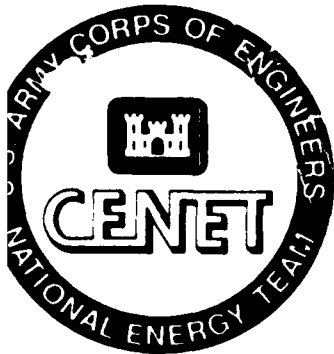




**US Army Corps
of Engineers**

Construction Engineering
Research Laboratory

**TECHNOLOGY
TRANSFER
TEST BED
PROGRAM**



AD-A231 633

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USACERL Technical Report M-91/12
January 1991
T³B: Voice Activated Inspection System

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Construction Site Voice Operated Information System (VOIS) Test

by
Debbie J. Lawrence
William Hettchen

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The Voice Activated Inspection System (VAIS), developed by USACERL, allows inspectors to verbally log on-site inspection reports on a hand-held tape recorder. The tape is later processed by the VAIS, which enters the information into the system's database and produces a written report.

The Voice Operated Information System (VOIS), developed by USACERL and Automated Sciences Group, through a USACERL cooperative research and development agreement (CRDA), is an improved voice recognition system based on the concepts and function of the VAIS.

To determine the applicability of the VOIS to Corps of Engineers construction projects, Technology Transfer Test Bed (T³B) funds were provided to the Corps of Engineers National Security Agency (NSA) Area Office (Fort Meade) to procure and implement the VOIS, and to train personnel in its use. This report summarizes the NSA application of the VOIS to quality assurance inspection of radio frequency shielding and to progress payment logs, and concludes that the VOIS is an easily implemented system that can offer improvements when applied to repetitive inspection procedures. Use of VOIS can save time during inspection, improve documentation storage, and provide flexible retrieval of stored information.

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TECHNOLOGY TRANSFER TEST BED PROGRAM

FINDINGS AND RECOMMENDATIONS OF TEST/DEMONSTRATION

WORK UNIT NO./TITLE OF TEST: T³B-EM-KE8

PERFORMING LABORATORY: USACERL **PRODUCTION/SYSTEM:** Voice Operated Information System (VOIS)

PERFORMING TEST SITE: U.S. Army Corps of Engineers Baltimore District National Security Agency (NSA) Area Office (Fort Meade).

DESCRIPTION/OBJECTIVE OF TEST/DEMONSTRATION:

Engineers from USACERL and the Corps of Engineers National Quality Assurance Team (CENQAT) tested the VOIS. The objectives were to evaluate the procurement and implementation of the VOIS, and to assess its applicability to Corps of Engineers' construction projects.

RESULTS OF TEST/DEMONSTRATION:

The VOIS was found to be easy to procure, implement, and learn. The equipment worked well, except when used with special clothing, such as gloves or face masks. The software also worked well as long as sufficient computer memory was available during changes to program vocabulary. Even though vocabulary states were individually limited to 50 words, total vocabulary size was unlimited and found to be adequate to the inspection task. Benefits of the VOIS system include potential time savings during inspection, improved documentation storage, and flexible retrieval of the stored information. The VOIS may be useful in Corps of Engineers' construction projects conducive to repetitive inspections, such as large concrete projects, highways, dams, and finish work.

RECOMMENDATIONS FOR PRODUCT/SYSTEM:

It is recommended that the controls for the hand-held tape recorder be altered for use with gloved hands. Future system updates should incorporate and expand upon existing VOIS vocabularies to broaden the application of the system and to shorten the time required in voice training.

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FOREWORD

This investigation was performed for the Corps of Engineers National Quality Assurance Team (CENQAT) under the Technology Transfer Test Bed (T³B) program, U.S. Army Corps of Engineers work unit T³B-EM-KE8, "Voice Activated Inspection System."

