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# **FINAL EVALUATION ZAMBIA RAILWAYS PROJECT**

(Project No. 690-0231)

**United States Agency for International Development  
Lusaka, Zambia**

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**USAID Contract: PDC-0249-I-00-0019-00**

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## **EXECUTIVE SUMMARY**

The objectives of this report are to assess:

- The overall economic benefits derived from the \$10.225 million locomotive rehabilitation project;
- The efficiency and effectiveness of the spares procurement process and workshop operations;
- The degree of achievement of project outputs; and
- The level of achievement of the overall project purpose as defined by the World Bank "to increase the efficiency of operations of Zambia Railways."

To acquire project information, the Consultant held discussions with USAID staff in Lusaka and spent several days at Zambia Railways (ZR) headquarters and main shop facilities in Kabwe. Discussions were held with senior ZR staff, observations were made of current workshop procedures, first-hand assessments were made of the workmanship of the rehabilitated locomotives and relevant comparative financial and operational statistics were developed for ZR. A complete list of individuals contacted is shown in Appendix G.

Evaluations of the results of the rehabilitation program were made in accordance with the criteria set out in the Terms of Reference for the project, the Project Paper as well as with additional criteria identified by the Consultant.

### **Project Results**

The Project Paper identified expected accomplishments of the locomotive rehabilitation as: (1) locomotive availability rate of 75 percent; (2) wagon availability to reach 90 percent; (3) average locomotive utilization of 105,000 kilometers per year; and (4) average wagon productivity to be 300,000 net tonne/kilometers per available wagon per year. Actual results of the program showed that the locomotive availability target was met with an average rate of 75.5 percent for the USAID locomotives for the 15 month period from January 1991 through March 1992. Wagon availability was 92 percent for 1990/91. The locomotive utilization target was not met. USAID locomotives ran an average of 207 kilometers per day for the 15 month period from January 1991 through March 1992, resulting in only 75,555 kilometers per year. Regarding wagon productivity, there were 308,680 net tonne kilometers per wagon in the 1990/91 financial year. These expected accomplishments and actual achievements are summarized in Table ES.1.

The Consultant identified an additional method of comparing the performance of the rehabilitated locomotives with the total ZR fleet. This method compared the locomotive availability percentage and kilometers between failures for the USAID rehabilitated units with the total ZR fleet, on a monthly basis from January 1991 through March 1992. Fifteen month average availability rates and kilometers between failures were computed for the USAID units and the total ZR fleet. Results showed that the USAID locomotives experienced availability rates 25 percent higher than the total ZR fleet, and the kilometers between failures indicated a 46 percent improvement.

**Table ES.1**

**ACHIEVEMENT OF EXPECTED ACCOMPLISHMENTS**

<b>Accomplishment</b>	<b>Target</b>	<b>Actual (1991)</b>	<b>Achievement (Yes/No)</b>
Locomotive Availability	75%	75.5%	Yes
Wagon Availability	90%	92%	Yes
Locomotive Utilization	105,000 km	75,555 km	No
Wagon Productivity	300,000 tkm	308,686 tkm	Yes

It is the Consultant's opinion, however, that the project's results will likely not be sustainable due to inappropriate project design and execution. USAID should have exerted more control and oversight during the process of locomotive selection, identification of specific rehabilitation work to be done, and ensuring that the work was carried out to acceptable and consistent standards.

**Evaluation of Project Implementation**

The Consultant found that the decisions made regarding the locomotives selected for rehabilitation and the extent of the rehabilitation for each locomotive, were not done in a consistent manner. In many cases, used or rehabilitated parts were applied to critical areas where replacement with new components was necessary. These instances were caused by decisions made at the ZR shop and not related to the quality problem experienced with certain suppliers. The results of these practices were locomotive failures soon after rehabilitation, and several locomotives experiencing repeated failures, far in excess of reasonably expected results after a rehabilitation.

One significant deficiency was the absence of a USAID-sponsored technical specialist on site during the initial selection of locomotives and the decision on work to be performed. This would have ensured more strict control over quality of the rehabilitation.

Other shortcomings in the ZR maintenance and overhaul procedures include the high percentage of locomotives which are overdue for inspections and the practice of bringing locomotives in for periodic inspections only if performance indicates an apparent problem. This practice effectively negates any positive preventive maintenance program.

Based on analyses of first failures on several of the USAID rehabilitated units, there are strong indications of inadequate running repairs to support the rehabilitation as well as a less than effectively executed rehabilitation program.

An economic analysis was undertaken to evaluate the costs and benefits of the project. The benefits were represented by the reduction in the need to hire Spoornet locomotives, with the increased availability of the USAID-rehabilitated fleet. Results of the economic analysis are shown in Table ES.2.

