONS

This section is used to establish the responsibilities of the Contractor and the State as they relate to the maintenance of equipment (including its operating software) and any other software except proprietary software, the maintenance of which is provided for in Rider G. It is intended that agencies tailor the Rider to conform to specific requirements.

The following language is intended to be for illustrative purposes only.

/// EXAMPLE ///
RIDER F - MAINTENANCE PROVISIONS

1. General

a. The purpose of this Rider is to prescribe the responsibilities of the Contractor for maintenance of the equipment listed on Rider B and the software listed on Rider C.

b. Equipment and Operating Software shall be maintained in good operating condition . All maintenance service, including both parts and labor, shall be furnished at the maintenance rates specified in Riders B and C.

c. The Contractor may charge for some software maintenance services, in accordance with the provisions of Paragraph 9 of this Rider.

d. Warranty provisions are specified in paragraph 25 of the General Terms and Conditions and in Rider A.

2. Termination

a. The State may terminate this Rider upon one month's prior written notice.

b. The State may withdraw any machine from this Rider at any time by giving one month's prior written notice.

3. Exclusions

Maintenance service does not include:

a. Electrical work external to the machines or maintenance of accessories, alterations, attachments, or other devices not listed in Rider B.

b. Repair of damage or increase in service time caused by: accident; disaster, which shall include, but not be limited to, fire, flood, water, wind and lightning; transportation; neglect or misuse; alterations, which shall include, but not be limited to, any deviation from Contractor's physical, mechanical, or electrical machine design; attachments, which are defined as the mechanical, electrical or electronic interconnection to a Contractor machine of noncontractor's equipment and devices not supplied by Contractor.

c. Repair of damage or increase in service time resulting from failure to provide a suitable installation environment with all facilities prescribed by the appropriate Contractor Installation Manual-Physical Planning (including, but not limited to, failure of, or failure to provide adequate electrical power, air conditioning or humidity control).

d. Repair of damage or increase in service time attributable to the use of the machines for other than data processing purposes for which acquired.

e. Furnishing platens, supplies or accessories; painting or refinishing the machines or furnishing material therefore; inspecting machines altered by other than Contractor, making specification changes or performing services connected with the relocation of machines; or adding or removing accessories, attachments or other devices.

f. Such service which is impractical for Contractor to render because of alterations in the machines or their connection by mechanical or electrical means to another machine or device.

/// EXAMPLE ///
RIDER F - MAINTENANCE PROVISIONS (Continued)

g. Repair of damage, replacement of parts (due to other than normal wear) or repetitive service calls caused by the use of supplies or materials not meeting Contractor's specifications for such supplies or materials.

h. Repair of damage or increase in service time caused by conversion from one Contractor model to another or the installation or removal of a Contractor feature whenever any of the foregoing was performed by other than the Contractor.

i. Replacement parts or increases in service time as set forth in the sections covering access to machines (Paragraph 5c) and in Paragraph 9c.

j. Repair of damage or increase in service time caused by catastrophe, by fault or negligence of the State, or by causes external to the equipment.

k. Repair or maintenance by Contractor that is required to restore such equipment to proper operating condition after any person other than Contractor's employee had performed maintenance or otherwise repaired an item of equipment. An additional charge for such repair or maintenance shall be at Contractor's applicable time and material rates and terms then in effect.

4. Responsibilities of the Contractor

a. The Contractor agrees to provide maintenance coverage during periods selected by the State to keep machines in good working order. This maintenance service includes:

(1) Scheduled preventive maintenance based upon the specific needs of the individual machines as determined by Contractor.

(2) Unscheduled, on--call remedial maintenance. Such maintenance will include lubrication, adjustments, and replacement of maintenance parts deemed necessary by the Contractor.

b. Maintenance parts will be furnished by Contractor and will be new or equivalent to new in performance when used in these machines. Replaced maintenance parts become the property of the Contractor.

c. The Contractor shall specify in writing the frequency and duration of preventive maintenance for the equipment in Rider B. Preventive (scheduled) maintenance shall be performed on a schedule which is mutually acceptable to the State and the Contractor, which is consistent with the State's operating requirements, and which is based upon the specific needs of the equipment as determined by the Contractor.

d. Remedial maintenance shall be commenced promptly after notification that equipment is inoperative and the Contractor shall always be responsive to the maintenance requirements of the State. The Contractor's maintenance personnel will normally arrive at the State's installation site within four (4) hours after notification by the State that remedial maintenance is required. For this purpose, Contractor shall have full and free access to the machines.