The CENQAT technical monitor was Mr. Glen Latta, CENPD-CO-C. The Headquarters, U.S. Army Corps of Engineers (HQUSACE) technical monitors were Mr. James Vredenburg, CEMP-CE, and Mr. Richard Carr, CEMP-CE, of the Directorate of Military Programs.

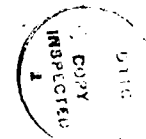
This work was performed by the Engineering and Materials Division (EM) of the U.S. Army Construction Engineering Research Laboratory (USACERL) and the National Security Agency (NSA) Area Office. Dr. Paul A. Howdyshell is Acting Chief of USACERL-EM. The USACERL technical editor was Mr. William J. Wolfe, Information Management Office.

COL Everett R. Thomas is Commander and Director of USACERL, and Dr. L.R. Shaffer is Technical Director.

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CONSTRUCTION SITE VOICE OPERATED INFORMATION SYSTEM (VOIS) TEST

1 INTRODUCTION

Background

In 1987, USACERL developed a Voice Activated Inspection System (VAIS), which allows inspectors to verbally log their inspection reports on a Walkman^{*} tape recorder at the inspection site.¹ After returning to the office, the tape is placed into the system and automatically translated into a meaningful printed report. To facilitate the many different applications required in field use, USACERL made the VAIS generic in nature. Field tests showed that the technology and concept of a generic VAIS was very much accepted and in demand. To speed this technology into the field, USACERL chose to cooperatively complete development of the generic VAIS with Automated Sciences Group, Inc. (ASG).²

The USACERL-ASG cooperatively developed version of the Voice Operated Information System (VOIS) is a generic system that gives the end user freedom to develop custom applications, without programming knowledge. The structure of the verbal inspection report, the vocabulary used to make the inspections, the format in which the reports are stored in the computer, and the formats of the written hard-copy inspection reports, are all determined by the VOIS user and are subject to guidelines provided for efficient use of the VOIS.

The VOIS is designed for use in repetitive data collection applications, typical in the DEH applications where it has been successfully tested. It should be understood that the VOIS is not a dictation system, but a data-collection device intended to enhance the productivity of inspectors/engineers by enabling them to spend more time in the field and less time in the office while still providing necessary documentation.

Objectives

The objectives of this study were to determine the applicability of the VOIS to Corps of Engineers construction projects, the ease with which the VOIS hardware can be procured and learned, and the amount and kind of training required to use VOIS for construction applications. Further objectives were to document deficiencies in equipment, software, and operational procedures, and to outline the improvements that would make the VOIS a useful technology for Corps applications.

^{*} Walkman is a registered trademark of Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656.

¹ Karen E. Wildblood and Debbie J. Lawrence, *Field Test of the Voice Activated Inspection System for Directorate of Engineering and Housing (DEH) Applications*, Unpublished Report M-87/11 (U.S. Army Construction Engineering Research Laboratory [USACERL], June 1987); *Field Evaluation of the Voice Activated Inspection System (VAIS), Version 2.0* UR M-87/12 (USACERL, June 1987).

² Automated Sciences Group, Inc., 700 Roeder Road, Silver Spring, MD 20910.

Approach

The VOIS was procured for the NSA Field Project Area Office through the U.S. Corps of Engineers Baltimore District Procurement Division. Training on the VOIS was scheduled at both the project office and the contractor's facility. Applications were developed using repetitive vocabularies, which were then trained and tested in the field. Records were maintained on the time and effort required to implement the applications.

Scope

The test was limited to one project office covering one construction contract. It should be noted that this study was conducted using an early version of the VOIS. Recent versions of the VOIS have incorporated enlarged vocabularies of up to 1000 words in each "state" to increase the program's applicability to construction inspection procedures.

Mode of Technology Transfer

The technology reported here is currently commercially available from ASG. The results of this test and further tests to optimize implementation methods and to document potential savings will be incorporated into a commercial training program. It is also anticipated that these test results will be summarized in a Construction Technical Letter to be distributed by CENQAT.