**Table ES.2**

**ECONOMIC ANALYSIS OF THE PROJECT**

<b>Economic Criteria</b>	<b>Result</b>
Internal Rate of Return (IRR)	16%
Cost/Benefit Ratio (C/B)	1.06
Net Present Value (NPV)	.753

**Recommendations**

While most of the specific availability and utilization targets were met, it is the opinion of the Consultant that these improvements will not be sustainable unless specific actions are taken by Zambia Railways mechanical department staff. These specific actions include the following:

- Periodic maintenance procedures should be strictly followed. Based on the Consultant's investigation of repeated failures of the USAID rehabilitated fleet, it appears that the periodic maintenance program is out of control. Repeated failures by the same locomotives and chronically late scheduled maintenance and inspections are indicators of this condition; and
- The ZR practice of excessive idling of locomotives should be eliminated. With units generating few annual kilometers, the long idling time causes excessive engine damage and can be readily eliminated by applying the appropriate procedures for starting.

## **PROJECT IDENTIFICATION DATA**

The purpose of the Zambia component of the Regional Development Project No. 690-0231 was to increase the efficiency of the operations of Zambia Railways.

In August 1985, \$5.0 million in project funds were authorized to finance the purchase of U.S. source spare parts exclusively for the rehabilitation of 12 General Electric locomotives. This project was amended in September 1986, to increase the funding to \$7.0 million and the number of locomotives to be rehabilitated to 17. In May 1987, the project was further amended to provide an additional \$3.0 million and to increase the number of locomotives to be rehabilitated to 25. In January 1990, the project was amended a final time to replace defective spares provided by two suppliers who were under investigation by the Office of the AID Regional Inspector General. The Project Assistance Completion Date is June 30, 1992.

The total cost of the project was \$10.225 million for the provision of locomotive spare parts and for specialized training.

The objectives of this report are to assess:

- The overall economic benefits derived from the \$10.225 million locomotive rehabilitation project;
- The efficiency and effectiveness of the spares procurement process and workshop operations;
- The degree of achievement of project outputs; and
- The level of achievement of the overall project purpose as defined by the World Bank "to increase the efficiency of operations of Zambia Railways."

At the time of the completion of the field work of this report, the input from the USAID Commodity Management Officer had not been received. This material has now been received and in accordance with the terms of reference, it is incorporated as Appendix H of this report.

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## Chapter 1.0

### TRAFFIC OPERATIONS

#### 1.1 Locomotive Requirements

Zambia Railways presently owns 68 locomotives; 12 of these are used primarily for shunting and branch line operation. Based on existing traffic levels, a total of 52 serviceable locomotives are required for movement of traffic. From the ZR fleet, 42 have been available (see Appendix E for average numbers of ZR units available from 1985-1987), with the difference made up from hired locomotives. Since the late 1970's, the railway has been plagued with low availability rates for their locomotives (between 1978 and 1985, the average availability rate has been 65 percent). It became necessary to hire locomotives from South Africa to supplement the ZR fleet. Table 1.1 shows the average number of South African Railways (Spoornet) locomotives on hire at Zambia Railways from 1980 to 1992.

Table 1.1

#### NUMBER OF SPOORNET LOCOMOTIVES HIRED BY ZAMBIA RAILWAYS

Year	Spoornet Locomotives
1980	11
1981	9
1982	1
1983	8
1984	8
1985	8
1986	7
1987	12
1988	13
1989	21
1990	24
1991	22
1992	8

source: ZR Ten Year Development Plan;  
ZR records

The number of Spoornet locomotives on hire decreased dramatically in 1992. The reasons for this decrease were discussed with ZR management, and it was concluded that the reasons were two-fold--decreasing traffic levels and the improved availability rates of the USAID-rehabilitated units.

The cost of hiring Spoornet locomotives has been a great burden on the financial resources of the Zambia Railways. At the current daily rate of Rands 2876 per day, the annual cost of hiring 22 locomotives is approximately US \$ 8.25 million. The high cost of hiring these South African locomotives is one of the primary reasons for the current efforts of ZR to increase the availability of their own locomotives. The costs saved by not hiring so many Spoornet locomotives represent a significant savings, partially attributable to the increased availability of ZR motive power. This increased locomotive availability will be calculated and shown further in this section.

Total traffic moved by Zambia Railways is shown in tonnes in Table 1.2, from 1985 to 1991, and in tonne-kilometers in Table 1.3. Traffic has been declining steadily since 1987/88, with a drop of 15 percent from 1990 to 1991. Appendix D shows the routing for Zambia Railways traffic for imports, exports and domestic freight movements.