e. When a Customer Engineer responds to a remedial maintenance call and the machine malfunction has not been diagnosed and repair begun within two (2) hours from the time of arrival of the Customer Engineer, the Contractor will utilize 2nd Level Technical Support. In the event that four (4) additional

/// EXAMPLE ///
RIDER F - MAINTENANCE PROVISIONS (Continued)

hours elapse from the time of response of the 2nd level of technical support and the machine's malfunction has not been diagnosed and repair begun, the Contractor will utilize 3rd Level Technical Support. In any event, the Contractor will assign one or more levels of support for analysis and repair of the problem until the machine has been returned to good operating condition.

2nd Level Technical Support - A machine(s) specialist with unique training and/or experience who specializes in providing diagnostic assistance and/or repair expertise when a service call is particularly difficult.

3rd Level Technical Support - A machine(s) specialist whose geographic responsibilities normally include multiple Field Engineering Branch Offices and who has received in-depth specialized training and experience and possesses extensive diagnostic ability specifically designed to assist on unusually complex problems.

5. Responsibilities of the State

a. The State will provide adequate storage space for spare parts, and adequate working space, including heat, light, ventilation, electrical current and outlets, for the use of the Contractor's maintenance personnel. These facilities shall be within a reasonable distance of the equipment to be serviced and shall be provided at no charge to the Contractor.

b. Unless mutually agreed on by the Contractor and the State, State personnel will not perform maintenance or attempt repairs to the equipment while such equipment is under the purview of this Rider.

c. Subject to the State's security regulations, the Contractor shall have full and free access to the machines to provide service thereon.

d. The State will be responsible for the additional cost of remedial maintenance if a system which has been modified by substitution and/or additions provided by a third party and the system or machine failure was caused by the system modification.

e. The State shall provide an appropriate operating environment, including temperature, humidity, and electrical power, in accordance with the environmental requirements contained in the Contractor's published specifications for the equipment listed on Rider B.

6. Maintenance Coverage

a. Period of maintenance coverage:

(1) The State may select a period or periods of maintenance coverage in accordance with the following:

(a) A minimum monthly maintenance charge entitles the State to maintenance coverage during the Principal Period of Maintenance.

(b) The State may select in lieu of the hours available for the minimum monthly maintenance charge, one or more of the optional periods of maintenance coverage for an additional charge as shown in Attachment to Rider C. The additional charge is based on a

/// EXAMPLE ///
RIDER F - MAINTENANCE PROVISIONS (Continued)

percent of the minimum monthly maintenance charge, depending on the optional periods selected and the applicable machine group.

(2) The hours of maintenance coverage for a machine on Monday through Friday shall be the same each day; and the hours on Saturday and Sunday shall be the same hours on all Saturdays or Sundays.

(3) The State may change its selected period of maintenance coverage by giving Contractor fifteen (15) days prior written notice.

(4) All machines covered under this Agreement must have a simultaneous span of time within the selected periods of maintenance coverage, at least equal to the shortest period offered for any machine in the system.

(5) If the State requests unscheduled, on-call remedial equipment maintenance to be performed at a time which is outside the selected periods of maintenance coverage, the service will be furnished at the applicable per-call rate per man-hour as set forth in Attachment to Rider C. Travel expenses are billable as set forth in Attachtment to Rider C.

b. Preventive Maintenance (scheduled)

(1) Preventive maintenance can either be performed within or outside of the Principal Period of Maintenance. An additional charge may be made for preventive Maintenance to be performed outside of the Principal Period of Maintenance (PPM), as set forth in Attachment to Rider C. No additional charge shall be made for preventive maintenance which is to be preformed within the PPM.

c. Remedial Manintenance (unscheduled)

(1) Remedial manintenance shall be performed after notification by authorized State personnel that the equipment is inoperative.

(2) The Contractor shall provide the State with a designated point of contact and will make arrangements to enable its maintenance representative to receive such notification.

(3) There shall be no additional maintenance charges for:

(a) Remedial maintenance during the period of maintenance coverage unless the remedial maintenance is due to the fault or negligence of the State.

(b) Time spent by maintenance personnel after arrival at the site awaiting the arrival of additional maintenance personnel and/or delivery of parts, etc., after a service call has been commenced.

(c) Remedial maintenance required because the scheduled preventive maintenance preceding the malfunction had not been performed, unless the State had failed to provide access to the equipment.