2 DESCRIPTION OF DEMONSTRATION

Procurement

The VOIS was procured under a purchase order contract through the Baltimore District Procurement Division requested on 13 April 1988 and awarded on 26 August 1988. While other vendors could provide the required system, only Astronics could provide a complete package. The system was delivered on 15 September 1988, including the hardware, software, documentation, and training for the VOIS system. System hardware included a commercially available speech recognition board, a tape playback unit, and eight Walkman field recorders with noise-canceling headsets. The system was to be installed on an existing personal computer (PC). Details of the system are given in Appendix A.

Training

Upon delivery, the system was set up on the field PC according to the VOIS manuals. Initial system training for one inspector (the NSA Area Office Project Engineer) was held at the Astronics office on 19 and 20 September, for approximately 4 hours each day. The training covered the steps necessary to develop the application. Additional training was conducted at the project office. This training involved creation of the necessary reports and of a voice template for the application. A complete listing of time expended on training is given in Appendix B.

Application Development

The original application developed for testing the VOIS was Quality Assurance (QA) of concrete formwork. A complete vocabulary had been constructed for this application; however, the VOIS was delivered just as most of the work in this area was being completed. USACERL developed two new applications for the VOIS, a Quality Assurance inspection of Radio Frequency (RF) shielding, and review of progress payments. These applications were chosen because their inspections included repetitive steps. Approximately 8 hours were required to develop each application, with some assistance from Astronics.

The RF-shielding inspection was a new procedure for the field office, developed in concert with the construction contractor's Quality Control (CQC) team to match their inspection system. The CQC inspector visually inspected the shielding for defects, and marked the defects for correction. The QA inspection consisted of verifying that the noted defects were corrected, that no defects were overlooked, and that the shielding was not damaged after the inspection date. After studying this process, an appropriate vocabulary was developed and a report format was developed.

The progress payment application was also developed using existing formats. The vocabulary for this application was derived directly from the existing contractor's progress report, and was limited to the information that changed on the payment form. All other information on the form was stored in auxiliary data files. Several reports were developed for this application so that the payment data would be available for different purposes.

The VOIS vocabulary is structured into groups of words called "states," each of which may contain up to 40 or 50 words (depending on the length of the uttered words). Each "question" vocabulary word

(recognition phrase) activates an "answer" state. Different states may contain new or repeated vocabulary items. In this way, states may overlap. Furthermore, a vocabulary word may activate a different state, or its own state.

For example, the inspector always begins in State 1, the entry state, which contains only question terms. The question "today is," activates State 2, which contains the answers: "January," "February," etc. These recognition phrases are themselves questions that activate State 4, which contains the answers: "zero," "one," "two," etc. Each spoken number in State 4 itself points to State 4 (the current state) as the next state. Thus, the inspector's taped entry guides the VOIS from state to state to enter the following meaningful phrase that dates the report: "Today is January One Four."

Every state in this application contains the repeated vocabulary word "return," which is coded for State 1. By saying "return," the inspector routes the VOIS to the beginning of the process. In this way, it is impossible to "get lost" in the system. The VOIS returns to the same starting point for each inspection procedure.

A complete listing of the application vocabulary and reports are given in Appendices C and D. Also included in the appendices are copies of help sheets with the application vocabularies for use in the field.

Voice Training

Voice training on the RF-shielding application started on 28 September. The initial training required approximately 2 hours to enter the entire vocabulary into the computer. The vocabulary was repeated into the system six times to incorporate the variations in word pronunciation. After this update, the computer was able to recognize most words spoken directly into the digitizer. Initial in-house taped accuracy was approximately 90 percent. After field inspections were made, selected words were updated to increase recognition accuracy. This process was repeated upon each application until recognition accuracy was improved to an acceptable level.

The application to progress payment logs also required approximately 2 hours for one inspector to enter the vocabulary and six updates to attain approximately 90 percent accuracy. The vocabulary for this application was smaller than for the shielding application.