**Table 1.2**

**ZAMBIA RAILWAYS GOODS TRAFFIC  
1985-1991  
(thousands of tonnes)**

<b>Year</b>	<b>Domestic</b>	<b>Int'l.</b>	<b>Transit</b>	<b>Total</b>
1984/85	2986	1353	588	4927
1985/86	2899	1112	569	4580
1986/87	2835	1150	605	4590
1987/88	2909	1144	581	4634
1988/89	2627	1131	649	4407
1989/90	2342	1179	570	4091
1990/91	2161	832	441	3434

Source: Zambia Railways

**Table 1.3**

**ZAMBIA RAILWAYS GOODS TRAFFIC  
1985-1989  
(millions of tonne-kilometers)**

<b>Year</b>	<b>Domestic</b>	<b>Int'l.</b>	<b>Transit</b>	<b>Total</b>
1984/85	598	426	457	1481
1985/86	601	461	303	1365
1986/87	596	338	403	1337
1987/88	546	356	453	1355
1988/89	511	381	450	1342

Source: ZR Ten Year Development Plan

There are several reasons for the steady decrease in ZR traffic. One important factor has been the decrease in copper production due to the falling world copper price as well as operational problems at ZCCM mines. For example, 1990 production was 450,000 tonnes, while 1991 output fell to 400,000 tonnes. In their report showing corridor traffic projections, (A Scenario Model for Goods Transport in the SADCC Region, SATCC, September 1988), the Southern African Transport and Communications Committee (SATCC) identified Zambia's copper exports at the 550,000 tonne level during the early 1990's. It is doubtful whether actual output will reach this level. Another factor contributing to the falling traffic is the declining Zambian economy, enabling it to purchase fewer imported goods.

The increase in road traffic is a region-wide characteristic being encountered in most regional corridors. In the recent USAID study (Tanzanian Transport Sector Assessment April, 1992), road transport was found to be enjoying a 22 percent share of the Zambia - Dar es salaam corridor market in 1991, compared with an estimated two percent during 1990. Also, in a study of border crossing road and rail traffic in South Africa, (Data Base of Heavy Vehicles Crossing South Africa's Borders, Pretoria, March 1992) total tonnage of road transport was found to have increased 57 percent from 1990 to 1991, and the road market share increased from 20 percent to 30 percent, compared with rail, during the same two-year period.

## **1.2 Performance of the USAID Rehabilitation Program**

A total of 25 locomotives were rehabilitated under the USAID program, between 1988 and 1991. The date each locomotive was completed is shown in Table 1.4.

The ultimate success of the locomotive rehabilitation project is dependent upon the project's execution, material provided, capabilities of shop personnel, technical aspects of the program and subsequent preventive maintenance support and control.

### **1.2.1 Execution of the Project**

A locomotive rebuild project involving 25 units should be subject to a comprehensive quality assurance audit performed by an independent party to ensure that the required work is performed in a uniform manner. This was not done, making it impossible to track individual locomotive costs. The problem of tracking individual unit costs was exacerbated by the fact that only a single project number was allocated to the work performed on all locomotives.

Typical locomotive maintenance practice dictates that periodic inspections are to be performed on a time and distance basis. The ZR practice, however, is based on distance travelled. As ZR locomotives travel comparatively few total kilometers each year, locomotives do not return to the shop for inordinately long periods of time. For example, rehabilitated locomotive number 51 (the first unit rehabilitated, in October 1988) had its first annual inspection in April 1992. The inspection was due in December 1989, as per GE maintenance recommendations. In addition, the rehabilitated locomotives should be subject to a special control period after release to assess the work quality.

**Table 1.4**

**COMPLETION DATES OF LOCOMOTIVES REHABILITATED  
UNDER THE USAID PROGRAM**

<b>Sequence</b>	<b>Locomotive Number</b>	<b>Type</b>	<b>Completion Date</b>
1	051	U20C	10/88
2	057	U20C	12/88
3	060	U20C	2/89
4	062	U20C	3/89
5	203	U20C	4/89
6	206	U20C	6/89
7	065	U20C	6/89
8	072	U20C	9/89
9	202	U20C	10/89
10	305	U20C	11/89
11	068	U20C	1/90
12	209	U20C	4/90
13	070	U20C	5/90
14	201	U20C	6/90
15	208	U20C	9/90
16	205	U20C	10/90
17	059	U20C	10/90
18	053	U20C	11/90
19	207	U20C	12/90
20	204	U20C	2/91
21	052	U20C	3/91
22	304	U15C	4/91
23	311	U15C	5/91
24	302	U15C	7/91
25	306	U15C	8/91

Source: ZR

**1.2.2 Material Supplied**

The Consultant examined several material schedules for selected locomotives, with the result that each unit was rehabilitated in a different manner. The project description did not clearly define the standard of rebuild which was to be achieved. Typically such rebuild standards are replacement OEM (Original Equipment Manufacturer), remanufactured OEM, power OEM with traction and main electrical components remanufactured OEM. Further review of the material lists did not identify new GE parts as distinguished from other new parts. Warranties for OEM and product liability are covered by General Electric (GE), but may have different conditions with substitute products and material. In addition, GE field service would be readily available for any GE parts purchased. Field service for other parts would be minimal and usually undertaken by third party non-proprietary vendors.