(d) For time of delay beyond the period described in Paragraph 4d, Contractor shall continue to perform maintenance for the same amount

/// EXAMPLE ///
RIDER F - MAINTENANCE PROVISIONS (Continued)

of time outside the covered period without additional charge to the State.

(e) Work performed during the first hour when remedial maintenance service is requested during the covered period of maintenance and the actual work is begun outside such period.

7. Maintenance Credit for Inoperative Machines

a. The Contractor shall grant a proportionate maintenance credit on a machine shown in Rider B when the machine is inoperative for consecutive scheduled work periods totaling 24 hours from the time the State notifies the Contractor the machine was inoperative, provided (1) the machine became inoperative through no fault of the State, and (2) the breakdown was attributable to equipment failure.

b. Contractor shall grant a credit to the State for each such hour in the amount of 1/168 of the total monthly maintenance charges for the inoperative machine plus 1/168 of the total monthly maintenance charges for any Contractor-supplied interconnected machine which became unusable as a result of a breakdown.

c. The amount of credit granted for each machine during a calendar month shall not exceed the total monthly maintenance charges.

8. Engineering Changes

a. Engineering changes, determined applicable by Contractor, will be controlled and installed by Contractor on equipment covered by this contract. The State may elect to have only mandatory changes, as determined by Contractor, installed on machines so designated. A written notice of this election must be provided to the Contractor for written confirmation. There shall be no charge for engineering changes made. Any Contractor-initiated change shall be installed at a time mutually agreeable to the State and the Contractor. Contractor reserves the right to charge, at its then current time and material rates, for additional service time and materials required due to noninstallation of applicable engineering changes after Contractor has made a reasonable effort to secure time to install such changes.

9. Relocation of Equipment

a. In the event the equipment being maintained under the terms and conditions of this contract is moved to another location within the State of California, the Contractor shall continue to maintain the equipment at the new location.

b. The charges of the Contractor to dismantle and pack the equipment and installation at the new location shall be at the rates set forth in Attachment to Rider C.

c. The State agrees to pay all costs incidental to any move, including costs for packing, crating, rigging, transportation, unpacking, uncrating, insurance, installation, and State and local sales tax, if any.

///EXAMPLE///
RIDER F - MAINTENANCE PROVISIONS (Continued)

10. Maintenance Charges

a. The monthly maintenance charges described in Rider B include all maintenance costs, and the State will pay no additional maintenance charges unless specifically set forth in this rider.

b. Maintenance charges for fractions of a calendar month shall be computed at the rate of 1/30 of the applicable Total Monthly Maintenance Charge, as shown in Rider B, for each day maintenance was provided.

c. There will be no charge for travel expense associated with maintenance service or programming service under this Agreement except that actual travel expenses will be charged in those instances where the site at which the machine is located is not normally accessible by private automobile or scheduled public transportation.

d. All maintenance and other service activities (including but not limited to activities relating to pre-installation planning, inspections, relocation of machines, engineering changes and altered programming) which may be made available by Contractor to the State at no additional charge or at Contractor's then applicable time and material charges, in connection with any machines or programming supplied under this Agreement, shall be subject to the terms and conditions of this Agreement - unless such activities are provided under another written agreement signed by the State and the Contractor.

e. Maintenance rates shall be firm for the contract period subject to a maximum annual maintenance escalation as set forth in Riders B and C.

11. Software Maintenance

a. Types of Service

(1) Category I Service - When Category I Service is specified, Contractor will provide a central service location which will accept documentation, in a format prescribed by Contractor, indicating that a problem is caused by a defect in the program. Contractor will respond to a defect in the current unaltered release of the program by issuing: defect correction information such as correction documentation, corrected code, or notice of availability of corrected code, or a restriction or a bypass. Unless Category II service is also specified for the program, the State shall be responsible for the preparation and submission of documentation to the central service.

(2) Category II Service - When Category II Service is specified and a problem occurs which the State determines is caused by the use of a program and the diagnosis of the designated Contractor representative indicates the problem is caused by a defect in the unaltered portion of a current release of the program, the Contractor representative will perform the following problem resolution activities:

(a) attempting to correct or bypass the defect by providing the State with correction information issued by the central service, if available, or

(b) assisting the State with preparing documentation for submission to the central service, if specified as available; and, in any event

///EXAMPLE///
RIDER F - MAINTENANCE PROVISIONS (Continued)

(c) if the program inoperable, making a reasonable attempt to resolve the problem by assisting the State in applying a local fix or providing a bypass.