Inspections

A field inspection consisted of creating a tape using the Walkman tape recorder, then playing the tape into the system. A tape was made at the construction site using a noise-cancelling microphone headset. When the tape was played back into the computer, it was monitored for accuracy. Any required corrections to the data were made immediately after the tape was played. A report was then generated from the data.

After the in-house accuracy was established for the shielding application, field inspections were made of the contractor's work. Each field inspection required approximately 1/2 hour to conduct, and approximately 15 minutes to process the cassette tape. The initial accuracy for the inspection dropped from 90 percent in house to 70 percent accuracy in the field. After processing several inspections and updating select words, the unedited accuracy was improved to 80 percent. (Editing produced 100 percent

accuracy.) After the application was used, the structure was revised to describe additional areas in the inspection.

The progress payment application was not fully field tested as of the date of this report.

Lessons Learned

Experience with field inspections brought out the limitations and capabilities of the system. The accuracy of recognition is highly dependent on the quality of the recording. Exceptionally loud or soft recordings were not accurately processed. Care had to be taken to ensure that the volume level on the Walkman was set to the recommended position, and that the speaker used an even speaking voice. The microphone headset used a noise-cancelling microphone and an earpiece adaptable for use with a hard hat. Although the Walkman was supplied with a shoulder strap for carrying, it was more convenient to carry it in a coat pocket during the test.

Use of the VOIS during cold weather was sometimes cumbersome. It was difficult to operate the rather small controls of the tape recorder while wearing gloves. The small size of the control button caused difficulty as well. Reports made using the pause control were occasionally missing sections of the inspection due to the pause not being fully released.

During vocabulary entry and update, it was important to have no other programs operating in computer memory. Several times, the PC locked up due to lack of available memory.

3 ANALYSIS OF RESULTS

Procurement

The procurement process consumed more time than expected (over 4 months). However, the system is relatively easy to procure. (Once approved, the system was delivered in 3 weeks.)

Training

The training provided by Astronics was more than enough to meet the testing requirements. The instruction manuals provided with the system were easily understood, and complete enough to develop and process new applications. Assistance for using the system was also available through the company's "hotline."

Application Development

Choosing and developing the proper application requires careful planning. The importance of choosing a repetitive inspection for use with this system cannot be overemphasized. Equally important is choosing the proper structure for the application. The application logic should follow the normal inspection procedure so that the inspector can both work and produce an inspection tape without restructuring the normal routine. Although the flexibility of the structure was limited by the maximum of about 50 words that can be recognized at one time, this limit can be extended by building "pointers" from each list of words to others.

Voice Training

Voice training for the VOIS requires some patience to achieve reasonable recognition accuracy. Once the voice-training principles are used in one application, new applications can be trained without assistance.

Inspections

Initial field inspections should be expected to have lower recognition rates than will occur after later refinements of the inspection process. The structure of the vocabulary can be modified to accommodate revisions to the inspection process without affecting previously entered data. For the RF-shielding inspection, use of the VOIS required approximately the same amount of time as noting deficiencies by hand. Once inspections were entered on the computer, the information was readily available for future reference using dBase reports stored in the computer.

4 CONCLUSIONS AND RECOMMENDATIONS

The VOIS was easy to procure, implement, and learn. The equipment worked well, except when used with special clothing, such as gloves or face masks. The software also worked well as long as sufficient computer memory was available during changes to application vocabulary. Even though vocabulary states were individually limited to 50 words, total vocabulary size was unlimited and found to be adequate to the inspection task.

The use of the VOIS was limited by two factors: the amount of time required to establish and voice-train the application, and the rigid inspection format required by the use of vocabulary states of 50 words. Benefits of the VOIS include potential time savings during inspection, improved documentation storage, and flexible retrieval of the stored information.

QA inspections that require a single individual to inspect a wide range of construction areas may not benefit from use of the VOIS. It is recommended that the VOIS be used in Corps of Engineers' construction projects conducive to repetitive inspections, such as large concrete projects, highways, dams, and finish work.

