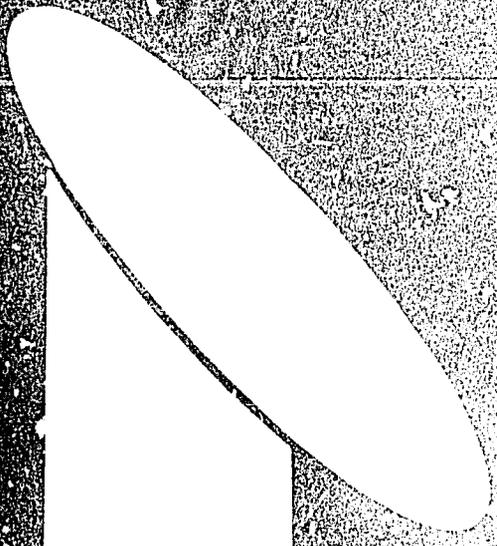


660-0026



**T-CAS**

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Prepared for:

UNITED STATES OF AMERICA  
AGENCY FOR INTERNATIONAL DEVELOPMENT  
Contract No. OTR-000-I-00-1011  
Work Order No. 01

REPORT ON  
INVESTIGATION INTO STATUS AND  
PROGRESS OF THE ONATRA  
TELECOMMUNICATIONS PROJECT  
(KINSHASA-MATADI NETWORK)

ZAIRE TRANSPORT SECTOR LOAN  
660-H-011

May 15, 1981

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## PREFACE

The USAID assignment, which is the subject of this report, required an on-site investigation into the status and the progress of a railway communications project for the National Transport Office (ONATRA) in Zaire, as supported by the USAID through Zaire Transport Sector Loan 660-H-011.

The purposes of the investigation were:

- Determine most effective means of concluding the project.
- Review contractor proposals for procurement and installation (especially as proposals relate to advance planning for railway).
- Assist in negotiation of contracts for above.
- Assist in reviewing contractor billings thus far.

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## SUMMARY

A T-CAS Engineering Specialist, Mr. Herbert E. Dawson, conducted the on-site study from March 18 through April 6, 1981.

The results of the study show that the project is not complete, is not ready for final test and is deficient in installation quality.

The specific conclusions reached were as follows:

- The quality of existing Dispatch and Gare-a-Gare voice circuits is at present poor and signaling is unreliable.
- The 2-wire speech plus telegraph circuits are not operational.
- The VHF base stations are not controlled in accordance with the Specification and full route radio coverage is not possible.
- Good installation practices and workmanship have not been provided.
- The present Contractor has not provided certain aspects of design services and tests, as called out in the Specification.
- Both proposals submitted by the Contractor are unsatisfactory in their present form.

The following options, which are directed at concluding the project, became the recommendations to be considered:

- Terminate USAID participation.
- Accept one or both Contractor proposals (with modifications).
- Upgrade the quality of the installations and complete, connect, and test required services.

### Recommendation

Based upon the conclusion that the most satisfactory method for completing the project is to up-grade and complete the system in accordance with the contract specification, the

## Summary (Continued)

Engineer has recommended that the last option be followed. Portions of one of the present contractor proposals must also be completed by the ONATRA Technical Director and Staff as part of this option. A full plan for this approach is included in the report (Section 6), together with the projected costs (Section 7).

## S E C T I O N 1

### OBJECTIVES AND PREPARATION

In accordance with the technical services requirement for a telecommunications engineer, Project 660-H-011, the objectives were defined as follows:

- a. Determine the most cost effective means of concluding project activities on the railway communications system.
- b. Review contractor proposal for procurement and installation.
- c. Make an assessment of modifications and additions as they relate to ONATRA's forward planning for railroad upgrading.
- d. Assist ONATRA in negotiating a contract for indicated procurement and installation services.
- e. Assist in review of any contract billings for services previously provided.

In preparation for providing these services the following actions were taken:

- a. Attend a briefing session at Motorola, Chicago for the purpose of obtaining information on the railway communications system installed by Motorola. Order No. OTR-8011-0-00-176-00 covered this work.
- b. Review USAID files on Loan 660-H-011 contained in the office of DEO, Mr. Lee Braddock, Kinshasa.
- c. Discuss past and present project activities with Cit. Mwilambwe Kitanda, Director S.E.C., NCCZ/RO Kinshasa.
- d. Visit the telecommunications department repair shop located at the gare, KIN-EST. Ride the rail car (draisine) with Cit. Mwilambwe from Matete to Malanga and inspect the stations at Matete, Kimuenza, Sono-Bata, Kisantu, Lufutoto and Malanga. Observe the operation of the mainline VHF radio system over this section of the route.
- e. Observe the operation of the central dispatch and control facility at ONATRA headquarters in Kinshasa. Visit the electronic equipment installation on the top floor of the ONATRA building.

(It should be noted that Mr. Dawson, the telecommunications engineer assigned by T-CAS, while earlier in the employ of MORCOM Systems, Inc., prepared the bid specification attachments 135-03 through 135-12 for this project.)

S E C T I O N 2  
DETAILS OF INVESTIGATION

2.           Overview

The original objective of the ONATRA telecommunications project was to expand and improve ONATRA's existing communications system serving the railroad from Kinshasa to Matadi. The objective was to be reached by providing U.S. technical assistance, technical and management expertise, material and services.