(3) Category III Service - When Category III Service is specified and the State encounters a problem, which the State diagnosis indicates is caused by a defect in the unaltered portion of a current release of the program, the State may request Contractor assistance in resolving the problem. Such assistance, if requested, will be provided by a designated Contractor representative and may be subject to the availability of personnel. This assistance may include, but not extend beyond, the following problem resolution activities:

(a) attempting to correct or bypass the defect by providing the State with correction information issued by the central service, if available; or

(b) assisting the State with preparing documentation for submission to the central service, if specified as available; and, in any event

(c) if the program is inoperable, making a reasonable attempt to resolve the problem by assisting the State in applying a local fix or providing a bypass.

(4) Other types of program services may be specified by Contractor and designated in Rider C.

(5) Although the Contractor shall make every reasonable effort to correct errors, Contractor does not guarantee service results or represent or warrant that all errors or program defects will be corrected.

b. Charges

(1) Category I and Category II Services shall be provided at no additional charges to the State. Category III Service shall be provided to the State at the rates shown in Attachment to Rider C.

(2) Contractor shall also have the right to charge for any additional effort which results from providing program services for an altered program or a release which is not current. Such charge(s) will be at the Contractor's then current rates.

RIDER G - SOFTWARE LICENSE

This Rider is intended to provide the State with a license to use those proprietary program products which are necessary (or advantageous) to the State in performing the work for which the equipment was acquired.

The following language was adapted from the State's model software contract and may be used as a model.

/// EXAMPLE ///
RIDER G - SOFTWARE LICENSE

1. License Grant

a. Contractor hereby grants to the State and the State hereby accepts from Contractor, subject to terms and conditions of this Rider, a nonexclusive, nontransferable license to use the Software Products listed in Rider B and C and further described in Contractor's technical specifications (hereinafter referred to as "Software Products").

b. The license granted above authorizes the State to use the Software Products in machine-readable form on the computer system located at (Installation address). Said computer system and its associated units (collectively referred to as "CPU") are designated as (Manufacturer name, model and serial number), provided that if the CPU is inoperative due to malfunction, the license herein granted shall be temporarily extended to authorize the State to use the Software Products, in machine-readable form, on any other State CPU until the designated CPU is returned to operation. By prior written notice, the State may redesignate the CPU on which the Software Products are to be used. The redesignation will be effective upon the date specified in the notice of redesignation.

c. The State may use the Software Products in the conduct of its own business, and any division thereof.

2. Maintenance

a. The correction of any residual errors in any Software Products which may be discovered by Contractor or by the State will be considered maintenance. Such maintenance will be performed by Contractor without additional charge for twelve (12) months after installation. Suspected errors discovered by the State in the Software Products will be handled by the following procedure:

(1) A listing of the output and a copy of the identical input data in machine-readable form will be submitted to the Contractor, along with a complete copy of the appropriate Contractor information form and a listing of the contents of pertinent portions of the main memory of the CPU at the time the error condition was noted.

(2) Errors in Software Products as verified by Contractor will be corrected by providing a new copy of said Software Products (or of the affected portions) in machine-readable form.

(3) The Contractor shall attempt to correct Software Product errors within a reasonable time.

b. Contractor will be available to assist the State in isolating and correcting error conditions caused by the State's particular hardware or operating system at rates listed in Attachment to Rider C.

c. If Contractor is called upon by the State to correct an error caused by State negligence, modification by State, State supplied data, machine or operator failure, or due to any other cause not inherent in the original Software Products, Contractor reserves the right to charge State for such services on a time and material basis at rates listed in Attachment to Rider C.

///EXAMPLE///
RIDER G - SOFTWARE LICENSE (Continued)

3. Right to Copy or Modify

a. Any Software Product provided by Contractor in machine readable form may be copied, in whole or in part, in printed or machine-readable form for use by the State with the designated CPU, for use by the State to perform one-time benchmark tests, for archival or emergency restart purposes, to replace a worn copy, to understand the content of such machine-readable material, or to modify the Software Product as provided below; provided, however, that no more than three printed copies and five machine-readable copies will be in existence under this Agreement at any one time without prior written consent from Contractor, such consent not to be unreasonably withheld. The original, and any copies of the Software Product, in whole or in part, which are made hereunder shall be the property of the Contractor.