APPENDIX A:

SYSTEM DESCRIPTION

Provided in the VOIS were:

1. Speech recognition board for IBM compatible computer
2. Instructions for installing board
3. External loud speaker
4. VOIS computer software (includes dBase III "runtime" program)
5. VOIS instruction manual
6. Marantz PMD430 Cassette recorder
7. Sony Walkman WM-D3 recorder
8. Noise-canceling headset microphone
9. Wires to connect system.

Provided by reviewer were:

1. Cassette tapes
2. Zenith Z-200 personal computer.

APPENDIX B:**TRAINING EFFORT**

Activity	Date	Time Used	Application
System received	9/15/88		
Initial training	9/19/88	4 hours	
	9/20/88	4 hours	
Application development	9/26/88	4 hours	RF
	9/27/88	4 hours	RF
Voice training - six updates	9/28/88	2 hours	RF
Test recognition	10/27/88	2 hours	RF
Updating voice - four updates	11/22/88	1 hour	RF
Application development	12/29/88	3 hours	%
Creating report format	12/30/88	2 hours	%
Voice training - six updates	12/30/88	2 hours	%
Modifying application	1/17/89	1 hour	RF
Voice update - selecting words	1/17/89	2 hours	RF
Adding report formats	1/20/89	4 hours	%
Test recognition	2/1/89	2 hours	%
Voice update	2/15/89	2 hours	%

SUMMARY

	RF Shielding Application	% Complete, Progress Payment Application
Voice training	15 hours	6 hours
Application development	9 hours	8 hours

APPENDIX C:

RF SHIELDING APPLICATION

FORT MEADE RF SHIELDING INSPECTION APPLICATION SCRIPT

	JANUARY-DECEMBER ZERO-NINE	PHONETIC ALPHABET
1. TODAY IS-----	ANY KEYWORD	ALPHA BRAVO CHARLIE DELTA ECHO FOXTROT GOLF HOTEL INDIA JULIET KILO LIMA MIKE NOVEMBER OSCAR PAPA QUEBEC ROMEO SIERRA TANGO UNIFORM VICTOR WHISKEY X-RAY YANKEE ZULU BACKUP DELETE
2. INSPECTOR-----	(YOUR NAME) ANY KEYWORD	
3. FLOOR-----	ZERO-NINE, BASEMENT ANY KEYWORD	
4. AREA-----	ALPHA-INDIA (phonetic alphabet) ANY KEYWORD	
5. COLUMN-----	ALPHA-ZULU (phonetic alphabet) DASH ZERO-NINE ANY KEYWORD	
6. SHIELD-----	WINDOW, COPPER GASKET, TERNE ANY KEYWORD	
7. TAG, COVERED, PENETRATED-----	DEFICIENCY/NO ANY KEYWORD	
8. MISCELLANEOUS-----	DEFICIENCY RETURN END OF INSPECTION END OF REPORT	

* After saying a keyword or question, you may give a corresponding word or answer appearing above the dashed line. Words below the line may be spoken after an entire answer has been given to a question or at any point during inspection.

RF SHIELD DAILY INSPECTION REPORT

INSPECTOR: Will

DATE:03/31/89

FLOOR	AREA	COLUMN	SHIELD TYPE	DEFICIENCIES
0	C	B-18	terne	WRONG TAG
1	C	E-20	terne	UNAPPROVED SHIELDING BEING COVERED
4	B	B-13	copper	SHIELDING PENETRATED AFTER APPROVAL