The expansion would continue their buried cable plant from Lufutoto (half-way down the line) to Matadi. Radio communications facilities connecting their dispatch centers with the locomotives on the mainline were to have provided them with the ability to respond rapidly to emergencies on the line. The addition of port radio in Kinshasa, Matadi and Ango-Ango would allow them direct communications with their yard operations, police, fire and commercial services. All of these activities were to have been connected through the ONATRA telephone switching system allowing access to all points within the Kinshasa-Matadi network.

The extension of the cable to Matadi was to provide more than 24 separate voice channels assignable to dedicated and switched telephone trunks. The switched trunks would terminate on the ONATRA private exchanges in Kinshasa and Matadi. Anyone with dial access to the switch would be capable of calling anywhere else in the network without having to use the P&T services. The cable extension would provide ONATRA with teleprinter channel capacity far in excess of their current requirements. High quality medium speed data circuits would be available for their planned computer system. Record traffic (teleprinter) and data transmission capability are most valuable services particularly when the railroad is a vital link in national commerce.

Unfortunately, few of these objectives have been met. The only cable services that are functioning on a daily basis between Kinshasa and Matadi are the original dispatch and station-to-station telephone circuits. The signaling is still carried on the open wire line between Lufutoto and Matadi. The Baton Pilote communications circuit between Lufutoto and Matadi is now on the new cable.

The quality of the dispatch and station-to-station voice circuits is poor and the signaling is unreliable.

What of the "new" services that were to have been implemented? These are discussed individually in the next paragraphs.

2.1.1       Two Wire Telephone Circuits. These circuits were to have provided the following capabilities:

- a. Two voice plus teleprinter circuits between Kinshasa and Lufutoto.
- b. Two voice plus teleprinter circuits between Kinshasa and M'Banza-N'Gungu.
- c. Two voice only circuits between Lufutoto and Matadi.
- d. Two voice only circuits between Matadi and M'Banza-N'Gungu.

None of these circuits are operational. Two speech plus teleprinter terminals were not supplied by the Contractor. Telephone switch signaling interface equipment is reported not to be available because of non-compatibility between U.S. manufactured signaling converters and European signaling systems. Some terminal modules are defective and no spares were supplied with the equipment.

2.1.2 VHF Radio-Main Line Locomotives to Dispatch. At the present time none of the VHF base stations along the line are controlled in accordance with the specification. The ONATRA technical staff have provided keying and talk circuits on a temporary basis for 9 of the 12 base stations installed on the route. Under the present arrangement full route coverage is not possible.

2.1.3 Cable Carrier System and 18 Channel Telegraph System. This system (Kinshasa-Matadi) is out of service because of repeater failures due to rodent damage. No spares were provided with the system. Some performance measurements were made on the carrier system (1980) by the contractor but not all those required by the specification. The 18 channel telegraph multiplex equipment is defective in Kinshasa.

2.1.4 Port and Shunting Radio Services. The port and shunting radio services are reported to be functioning. No direct observations were made of these services in operation, because of the needs elsewhere and because reports indicated they were satisfactory.

## 2.2 Quality of Installations.

2.2.1 Kinshasa Center. At this facility VHF base stations, power combiners and filters are located in a random fashion around the equipment room. Little consideration has been given for cable routing, lead dress, grounding and workmanship. Interference problems are reported on some channels, supposedly co-channel. There is a good possibility that receiver diplexer or transmitter combiner alignment, along with haywire installation, may be contributing factors to these problems.

2.2.2 Stations Observed Along the Route. At Kimuenza, Sonabata, Kisantu, Lufutoto, Malanga, good installation practice and workmanship have not been provided in the facilities observed. Cable terminations, pair protection, grounding, lead dress, all need rework with particular emphasis on cable termination practice and grounding. The Telephone Engineering and Construction Manuals (TE&CM) of the Rural Electrification Administration (REA) are the standards that should have been used for this work.

### 2.3 System Engineering.

2.3.1 Cable Plant, 16 ga. In undertaking the responsibility for Task 1b of the basic contract, the contractor (with his sub-contractor) was committed to verify by measurement the transmission characteristics of the ONATRA 16 ga. quad and paired cable in place between Kinshasa and Lufutoto. The results of the tests were to have been included in a test report and submitted to ONATRA. If at that time it was indicated by measurement that the cable would not provide transmission capability in accordance with the specification, corrective methods could have been developed or alternate transmission methods could have been considered. The measurement program was essential because the success of the specified control system for the mainline VHF radio depended upon acceptable quality of the assigned loaded pairs.

The contractor or his sub-contractor did not perform and document these tests as called for in the specification. These requirements are called out in the specification on pages 36, 51, 63, 64.

2.3.2 Cable Plant, 19 ga. With regard to the 19 ga. 25 pair cable installed between Lufutoto and Matadi, there appears to have been no engineering performed on trunk design except that provided by Lenkurt Electric for the 46B system. There is absolutely no way that 186 kilometers of telephone cable with multi-drops and hybrid terminations can be installed underground and be expected to perform satisfactorily without careful planning and design in accordance with standard practice. This applies equally to electrical design requirements and direct burial procedures and practices.