b. The State agrees to keep any such copies and the original at a mutually designated State location, except that the State may transport or transmit a copy of the original of any Software Product to another State location for backup use when required by CPU malfunction, provided the copy or the original is destroyed or returned to the designated location when the malfunction is corrected.

c. The State may modify any Software Product, in machine-readable form, for its own use and merge it into other program material. Any portion of the Software Product included in any merged program material shall be used only on the designated CPUs and shall be subject to the terms and conditions of this Rider.

d. The State agrees to reproduce and include the Contractor's copyright or other proprietary notice on any copies, in whole or in part, in any form, including partial copies of modifications, or Software Products furnished under this contract.

4. Protection of Software Product

a. State agrees that all materials furnished hereunder, appropriately marked or identified as proprietary, are provided for the State's exclusive use and will be held in confidence. All proprietary data shall remain the property of the Contractor. The State will not provide or otherwise make available any program materials in any form without Contractor's prior written consent except to State employees, Contractor employees or other persons during the period they are on the State's premises for purposes specifically related to the State's use of the program.

b. The State will insure, prior to disposing of any media, that any licensed materials contained thereon have been erased or otherwise destroyed.

c. The State agrees that it will take appropriate action by instruction, agreement, or otherwise with its employees or other persons permitted access to licensed programs and/or optional materials to satisfy its obligations under this Rider with respect to use, copying, modification and protection and security of licensed programs and optional materials.

5. Termination

a. The State may terminate this Rider in its entirety, without penalty, upon thirty (30) days prior written notice to the Contractor.

/// EXAMPLE ///
RIDER G - SOFTWARE LICENSE (Continued)

b. Within fifteen (15) days after cancellation or termination of this Rider, for whatever cause, State agrees to certify to Contractor in writing that the original and all copies, in whole and in part, in any form including partial copies, and modifications of any Software Product subject to this Rider, have been destroyed. However, upon prior written notification to the Contractor, the State may retain a copy for archive purposes only.

c. If this Rider shall be terminated as to certain, but not all, Software Products, the State will certify to Contractor in writing that the original and all copies, in whole or in part, in any form, have been destroyed.

6. Future Releases

If improved versions of this Software Product are developed by the Contractor (other than those described in Contractor's technical specifications), and are made available to other licensees, they will be made available to the State at the State's option provided such versions are operable on the same computer configuration.

RIDER H - TRAINING

This Rider, if used, is unique to each procurement. Normally, the vendor will author the specific language to be included herein, in order to be responsive to the requirements set forth in the solicitation document. Such language must not only be acceptable to the agency procuring the services, but it must be acceptable to the Department of General Services.

No illustrative language is provided for this Rider. The language will be specified in those EDP procurements which require its use.

RIDER I - PERSONAL SERVICES

This Rider is intended to establish the contractual aspects of any personal services to be furnished by the vendor in support of the equipment acquisition and is unique to each procurement. Such services may include program conversion, data base conversion, programming, systems analysis, etc. If used, the specific language must be prescribed by the State, submitted by the vendor, or developed by negotiation during the procurement process. In any event, it must be responsive to the requirements of the bid solicitation document (IFB, RFP, etc.) and be acceptable to the agency procuring the equipment and the Department of General Services.

A sample Rider is provided for illustrative purposes. The State's Model Contract for Personal Services (Section 5272 of the State Administrative Manual) was used as a guide in developing this Rider.

/// EXAMPLE ///
RIDER I - PERSONAL SERVICES

The maximum amount of this Rider shall not exceed $_____, consisting of $_____ for the fixed price tasks prescribed in Task Schedule 1- _____ and $_____ set aside for payment of any unanticipated tasks specifically authorized under the provisions of Paragraph 7.

1. General

   a. The purpose of this Rider is to define certain tasks required to: (define purpose) _____ establish the responsibilities for accomplishing these tasks, and prescribe the payment therefore. These tasks include: (describe tasks) _____.

   b. For that work which has been clearly identified, Task Schedules, as described herein and attached hereto, define and authorize such work on a Fixed Price basis, with a guarantee of task completion.

   c. To the extent that additional work, not foreseen at the time this Agreement is executed, must be accomplished, Work Authorizations, as described in Paragraph 7, will be the means for defining and authorizing such work on a Labor Hour basis.