VOIS Vocabulary Structure
Tuesday, January 17, 1989

==> Vocabulary words and rules for state number 1 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Today is	INSP_DATE	2	Y	N
Inspector	INSPECTOR	6	Y	N
Shield	SHIELD	8	N	N
Floor	FLOOR	10	Y	N
Area	AREA	12	Y	N
Column	COLUMN	14	N	N
Covered	COVERED	16	N	N
Penetrated	PENETRATED	16	N	N
Tag	TAG	16	N	N
Misc	MISC	18	N	Y
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 2 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EQ1
Return		1		
Today is		2		
January	01	4		
February	02	4		
March	03	4		
April	04	4		
May	05	4		
June	06	4		
July	07	4		
August	08	4		
September	09	4		
October	10	4		
November	11	4		
December	12	4		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Misc	Yes	18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 4 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EQ1
Return		1		
Today is		2		
Zero	0	4		
One	1	4		
Two	2	4		
Three	3	4		
Four	4	4		
Five	5	4		
Six	6	4		
Seven	7	4		
Eight	8	4		
Nine	9	4		
Backup	/b	4		
Delete	/d	4		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Misc	Yes	18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 6 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EQ1
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Dawn	Dawn Aymami	8		
Key	Key Whiting	8		
Mike	Mike Pfarr	8		
Sam	Sam Wright	8		
Will	William Hettchen	8		
Floor		10		
Area		12		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Misc		18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 8 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Window	Window	16		
Copper	Copper	16		
Gasket	Gasket	16		
Terne	Terne	16		
Misc		18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 10 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EOI
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Zero	0	10		
One	1	10		
Two	2	10		
Three	3	10		
Four	4	10		
Five	5	10		
Six	6	10		
Seven	7	10		
Eight	8	10		
Nine	9	10		
Basement	B	10		
Roof	R	10		
Backup	\b	10		
Delete	\d	10		
Area		12		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Misc		18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

--> Vocabulary words and rules for state number 12 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EOI
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Alpha	A	12		
Bravo	B	12		
Charlie	C	12		
Delta	D	12		
Echo	E	12		
Foxtrot	F	12		
Golf	G	12		
Hotel	H	12		
India	I	12		
Backup	\b	12		
Delete	\d	12		
Space	\s	12		
Dash	-	13		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Misc		18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 13 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	E01
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Zero	0	13		
One	1	13		
Two	2	13		
Three	3	13		
Four	4	13		
Five	5	13		
Six	6	13		
Seven	7	13		
Eight	8	13		
Nine	9	13		
Backup	\b	13		
Delete	\d	13		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Misc		18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 14 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Column		14		
Alpha	A	14		
Bravo	B	14		
Charlie	C	14		
Delta	D	14		
Echo	E	14		
Foxtrot	F	14		
Golf	G	14		
Hotel	H	14		
India	I	14		
Juliet	J	14		
Kilo	K	14		
Lima	L	14		
Mike	M	14		
November	N	14		
Oscar	O	14		
Papa	P	14		
Quebec	Q	14		
Romeo	R	14		

Vocabulary words and rules for state number 14

Recognition Phrase	Associated Keystrokes	Next State	Set	EOI
Sierra	S	14		
Tango	T	14		
Uniform	U	14		
Victor	V	14		
Whiskey	W	14		
X-ray	X	14		
Yankee	Y	14		
Zulu	Z	14		
Backup	\b	14		
Delete	\d	14		
Space	\s	14		
Dash	-	15		
Tag		16		
Covered		16		
Penetrated		16		
Misc		18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 15 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	E01
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Column		14		
Zero	0	15		
One	1	15		
Two	2	15		
Three	3	15		
Four	4	15		
Five	5	15		
Six	6	15		
Seven	7	15		
Eight	8	15		
Nine	9	15		
Backup	\b	15		
Delete	\d	15		
Tag		16		
Covered		16		
Penetrated		16		
Misc		18		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 16 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
No	NO	16		
Misc		18		
Deficiency	YES	20		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

==> Vocabulary words and rules for state number 18 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EOI
Return		1		
Today is		2		
Inspector		6		
Shield		8		
Floor		10		
Area		12		
Column		14		
Tag		16		
Covered		16		
Penetrated		16		
Misc		18		
Deficiency		20		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	999		

=> Vocabulary words and rules for state number 20 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Return		1		
End of inspection	*** END OF INSPECTION ***	998		
End of report	*** END OF REPORT ***	0		