The specifications called for " furnish, install, and test equipment meeting the enclosed specifications and in accordance with the attached instructions." The "attached instructions" are implicit in their requirements for the contractor to provide impedance matching design, all material, test equipment and supervision required for the correct installation of the cable. Complete testing and documentation of results were required by the specification. The specification calls for a working system which includes quality goods and services.

2.3.3 Compliance with Specifications. From the records available and the status of the present system, the contractor

did not provide the services and tests as called for in the specifications. These requirements are called out on the following pages of the specification: 70, 71, 72, 78, 87. Appendix A summarizes the bid specifications as a basis for this conclusion.

With regard to the quality of installation, the contractor was required to provide workmanship and installation practices reflecting good commercial standards. In addition, "The contractor as directed by the purchaser or the purchaser's inspector shall correct any installation deficiencies prior to subsystem testing." These requirements were explicitly referenced to Tasks 2, 3, 4, 5 and 6 of the basic contract.

## S E C T I O N    3

### REVIEW OF CONTRACTOR PROPOSALS AND ANALYSIS OF BILLINGS

3.1        Contractor Proposals. The required review of the contractor proposals for procurement and installation, produced the following conclusions. Acceptance of the proposals is not recommended for the specific reasons stated in Appendix B. The quoted material and labor price is \$166,763.50 for both proposals.

The reviews of these two proposals for gare-à-gare signaling and Lenkurt Electric terminal equipment--are provided in full detail in Appendix B.

3.2        Review of Billings. The review of known contract billings is presented here:

3.2.1.     The contractor has apparently claimed \$31,625 for costs involved in setting up the 2-wire test circuit in Schaumburg, IL. In the opinion of the Engineer this cost should be absorbed by the contractor. Paragraph 2.12, page 7, of the bid specification would appear to cover set-up and demonstrations of equipment by the contractor.

3.2.2     With reference to the message addressed to Mr. DeWilde, Controller General, ONATRA, dated 11 December 1980, the billing for the amount \$43,708.74 represents the costs for two contractor personnel. Their purpose in Zaire was to align and test the 46B cable carrier system between Kinshasa and Matadi. It would appear that this billing is for services that were included in the original contract price. In addition, the testing that was accomplished did not cover all the test requirements for the cable carrier system as required by the bid specification. ONATRA has already requested that all tests called out in the bid specification be completed before formal acceptance is made. Payment for this invoice would set a precedent for each trip the contractor had to make to do work that was actually required and covered by the basic contract.

3.2.3     It should be noted that any claims for delay by the contractor because of moisture in the existing 16 ga. cable are not on firm ground. If the contractor had initially performed and documented the tests on the existing cable as called for in the bid specifications, moisture problems and other faults would have been identified early in the program. Corrective action could have been taken well before the installation of the cable and other line equipment.

3.2.4     The assignment also required the Engineer to assist ONATRA in negotiating a contract for indicated procurement and installation services. Since the procurement and installation services proposed by the Contractor are not recommended by the Engineer (in accordance with the review contained in Appendix B), contract negotiations were not required.

## S E C T I O N 4

### FORWARD PLANNING CONSIDERATIONS

This portion of the Engineering assignment specified assessment of modifications and additions as they relate to ONATRA's forward planning for railroad upgrading.

4.1 Based on the discussions with the Director, SNCZ/RO, Cit Mwilambwe, it was learned that a feasibility study for electrification of the railroad has been completed by a German consulting firm. It is also understood that the next project phase will include a field survey by experts from a Belgian consulting firm. The objective of the survey is to obtain sufficient data to generate the bid specifications for the electrification project. The survey team is to include a telecommunications expert who will evaluate the existing and planned requirements for ONATRA's telecommunications. The team is scheduled to arrive in approximately one month according to Cit. Mwilambwe. It was reported that the project would be financed from Belgium and/or French sources.

4.2 It is the opinion of the Engineer that the quality of the existing cable and electronic system installation along the route is not adequate to guarantee trouble free operation now, let alone operation after electrification. The electrification project will take several years for implementation. The existing telecommunications system, if upgraded and completed, as recommended in Section 6, would serve the railroad throughout that period with adequate capacity to provide additional control and telemetering services for the electrified system.

## S E C T I O N 5

### RECOMMENDATIONS

#### 5.1 First Objective.

This was to determine the most cost effective means of concluding project activities.

The project review has disclosed that the project is not complete, is not ready for final test, and is seriously deficient in installation quality. The customer's requirements are not being met.

#### 5.2 Options/Approaches

T-CAS has considered the following approaches or recommended options to concluding the project. They are:

- a. Terminate AID participation.
- b. Accept one or both hardware and installation proposals submitted by the Contractor (Proposals A & B).
- c. Up-grade the quality of the installation to meet accepted standards; complete, connect and test required services.

A fourth approach was suggested by the T-CAS Engineer: replace the existing system with a coaxial cable system. This approach, while technically sound, is prohibitively expensive and therefore will not be discussed further as a feasible alternative.