2. Statement of Work

   a. Contractor shall make available to the State technically competent personnel for the purpose of providing the services required to accomplish the tasks prescribed in Task Schedules 1 -_____, in the manner described therein. Each such task will be considered complete when the completion criteria, as defined in the applicable Task Schedule, is met.

   b. Each Task Schedule contains, as a minimum, a description of the task, a statement of the Contractor's responsibilities, completion criteria, a list of deliverable items (if any), the estimated starting date, the scheduled completion date, and a fixed cost for each task. The aggregate of the fixed costs for all Task Schedules constitutes the fixed price ceiling for all tasks described in the various Task Schedules.

   c. The Contractor agrees that he will perform the services for which he is responsible, that he will accomplish this work in the manner and in the time stated in the Task Schedules, and that he will provide the deliverable items as required. This performance is predicated, however, on the State meeting its responsibilities in the time and manner described in the Task Schedules.

3. Control and Supervision

   The services provided by the Contractor to accomplish the Statement of Work shall be under the control, management, and supervision of the Contractor.

4. Personnel

   a. Contractor personnel shall perform their duties on the premises of the State, during the State's regular work days and normal work hours, except as may be specifically agreed to otherwise by the State.

///EXAMPLE///
RIDER I - PERSONAL SERVICES (Continued)

b. The State reserves the right to disapprove the continuing assignment of Contractor personnel provided to the State under this Rider. If the State exercises this right, and the Contractor cannot immediately replace the disapproved personnel, the State agrees to an equitable adjustment in schedule or other terms that may be affected thereby.

c. The Contractor will make every effort consistent with sound business practices to honor the specific requests of the State with regard to assignment of its employees; however, subject to paragraph 4.b. above, the Contractor reserves the sole right to determine the assignment of its employees. If a Contractor employee is unable to perform due to illness, resignation, or other factors beyond the Contractor's control, the Contractor will make every reasonable effort to provide suitable substitute personnel.

d. In recognition of the fact that Contractor personnel providing services under this Rider may perform similar services from time to time for others, this Rider shall not prevent Contractor from performing such similar services or restrict Contractor from using the personnel provided to the State under this Rider, providing that such use does not conflict with the performance of services under this Rider.

5. Responsibilities of the State

a. The State shall provide normal office working facilities and equipment necessary for Contractor performance under this Rider. Any special requirements (e.g., reprographic services, computer time, key data entry, etc.) is identified in the Task Schedules.

b. The State is responsible for providing required information, data, documentation, and test data to facilitate the Contractor's performance of the work, and will provide such additional assistance and services as is specifically set forth in the various Task Schedules.

c. Delay or failure by the State to fulfill the above described responsibilities, such that the Contractor is prevented from performing in accordance with the applicable Task Schedules, may result in additional costs to the State and deviations from previously agreed upon work schedules. In this event, the State and the Contractor will initiate one or more Work Authorizations, as described in Paragraph 7. Should the Contractor determine that a delay exists, or is probable due to failure of the State, the Contractor will notify the State in writing immediately.

d. (Name of State person responsible) _____ is responsible for ensuring the performance of the state personnel under this Rider, and is the state individual to whom all communications relative to this Rider will be addressed.

6. Rights in Data

a. All technical communications and records originated or prepared by the Contractor pursuant to this Rider including papers, reports, charts, computer programs, and other documentation, but not including Contractor's administrative communications and records relating to this Agreement shall be delivered to and shall become the exclusive property of the State and may be copyrighted by the State.

///EXAMPLE///
RIDER I - PERSONAL SERVICES (Continued)

b. The ideas, concepts, know-how, or techniques relating to data processing, developed during the course of this Rider by the Contractor or jointly by the Contractor and the State can be used by either party in any way it may deem appropriate.

c. All inventions, discoveries or improvements of the computer programs developed pursuant to this Rider, shall be the property of the State. The State agrees to grant a nonexclusive royalty-free license for any such invention, discovery, or improvement to the Contractor or any other person and further agrees that the Contractor or any other such person may sublicense additional persons on the same royalty-free basis.

d. This Rider shall not preclude the Contractor from developing materials outside this Agreement which are competitive, irrespective of their similarity to materials which might be delivered to the State pursuant to this Rider.