APPENDIX D:

PROGRESS PAYMENT APPLICATION

FORT MEADE PERCENT COMPLETION APPLICATION SCRIPT

ALPHA, CHARLEY, DELTA, WHISKEY
0-9, DASH
1. CONTRACT NUMBER-----
ANY KEYWORD

JANUARY-DECEMBER
0-9
2. INSPECTION DATE-----
ANY KEYWORD

***** EACH ACTIVITY *****

0-9
3. I NODE-----
ANY KEYWORD

0-9
4. J NODE-----
ANY KEYWORD

0-9
5. STARTED-----
ANY KEYWORD

JANUARY-DECEMBER
0-9
6. FINISHED-----
ANY KEYWORD

0-9
7. PERCENT COMPLETED-----
ANY KEYWORD

8. END OF INSPECTION
9. END OF REPORT (ON LAST REPORT)

KEYWORDS:

CONTRACT NUMBER, INSPECTION DATE, I NODE, J NODE,
FINISHED, STARTED, PERCENT COMPLETED, END OF INSPECTION,
END OF REPORT

* After saying a keyword or question, you may give a corresponding word or answer appearing above the dashed line. Words below the line may be spoken after an entire answer has been given to a question or at any point during inspection.

SUMMARY OF ACTIVITIES

CONTRACT NUMBER: DACA31-86-C-0059

I NODE	J NODE	DESCRIPTION	DOLLARS
2	4	SITE SURVEY & SEDIMENT CONTROLS	20033
3	5	BONDS & INSURANCE	735933
6	8	G.C. MOBILIZE 50%	0
8	10	G.C. MOBILIZE 100%	0
12	14	CONSTRUCTION FENCE 50%	5000
14	16	CONSTRUCTION FENCE 100%	5000
18	20	STABILIZE CONSTRUCTION ENTRANCES	10859
20	22	GRAVEL AT TRAILERS	113000
24	26	SET TRAILERS	98000
26	38	HOOK UP TRAILERS	10000
40	42	U/G MAIN DISTRIB	33900
42	44	U/G MAIN DISTRIB AREA B	33900
46	50	TEMP ELECTRIC	288150
52	54	DRILL F-3 HOLE	7500
68	70	EXC. CRANE PADS	7500
70	72	POUR CRANE PAD 1	20000
72	74	POUR CRANE PAD 2	20000
74	76	POUR CRANE PAD 3	20000
78	80	ERECT CRANE 2	45000
102	104	REMOVE TC 2	30000
106	108	ERECT TC 1	45000

RESEARCH & ENGINEERING PHASE 2
CONTRACT NO. DACA31-86-C-0059

I NODE	J NODE	DESCRIPTION	DOLLARS	%COMPL	VALUE
0	0	ERECT CRANE 2	45000	90	\$40,500.00
1	3	BONDS & INSURANCE	735933	100	\$735,933.00
2	4	SITE SURVEY & SEDIMENT CONTROLS	20033	100	\$20,033.00
6	8	G.C. MOBILIZE 50%	0	10	
8	10	GRAVEL AT TRAILERS	113000	50	\$56,500.00
12	14	G.C. MOBILIZE 100%	0	75	
14	16	CONSTRUCTION FENCE 50%	5000	100	\$5,000.00
18	20	POUR CRANE PAD 1	20000	45	\$9,000.00
24	26	POUR CRANE PAD 2	20000	100	\$20,000.00
46	50	POUR CRANE PAD 3	20000	90	\$18,000.00
90	294	U/G MAIN DISTRIB AREA B	33900	90	\$30,510.00
284	26	HOOK UP TRAILERS	10000	95	\$9,500.00
288	290	U/G MAIN DISTRIB AREA C	33900	90	\$30,510.00
318	3320	TEMP ELECTRIC	288150	75	\$216,112.50
		-----			-----