Considerations for each of the approaches/options are as follows:

a) Terminate AID Participation This approach will be least expensive but will leave ONATRA with a system that is not complete and will not provide the services for which it was planned. The project in its present state is a poor advertisement for U.S. technical assistance.

b) Accept One or Both Proposals Submitted by the Contractor Both proposals are discussed in detail in Appendix B. Proposal A is for gare-a-gare signaling conversion. This is an addition to the original scope of work but is quite essential to place the dispatch and gare-a-gare circuits on the new cable. For reasons stated in the Appendix, acceptance of this proposal is not recommended.

Proposal B can be made technically acceptable with the addition of several requirements as developed in the Appendix. However, provision of additional multiplex facilities at Lufutoto in order to free two physical pairs for use as radio control circuits will not complete the system with regard to circuit terminations, completion and testing of services or installation quality. For reasons stated in the Appendix, acceptance of this proposal is not recommended.

c) Upgrade the Quality of the Installation to Meet Accepted Standards, Complete, Connect and Test Required Services.

It is the opinion of the T-CAS assigned Engineer that any addition of electronic hardware to this system in its present condition is a waste of money. What is needed are fundamental improvements to the quality of installation, and the services originally planned must be correctly terminated and made functional. If this work is accomplished, certain test and power supply improvements can be added to facilitate maintenance routines and to improve reliability. A plan for this work is contained in the next section.

5.3 Recommendations: Upgrade

The last option as discussed represents the recommendation of the Engineer: the system should be upgraded in the manner described in the plan provided in Section 6. This includes work by the present Contractor and work by the ONATRA Technical Director and Staff.

## S E C T I O N 6

### IMPLEMENTATION PLAN FOR UPGRADE

6.1 Site Survey and Development of Statement of Work. A consulting Telecommunications Engineer will be required to prepare for the Customer a definitive, statement of work for tasking the Contractor. The consultant shall be made available throughout the "upgrade" to inspect and verify that the work is being performed in accordance with requirements. The consultant shall provide written status reports to AID on a schedule to be arranged.

The consultant shall perform a survey of each site and station included in the ONATRA telecommunications system. His work shall include but not be limited to the detailed tasks discussed in the following paragraphs.

6.1 Test Board Integration. Determine the best method for integrating test boards at each site. Kinshasa and Matadi should have line test facilities with test jacks configured in standard telephone practice. Other sites should have test facilities allowing technician to plug-in transmission test set at known level and impedance point. Prepare line diagrams showing the configuration. Show the physical location of test facility.

6.1.2 Punch List. Prepare a punch list for each site. The items covered will include the following:

- a. Power ground and equipment grounds are to be physically separated until joined at one ground rod. The absolute shortest runs of not less than #6 AWG are to be provided. Solid copper ground bus is to be provided in each rack. The rack frame will not be used as a ground conductor. Solid grounding for radio will be provided and tower grounding will be verified.
- b. Correct gas tube arrestors and cable termination assemblies must be specified. Termination blocks and arrestors are to be located in best manner to achieve the shortest ground and cross connect routing.
- c. The best method for lead dress is to be recommended. Separate signal and power wiring will be specified. Specify physical protection of wires and cables as required.
- d. Battery back-up is recommended. Design must show physical location and size for capacity. At least 8 hours reserve for cable system should be specified.

- e. With regard to the Kinshasa headquarters (and Matadi), all of the above items plus a professional installation of the VHF base stations and accessories are required.
- f. At all locations where VF and teleprinter circuits terminate, it must be determined in conjunction with the customer, where the wire terminations for customer supplied equipment shall be located. The wiring route and method must be described. Sign-off for each termination arrangement from the customer must be obtained.
- g. During survey, inventory of equipment installed is to be taken. This must be correlated with project requirements.
- h. Verification of performance of dual diesel engines must be made.

6.1.3 A Bill of Materials required for upgrade of each site must be provided. The Engineer can perform this work in Kinshasa, with reference material brought from the U.S.

6.1.4 A statement of Work is to be prepared for each site. All work is to be in accordance with referenced REA, NEC and EIA practices and standards.

6.1.5. Quality assurance inspection procedures are to be prepared as well as performance test plan requirements.

6.1.6. The Bill of Materials, Work Statements and Test Requirements must be assembled into a package. The Task Contractor is to follow the instructions and complete the job.

6.1.7. A solicitation for spare parts from manufacturers is to be prepared as the final document.

## 6.2 Notes to Implementing Plan.

6.2.1. There are 43 railroad sites including M'Banza-N'Gungu. The best way to cover the track is by Draisine equipped with sleeping bag and some canned food. The 38 small stations could be documented in about 7 days. Kinshasa would take at least 3 days; Lufutoto, and M'Banza-N'Gungu, one day each; Matadi, 2 days including Ango-Ango. Total estimated time is two weeks on the road, plus two weeks to prepare work package. Probably 5 weeks for project should be allowed. ONATRA should provide the Draisine and test technician to accompany the Engineer.

6.2.2. The contractor must guarantee that he will supply one qualified Cable Completion Engineer having the capability to measure and treat loaded physical pairs. The Engineer must be

assisted by a qualified technician capable of transmission testing, equipment installation and alignment. These specialists would measure and treat pairs as required. They would install and align 2 wire VHF radio control and talk, circuits and would provide final level coordination for all services. They would be responsible for documentation for maintenance purposes. They will verify performance of all VF repeaters. This team should arrive after the completion of installation "up-grade" as proposed.