7. Unanticipated Tasks

a. In the event that additional work must be performed which was wholly unanticipated, and which was identified in neither the State's Invitation for Bid nor the Contractor's bid submitted in response thereto, but which in the opinion of both parties is necessary to the accomplishment of the general scope of work outlined, the procedures outlined herein will be employed.

b. For each item of unanticipated work, a Work Authorization will be prepared in accordance with the sample attached as Exhibit A and will be incorporated as a Schedule to this Rider.

c. It is understood and agreed by both parties to this Rider that all of the terms and conditions of this Rider shall remain in force with the inclusion of any such Work Authorization added as a Schedule to this Rider. Such Work Authorization shall in no way constitute a contract other than as provided pursuant to this Rider nor in any way amend or supersede any of the other provisions of this Agreement.

d. Each Work Authorization shall consist of a detailed statement of the purpose, objective or goals to be undertaken by the Contractor, the job classification or approximate skill level of the personnel to be made available by the Contractor, an identification of all significant material to be developed by the Contractor and delivered to the State, an identification of all significant materials to be delivered by the State to the Contractor, an estimated time schedule for the provision of these services by the Contractor, completion criteria for the work to be performed, the name or identification of the Contractor personnel to be assigned, the Contractor's estimated labor-hours required to accomplish the purpose, objective or goals, the Contractor's billing rates per man-hour, and the Contractor's estimated total cost of the Work Authorization.

e. All Work Authorizations must be in writing and signed by (Name of Contractor Representative) _____ for the Contractor and by (Name of State Representative) _____ for the State prior to beginning work.

f. The State has the right to require the Contractor to stop or suspend work on any Work Authorization by fifteen (15) calendar days' written notice. The Contractor agrees to stop or suspend work earlier than fifteen (15) days, if Contractor employees engaged in the work can be reassigned to other duties.

///EXAMPLE///
RIDER I - PERSONAL SERVICES (Continued)

g. Personnel resources will not be expended (at a cost to the State) on task accomplishment in excess of the estimated labor-hours required unless the procedure below is followed:

(1) If, in the performance of the work, the Contractor determines that a Work Authorization to be performed under this Agreement cannot be accomplished within the estimated labor-hours, the Contractor will immediately notify the State in writing of the Contractor's estimate of the labor-hours which will be required to complete the Work Authorization in full. Upon receipt of such notification, the State may:

(a) Authorize the Contractor to expend the estimated additional labor-hours of service in excess of the original estimate necessary to accomplish the Work Authorization (such an authorization not unreasonably to be withheld); or

(b) terminate the Work Authorization; or

(c) alter the scope of the Work Authorization in order to define tasks which can be accomplished within the remaining estimated labor-hours.

(2) The State will notify the Contractor in writing of its election within seven (7) calendar days after receipt of the Contractor's notification. If no notice of the election is received, the Contractor may act as if authorization to proceed had been given by the State, and may expend the estimated additional labor-hours of services as if formally notified. The State agrees to reimburse the Contractor for such additional labor-hours.

8. Reporting, Invoicing, and Payment for Services

a. The Contractor shall provide a weekly written and oral status report, including a review of current and subsequent weeks' work plans and an analysis of any problems previously encountered and still unresolved or anticipated to be encountered. These reports will be made to (Name of State Representative) _____ and to any other personnel either deems appropriate.

b. During the execution of each Task Schedule which involves the delivery to the State of identified deliverable items, the Contractor may submit periodically to the State invoices reflecting a pro rata cost of the task schedules, determined on the basis of the lesser of either:

(1) the number of deliverables provided to the State divided by the total number of deliverables required to be delivered to the State, less 25 percent, less any amounts previously invoiced; or

(2) the number of labor-hours expended by the Contractor in the performance of the task divided by the number of labor-hours scheduled for the task, less 25 percent, less any amounts previously invoiced.

c. For those Task Schedules which do not include delivery to the State of identified deliverable items, but which are of a continuing nature, the Contractor may submit invoices reflecting pro rata cost of the Task Schedule, less 10 percent, less any amount previously invoiced. Actual progress payment amounts, for such Task Schedules, must be based on at least equivalent services rendered and, to the extent practicable, will be keyed to clearly

///EXAMPLE///
RIDER I - PERSONAL SERVICES (Continued)

identifiable stages of progress as reflected in written reports submitted with the invoices.

d. Upon completion of a Task Schedule to the satisfaction of the State, the full charge for such Task Schedule, less amounts previously invoiced to the State in accordance with paragraph 8.b. or 8.c. above, may be submitted for payment.