TOTAL CONTRACT AMOUNT: \$1,344,916

TOTAL VALUE COMPLETED:..... \$1,191,598.50

VOIS Vocabulary Structure
Friday, January 10, 1989

==> Vocabulary words and rules for state number 1 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Contract number	CONTRACTING	5	Y	N
Inspection date	INSP_DATE	10	Y	N
I node	I_NODE	15	N	N
J node	J_NODE	20	N	N
Finished	FINISHED	25	N	N
Started	START	25	N	N
Percent completed	PCT_COMPL	30	N	N
End of report		998		
End of inspection		999		

==> Vocabulary words and rules for state number 5 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	E01
Return		1		
Contract number		5		
Dash	-	5		
Zero	0	5		
One	1	5		
Two	2	5		
Three	3	5		
Four	4	5		
Five	5	5		
Six	6	5		
Seven	7	5		
Eight	8	5		
Nine	9	5		
Alpha	A	5		
Charlie	C	5		
Delta	D	5		
Whiskey	W	5		
Backup	/b	5		
Delete	/d	5		
Inspection date		10		
I node		15		
J node		20		
Started		25		
Finished		25		
Percent completed		30		

==> Vocabulary words and rules for state number 10 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	E01
Return		1		
Contract number		5		
Inspection date		10		
January	01	12		
February	02	12		
March	03	12		
April	04	12		
May	05	12		
June	06	12		
July	07	12		
August	08	12		
September	09	12		
October	10	12		
November	11	12		
December	12	12		
I node		15		
J node		20		
Started		25		
Finished		25		
Percent completed		30		

==> Vocabulary words and rules for state number 12 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Return		1		
Contract number		5		
Inspection date		10		
Zero	0	12		
One	1	12		
Two	2	12		
Three	3	12		
Four	4	12		
Five	5	12		
Six	6	12		
Seven	7	12		
Eight	8	12		
Nine	9	12		
Backup	/b	12		
Delete	/d	12		
I node		15		
J node		20		
Started		25		
Finished		25		
Percent completed		30		

==> Vocabulary words and rules for state number 15 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Return		1		
Contract number		5		
Inspection date		10		
Zero	0	15		
One	1	15		
Two	2	15		
Three	3	15		
Four	4	15		
Five	5	15		
Six	6	15		
Seven	7	15		
Eight	8	15		
Nine	9	15		
Backup	/b	15		
Delete	/d	15		
I node		20		
J node		25		
Started		25		
Finished		25		
Percent completed		30		

==> Vocabulary words and rules for state number 20 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EO1
Return		1		
Contract number		5		
Inspection date		10		
I node		15		
J node		20		
Zero	0	20		
One	1	20		
Two	2	20		
Three	3	20		
Four	4	20		
Five	5	20		
Six	6	20		
Seven	7	20		
Eight	8	20		
Nine	9	20		
Backup	/b	20		
Delete	/d	20		
Started		25		
Finished		25		
Percent completed		30		

==> Vocabulary words and rules for state number 25 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	EOI
Return		1		
Contract number		5		
Inspection date		10		
I node		15		
J node		20		
Started		25		
Finished		25		
January	01	27		
February	02	27		
March	03	27		
April	04	27		
May	05	27		
June	06	27		
July	07	27		
August	08	27		
September	09	27		
October	10	27		
November	11	27		
December	12	27		
Percent completed		30		
End of inspection		998		
End of report		999		

==> Vocabulary words and rules for state number 30 <==

Recognition Phrase	Associated Keystrokes	Next State	Set	E01
Return		1		
Contract number		5		
Inspection date		10		
I node		15		
J node		20		
Started		25		
Finished		25		
Percent completed		30		
Zero	0	30		
One	1	30		
Two	2	30		
Three	3	30		
Four	4	30		
Five	5	30		
Six	6	30		
Seven	7	30		
Eight	8	30		
Nine	9	30		
Backup	/b	30		
Delete	/d	30		
End of inspection		998		
End of report		999		

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