6.2.3 The contractor shall supply a qualified Installation Supervisor and at least one 2-man team of skilled installers (craftsmen). Two teams would be preferred, but real problems may occur in trying to coordinate their transportation on the track.

6.2.4 The method of shipping materials would have to be determined after completion of the Bill of Materials. It would be preferable if the material came by air along with the assigned installation people.

6.2.5 It is estimated that the work in Kinshasa Center would take two weeks; Mata-di and Ango-Ango would take two weeks, with each station averaging one day. The total estimated duration of time for the 3-man installation crew is 3 months.

6.2.6. The total estimated time for the Cable-Completion Engineer and the technician for radio control and talk system installation and alignment, plus level coordination and documentation, is 5 weeks.

6.2.7. The provisioning of spare parts for the system and the factory training for selected technicians are essential for satisfactory operation and maintenance of the system.

S E C T I O N 7

COST ESTIMATES FOR SYSTEM UP-GRADE

The following cost estimates have been prepared for this work:

a.	Consulting Engineer for 5 weeks:	@350/day	12250
	Transportation	@1500	1500
	Living expenses	@100/day	3500
			<u>17250</u>
	Continuing Activity on program -- 4 weeks:	@350/day	9800
	Transportation	@1500 X 3	4500
	Living expenses	@100/day	2800
			<u>34350</u>
b.	3-man installation team for 90 days:	@320/day X 3	86400
	Transportation	@1500 X 3	4500
	Living expenses	@100/day	27000
			<u>117900</u>
		+25%	<u>24475</u>
		Subtotal	<u>147374</u>
c.	2-man telephone team for 5 weeks:	@320/day X 2	22400
	Transportation	@1500 X 2	3000
	Living expenses	@100/day	7000
			<u>32400</u>
		+25%	<u>8100</u>
		Subtotal	<u>40500</u>
		Total Labor	222225
d.	Material & shipping (estimated)	@avg 1500/ site X 43	<u>64500</u>
		Total Job	<u><u>286725</u></u>
e.	Training - ONATRA to factories @ no cost		-0-
f.	Spares, adequate provisioning		100,000

## APPENDIX A

### SUMMARY OF BID SPECIFICATION CONTRACTOR REQUIREMENTS

(ONATRA TELECOMMUNICATIONS REPORT, LOAN 660-H-011)

The specification required that "qualified manufacturers-suppliers" submit bids "to furnish, install, and test equipment meeting the enclosed specifications and in accordance with the attached instructions." The "attached instructions" included the following delineations of responsibilities:

1. ONATRA will be responsible for carrying out certain work as described in this IFB. However, the contractor will be responsible for ultimate system performance. (P.24)
2. The layout design includes the placement of repeaters in the railway stations where possible. Repeaters located outside existing stations will be installed in enclosures which provide both weather and security protection. (P.34)
3. The contractor will provide skilled manpower to splice the cables and install the loading coils. The contractor shall inspect all the cable installation, including the routing of cable ends, locations of repeaters and voice frequency amplifiers and shall advise ONATRA regarding procedures involved in the cable installation. The contractor shall ring out, measure and test all pairs belonging to ONATRA in the existing buried cable, and all pairs in the new cable, before and after installation. (P.36)
4. Testing by the contractor is required of the 24 ONATRA pairs located in the existing 46 pair buried cable from Kinshasa center to Lufutoto, for proper transmission performance. (P.51)
5. Furnishing, installation, and placing in service, by the contractor, of the following equipment (P-52):
  - a. Speech plus duplex equipment for simultaneous operation of VF dial and teletype circuits: five at Kinshasa Center, one at M'Banza N'Gungu, one at Lufutoto, and three at Matadi.
  - b. Dial pulse converters: 50 Hz to E and M and vice versa, for five two-way dial circuits at Lufutoto and Matadi.
  - c. Testing and placing in service of one VF 4-wire circuit for data transmission from Matadi to the computer at the Kinshasa Center.

6. The contractor will be responsible for the performance of these tests: (P.63)
  - a. Testing of the existing buried cable: the 24 ONATRA pairs; one carrier pair and 23 pairs quadded, of which 13 are loaded and 10 non-loaded.
  - b. Four selected non-loaded pairs will be tested and repaired as needed for the transmission of high frequency signals in the 12 channel and 24 channel carrier frequency band.
7. The pairs in the existing buried cable will be checked by the contractor for the following characteristics:
  - a. Insulation, resistance, leaks in the cable (pressure test), split-up pairs, loop resistance, deviation in resistance tip and ring, overall net loss, characteristic impedance, and cut-off frequency for loaded pairs.
  - b. Capacitance: pair tip to ring, pair to pair, pair to cable lead shield, longitudinal balance, far end crosstalk, impulse noise, and crosstalk between pairs selected for cable carrier.
  - c. The conditions of cable terminations on terminal blocks at each station with respect to: reflection, loading characteristics, and impedance matching of the existing repeat coils.
  - d. Interference from ONATRA circuits: dispatcher, baton pilote, etc.
  - e. Interference from PTT circuits via the remaining 22 pairs.
8. The contractor will submit a report of the results of the cable tests, together with records, giving location of repeat coils, splices, transposition of pairs (if any), etc., normally available at long distance outside plant section. The contractor will furnish his own test equipment. (P.64)
9. The contractor will furnish and install all of the electronic equipment: repeater, power converters, multiplex equipment, test equipment, as specified herein. The contractor will also make all of the electrical cable connections: splices, loading coils, terminal boxes, lightning protectors, grounding, etc. (P.70)
10. The contractor will inspect, splice test, and place in service the new 25-pair cable described in attachment