e. In the event that unanticipated work is performed, invoices for services as reflected on Work Authorizations will be submitted to the State for payment. The Contractor will invoice the State monthly for the labor-hours expended in each Work Authorization for the preceding month. Each such invoice shall reflect the number of hours worked by each classification of Contractor personnel and the applicable billing rates. In no event shall the total amount paid for such unanticipated work exceed 10 percent of the total amount of this Rider.

f. Invoices prepared in accordance with paragraphs 8.b, c., d., and e. above will not be submitted more frequently than monthly to the State.

g. In the aggregate, invoices reflecting progress payments will not exceed 90 percent of the ceiling amount of the Agreement, with the balance to be invoiced upon satisfactory completion of the Agreement.

h. The State shall make payment to the Contractor as promptly as fiscal procedures permit for performance under this Rider in accordance with applicable completion criteria as accepted by the State and in accordance with invoices submitted.

9. Liabilities for Damages

The Contractor shall be relieved of liability with respect to the performance of work as outlined in each Task Schedule when the State agrees the Task Schedule has been satisfactorily completed.

/// EXAMPLE ///
RIDER I - PERSONAL SERVICES (Continued)
TASK SCHEDULES

Task Schedule No. 1 Application Conversion

A. Task Description

The purpose of this task is for Contractor to deliver converted applications to the State as required (RFP XYZ 86-01, Exhibit V-B).

These will be installed at all remote locations. Documentation will be made available describing their interface to control programs and functions.

B. Contractor Tasks and Responsibilities

1. Convert, install, and document Zip Code Generation.

2. Convert, install, and document County Code Generation.

3. Convert, install, and document Transaction Compression.

4. Convert, install, and document Master File Explosion.

C. Deliverables

Contractor will deliver for each program listed under B, above, source code and brief program descriptions.

D. Completion Criteria

Each function listed under B, above will be functionally demonstrated at the State Agency Headquarters facility in Sacramento, California. This demonstration will provide output equivalent to current application output.

E. State Responsibilties

1. Appoint a State contact by start of conversion to interface with Contractor and to provide consultation as necessary for the completion of this task. This contact will also coordinate the approval of the completion of this task.

2. Provide current program listings on hardcopy and magnetic tape to Contractor for tasks listed under B, above, by start date.

3. Provide known test data and required program interfaces to be used in testing the applications listed under B, above.

4. Provide appropriate computer time on prime shift between 8:00 a.m. and 5:00 p.m. weekdays.

F. Scheduled Dates

Start Date: March 1, 1986

Completion Date: May 15, 1986

G. Fixed Price $_____

/// EXAMPLE ///
RIDER I - PERSONAL SERVICES (Continued)

EXHIBIT A

WORK AUTHORIZATION

Schedule 1

TITLE: 70/752 Output Formatter

Task Summary

Develop program to format and print simulated 70/752 displays using a sequential data set as input.

Schedule Dates

State Date: February 8, 1986
Completion Date: February 28, 1986

Estimated Labor-hours	L/H Rate	Estimated Total Cost
100	$40.00	$4,000.00

Contractor Personnel To Be Assigned	Job Classification/Skill Level
Bill Jones	Staff Programmer Analyst

This task will be performed in accordance with this Work Authorization and the provisions of Contract Rider I, Paragraph 7, entitled "Unanticipated Tasks."

Approval

Contractor Project Manager

STATE DATA CENTER Director

RIDER K - NON-APPLICABILITY

This Rider is used to identify any provision which is inapplicable for the transaction at hand. It is unique to each procurement, and may frequently be omitted.

/// EXAMPLE ///
RIDER K - NON-APPLICABILITY

Paragraph 9, Acceptance Testing for Software (other than Operating Software), is not applicable.

STATE OF CALIFORNIA
STD. 17A (New 5/83)

NONDISCRIMINATION CLAUSE

(OCP - 1)

1. During the performance of this contract, contractor and its subcontractors shall not unlawfully discriminate against any employee or applicant for employment because of race, religion, color, national origin, ancestry, physical handicap, medical condition, marital status, age (over 40) or sex. Contractors and subcontractors shall insure that the evaluation and treatment of their employees and applicants for employment are free of such discrimination. Contractors and subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code, Section 12900 et seq.) and the applicable regulations promulgated thereunder (California Administrative Code, Title 2, Section 7285.0 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code, Section 12990, set forth in Chapter 5 of Division 4 of Title 2 of the California Administrative Code are incorporated into this contract by reference and made a part hereof as if set forth in full, Contractor and its subcontractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.

2. This contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.