135-02, "Multipair underground cable." Before installation, the contractor will inspect the cable reels for damage, and will test each cable electrically. (The cable will be supplied in 3,000 ft. lengths per reel). A report on these tests will be submitted to the ONATRA engineer. (P.70)

11. Cable building-out networks will be located at the terminal locations as required. Repeat coils will be provided as required. These items will be supplied by the contractor. (P.70)
12. Testing of the installed cable has requirements as follows: (P.71)
  - a. The contractor will submit a report of the results of the cable tests, together with records giving the locations of loading coils, splices, transposition of pairs (if any), etc., normally available at long distance outside plant sections.
  - b. The contractor will furnish his own test equipment. (P.72)
13. Circuit transmission requirements--for the cable carrier. (P.78)
14. The bidder should inspect this attachment, and should include in his proposal any additional hardware and accessories which will be required by ONATRA in installing this cable. (P.87)
15. The contractor will be responsible for the following:
  - a. Furnish, install, test and place in service mainline base stations, antennas, transmission line and connectors, 2-wire/4-wire connections and line treatment equipment at 12 trackside locations between Kinshasa and Matadi.
  - b. Furnish, install, test and place in service 20 mainline locomotive mobile radios, antennas, and transmission line.
  - c. Furnish, install, test and place in service mainline dispatch consoles and terminations, at Kinshasa and Matadi.
  - d. Furnish tower assemblies.
  - e. Furnish generator assemblies.
  - f. Conduct system acceptance testing on the installed VHF radio system in the following manner:.

- g. The contractor shall install, integrate and test all equipment that constitute the VHF radio and paging systems (with the exception of the ONATRA installed engine-generators and towers). The contractor shall supply tools, materials, spare parts and test equipment necessary to accomplish the work. Workmanship and installation practices shall reflect good commercial standards. The contractor, as directed by the purchaser or the purchaser's inspector, shall correct any installation deficiencies prior to subsystem testing. Testing shall be conducted during work days, when ambient noise conditions are normal. These requirements are applicable to Tasks 2, 3, 4, 5 and 6.
16. The contractor will be responsible for the following:  
(P.90)  
Furnish, install, test and place in service all requirements for shunting locomotive VHF systems, Tasks 3 and 4.
17. The contractor will be responsible for the following:  
(P.91)  
Furnish, install, test and place in service all requirements for Port VHF and paging systems Tasks 5 and 6.

## APPENDIX B

### REVIEW OF CONTRACTOR PROPOSALS

#### ONATRA TELECOMMUNICATIONS REPORT LOAN 660-H-011

PROPOSAL A. Gare-a-Gare Signaling, submitted under cover letter to USAID, 25 March 1980.

The bid specification did not require the contractor to provide in-band signaling for the Dispatch circuits and Gare-a-Gare circuits. At the present time the pulsed signaling is carried on the 16 ga. cable to Lufutoto where these circuits are then carried on the open wire lines to Matadi. The higher loss of the 19 ga. cable and lack of pulse repeaters on this section prevent using the new cable for dispatching and gare-a-gare signaling circuits. ONATRA requested that the contractor submit a proposal for providing tone coded signaling and 4-wire telephones for these circuits. The original proposal was submitted 5 January 1979 with the latest revision dated 17 March 1980. The material cost was quoted as \$54,906.50 and the estimated cost of installation supervision was \$19,256.00.

The technical proposal has been reviewed and contractor personnel responsible for the proposal have been queried. The communications requirements of ONATRA with regard to dispatch and gare-a-gare circuits have been reviewed and are understood.

The contractor does not guarantee an operating system and there are enough disclaimers and contract conditions tied to the offer to make the offer invalid as a fixed price job.

The following comments are applicable:

- a. The WABCO DTMF encoder/decoders proposed are no longer manufactured. The product line was sold to SAB Harmon in Grain Valley, Missouri. No response was received from this manufacturer when requested to provide information and budgetary quotes on the units. Alternate sources are available.
- b. The station telephones proposed by the contractor were stated to be GTE/AE local battery model L8308-B2 which was defined as a 4-wire telephone to be high impedance bridged across the 4-wire loaded pair at the station drops. AE-Chicago stated that the proposed telephone set is an obsolete model. It could be manufactured on special order. It is a 2-wire, not a 4-wire, telephone as stated by the contractor.
- c. The bill of material submitted by the contractor did not include high impedance bridging equipment.

- d. All decoders, encoders for answerback and telephone require voltage for operation. Approximately twelve stations will require battery for this equipment. Proposed batteries are rechargeable with a projected recharge cycle of 3 weeks as a requirement.

Recommendations:

The conclusions reached and the recommendations presented are based upon:

- a) The current condition of the system.
- b) The content and terms of the Contractor proposal.
- c) The fact that the ONATRA technical director, with his staff, is most capable of handling this modification to the system.

The recommendation is made that ONATRA obtain from stock or procure through their purchasing department sufficient high impedance bridging units equivalent to those used on the Kinshasa-Lufutoto section. These units would then be installed on the Lufutoto-Matadi section. Also ONATRA should procure from the U.S. or European sources the coded selectors, detectors and answerback equipment. Some technical data on the encoding and decoding equipment has been provided to the director. Additional specifications and applications information can be mailed to him by T-CAS, Inc. via the pouch at no charge. List price information will also be provided with the technical data.

PROPOSAL B. Lenkurt Terminal Equipment, submitted under cover letter to USAID, 25 March 2980

Resulting from his inability to implement the 2-wire VHF control circuits, as required by the specifications, the contractor has submitted (at ONATRA's request) a proposal to provide a twelve voice channel drop and insert capability at Lufutoto. This approach will theoretically free two loaded pairs for use in implementing 4-wire control circuits for the VHF main-line radio system.

The proposal can be considered technically acceptable, provided the following requirements are added:

- a. The equipment rack shall be wired and equipped with suitable terminal blocks for 6-wire terminations. A 6 AWG (minimum) solid copper ground bus, installed in a workmanlike manner, shall be mounted in the rack. The ground bus shall be mounted on the left rear vertical support channel and shall run from top crossbar to base flange. The bus will be mounted to allow individual solder

connection of 18 AWG shelf or chassis ground conductors. A suitable copper lug shall be provided for connection of 4 AWG to station ground. The terminal assembly shall be racked, wired and tested in the factory prior to shipment.

- b. Upon completion of the installation (including power, signal and ground connections), alignment and level coordination of the modified 46B terminals at Lufutoto by the contractor, end-to-end voice teleprinter and signaling tests shall be performed in both directions of transmission at the 4-wire terminations of the 12-channel through-group between Kinshasa and Matadi. The same tests shall be performed in like manner on the 12-channel groups between Matadi and Lufutoto and between Kinshasa and Lufutoto.
- c. Voice frequency measurements shall be conducted by the contractor and shall consist of the following:

TEST	OBJECTIVES	
	MATADI-LUFUTOTO KINSHASA-LUFUTOTO	MATADI-KINSHASA
Attenuation	300-3000Hz	Same
Distortion	-1.5 to +4.0 dB 500-2800Hz -0.5 to+2.0 dB	
Harmonic Distortion	Harmonics of a 740Hz sinewave test tone shall be 40 dB or more below the fundamental.	Same
Channel Frequency Stability	Maximum Frequency error within any channel shall not exceed <u>+2Hz</u>	Same
Net Loss Stability	Not to exceed <u>+1.5dB</u> , 1000 Hz for 24 hours	Same
Idle channel noise Compandered, 4 wire	Not to exceed 26dB <sub>r</sub> NCO	Not to exceed 29dB <sub>r</sub> NCO

- d. Signaling tests shall be performed on each 4-wire plus E and M circuit in both directions of transmission. The tests shall demonstrate satisfactory SF and E and M performance.

The contractor quoted costs (17 March 1980) for "Terminal equipment (CIF Kinshasa)" result in a total of \$70,761.00. Over and above this, the "Terminal equipment optimization, and acceptance testing total" is given as \$18,370.00

For a hardware cost comparison of these charges, a quotation on a per unit basis was requested from GTE Lenkurt. (This is provided at the end of this Appendix as an attachment.) The total cost of the hardware proposed FOB manufacturer is approximately \$45,000. To this amount, add 7% for options and factory testing and 10% for shipping. The estimated cost of the hardware delivered in Kinshasa would be approximately \$53,000 without contractor mark-up.

It is not clear from the most recent contractor quotation whether or not:

- a. Factory testing has been included
- b. Labor costs include installation by the contractor or supervision of ONATRA personnel by the contractor.
- c. Guaranteed performance is part of a fixed price contract.

The original terms and conditions for the signaling system contained many requirements for system operation and support which presumably are also part of the terminal equipment offer. For this reason, in the opinion of the Engineer, this offer is invalid as a fixed price job.

#### Recommendations:

The addition of this hardware does not correct existing installation deficiencies or complete the facilities as originally called for in the specification. In fact, if this system were installed there would still be additional hardware required to correctly bridge the VHF base stations on the 4-wire circuits. Acceptance of this proposal is not recommended.

In addition, the installation of a multiplex terminal in Lufutoto to provide 12-voice channel drop and insert capability will theoretically free two loaded pairs between Kinshasa and Lufutoto for use in implementing 4-wire control circuits for the VHF mainline radio system.

ATTACHMENT TO APPENDIX B

Communications  
Transmission Systems

T-CAS  
7115 Leesburg Pike  
Falls Church, VA 22043

March 6, 1981

ATTENTION: Mr. Frank McCutchen

SUBJECT: GTE Lenkurt Quote RAD 3-6-81  
46B-37040 Cable Carrier System

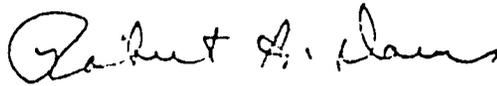
Gentlemen:

GTE LENKURT is pleased to submit the attached quote for your review and consideration.

Please note we have quoted prices on a per unit basis only. Should you select to use the 46B System certain options have not been defined, also the quantity of channel shelves and channel units.

Please advise me if I can offer any added information. Shipment will be approximately 180 days after receipt of order. F.O.B. San Carlos, California. Terms are net 30 days.

Very truly yours,



Robert A. Davis  
Staff Communications Engineer

RAD/slm

Attachments

NAME <b>T-CAS</b>	DATE <b>March 6, 1981</b>	PAGE <b>1</b>
ADDRESS <b>7115 Leesburg Pike</b>	ATTENTION <b>Frank McCutchen</b>	
REFERENCE <b>Falls Church, VA 22043</b>		

ITEM	QTY	DESCRIPTION	PRICE	
			UNIT	TOTAL
<u>46R-37040 CABLE CARRIER SYSTEM</u>				
1	1	41316-01 Channel Equipment Shelf	\$ 1,090.00	
2	1	41318-01 Dual Channel Regulator Shelf	165.00	
3	1	41300-01 Line Group Shelf	228.00	
4	1	41320-01 Frequency Supply Shelf	228.00	
5	1	41333-01 Frequency Distribution Shelf	146.00	
6	1	41350-01 Group Connector Shelf	93.00	
7	1	41359-01 Filter Mod Unit	192.00	
8	1	41323-01 64/4 kHz Divider Unit	114.00	
9	1	41324-01 Harmonic Generator	228.00	
*10	1	41325-XX Filter Unit	47.00	
*11	1	41326-XX Filter Unit	63.00	
12	1	41328-01 Filter Unit	138.00	
13	1	41335-01 Pilot Combiner Unit	63.00	
14	1	41351-01 Group Attenuator Unit	33.00	
*15	1	41353-XX Group Alarm Unit	100.00	
16	1	41354-01 Carrier Filter	268.00	
17	1	41319-03 Dual Channel Regulator Unit	262.00	
18	1	41356-01 96 kHz Blocking Filter Unit	70.00	
19	1	41334-01 Frequency Distribution Unit	63.00	
*20	1	41327-XX Pilot Regulator Unit	111.00	
21	1	41361-01 Compandor Unit	125.00	
*22	1	26523-XX Channel Transmit Unit	282.00	
*23	1	26522-XX Channel Receive Unit	309.00	
24	1	41301-01 Line Group Unit	240.00	
25	1	41302-01 Line Group Unit	240.00	
26	1	41303-01 Attenuator Unit	63.00	
27	1	41304-01 Line Regulator Unit	159.00	
28	1	41305-01 Line Term Unit	296.00	
28.1		Optional Codes A or B	17.00	
28.2		D-H or J	24.00	
29	1	41306-01 Group Demod Unit	214.00	
30	1	41307-01 Group Mod Unit	192.00	
31	1	41309-01 Phase Lock Filter	290.00	
32	1	41311-01 Group Receive Carrier Unit	153.00	
33	1	41310-01 Pilot Filter Unit	100.00	
34	1	41315-01 Group Transmit Carrier	138.00	
35	1	41340-01 Power Distribution Shelf	302.00	
36	1	41341-01 DC to DC Converter	201.00	
37	1	41342-01 -31V Regulator Unit	131.00	
38	1	41343-01 -40V Regulator Unit	153.00	
39	1	41344-01 Repeater Power Control	70.00	
40	1	1189A-01 SF Tone Shelf	80.00	
41	1	31051-00 6 Foot Self Supporting Rack	143.00	

THIS QUOTATION IS SUBJECT TO CONDITIONS PRINTED ON THE REVERSE SIDE.

5 COUNTY ROAD, SAN CARLOS, CALIFORNIA 94070 • 415 555 2000

WHEN ORDERING, PLEASE REFER TO

Quotation No. 57

PAGE 1

NAME  
E-CAS

DATE  
March 6, 1981

ADDRESS  
7115 Leesburg Pike

ATTENTION  
Frank McCutcheon

REFERENCE  
Falls Church, VA 22043

ITEM	QTY	DESCRIPTION	PRICE	
				UNIT
<u>46B Continued</u>				
42	1	1160A-01 2600 Hz Oscillator Unit	\$	129.00
43	1	1161A-01 SF Supply Alarm Unit		66.00
44	1	1199A-01 Signaling Shelf		442.00
45	1	1100A-01 SF Converter Unit (48V)		164.00
46	1	11C2A-02 2W E&M Interface Unit		180.00
47	1	41324-01 Harmonic Generator		228.00
48	1	41353-XX Group Alarm Unit		100.00
49	1	41319-XX Dual Channel Regulator Unit		262.00
50	1	41327-XX Pilot Regulator Unit		111.00
51		<u>353A Order Wire</u>		
51.1		35300-19 Order Wire W/DTMF (600 OHM)	\$	928.00
51.2		149-50440-02 Hand Set		37.00
51.3		087-56804-02 Sub Assembly		315.00
51.4		087-56912-01 Sub Assembly		315.00
51.5		087-57076-01 DTMF Signal Unit		330.00

\*NOTE: XX indicates options that must be identified.

THIS QUOTATION IS SUBJECT TO COMPANY POLICY AND DOES NOT CONSTITUTE AN OFFER