### **1.2.3 Capabilities of Shop Personnel**

The technical capabilities required by shop machinists and electricians include the ability to make precision measurements and some knowledge of the manufacturing process. These skills are needed in order to visualize the functioning locomotive, rather than each component in isolation.

A particularly critical skill is the qualifying of the engine frame alignments, especially the main bearing saddles for deflection and concentricity prior to bedding the crankshaft. It is also critical to recognize mechanical and chemical defect conditions by periodic testing, such as spectroanalysis and oil testing.

A good quality control program should become corporate policy and be implemented at every level of the organization. It is apparent from various maintenance and performance data, even in the beginning of 1989, that the quality control program at ZR was merely a monitoring and recording function rather than an effective maintenance control and improvement tool.

### **1.2.4 Technical Aspects**

Several tools necessary to support the rebuilding program were not found in the tool list at ZR. Technical aspects of the rebuild program require special tools and testing. In reconditioning cylinders that are out of standard to the next undersize requires a special boring head that provides for a variable dimension in three sections of the cylinder: above the top ring, the ring clearance, and below the skirt. Further, a cylinder hone must be employed to assure oil retention grooves. This tool is not listed in the major tool list. An assembly test that should be performed at this point is a cylinder leak off test to ensure that a blow-by problem does not exist prior to performance testing. Another capability needed is align boring for reworking traction motor cases. In the shop machinery list there was neither a tool provided for this purpose nor an axle lathe.

Preventive maintenance support should include periodic maintenance for two years after the rebuild. Review of the monthly locomotive inspection records shows that between 20 percent and 30 percent of the locomotives are overdue for scheduled inspections. Even though the duty cycle generates low mileage, material scarcity and lack of expedient field service and factory apparatus shops should dictate diligent and on-time inspection planning.

Certain performance and mechanical indicators can reveal the quality achieved by the rebuild. Load testing is a guideline to determine if nominal horsepower was restored. Only one locomotive achieved nominal horsepower output and all were at less than nominal horsepower with an average of 9 percent horsepower reduction. By the load test record the trend shows a constant degrade in horsepower rating with some of the values out of control. If the goal was to restore the engine to nominal horsepower, then the typical range for this would be above and below the nominal horsepower curve plus or minus 5 percent. Factors such as equipment error, interpretation or fuel conditions could affect the load readings. In Appendix C, a record of load test readings performed in the Kabwe shop is shown.

## **1.3 Locomotive Performance**

Two primary indicators were selected as representative of the relative performance of the USAID-rehabilitated locomotives compared with the total ZR fleet. These indicators were (1) increased

locomotive availability from 62 percent to 75 percent; and (2) kilometers between failures. Comparisons of locomotive availability and kilometers between failures are shown in Table 1.5.

In order to give a representative comparison of USAID locomotive availability and reliability, average availability and kilometers between failures were calculated for the 15 month period, January 1991 to March 1992. These figures indicate significant improvements and are shown in Table 1.6.

The kilometers per month for USAID locomotives are shown in Appendix A for the year 1991 and the first two months of 1992. Availability statistics from 1989 and 1990 are shown in Appendix F, although there were relatively few units that had completed rehabilitation during these early years in the program. The monthly average utilization is 207 kilometers, or a total of 75,555 annual kilometers.

Statistics showing locomotive availability for the USAID rehabilitated units compared with total ZR fleet, by rebuild year, are presented in Table 1.7. Some additional locomotive productivity statistics are shown in Table 1.8.

The number of serviceable ZR units per day showed a 13 percent increase from 1988/89 to 1990/91. This is the period within which all USAID rehabilitation work was performed. However, kilometers per unit per day and gross tonne kilometers per unit per day showed dramatic declines, likely reflecting the sharp decreases in traffic levels. Statistics showing locomotive hours were not available from ZR records.

While not all of these productivity improvements can be attributed to a more reliable locomotive fleet, the improved availability and longer time between failures for the USAID units certainly would have had an impact in reducing the wagon cycle. Even though wagon availability has improved moderately, wagon kilometers per day have declined dramatically. Wagon availability by type of wagon, however, was not available from ZR records. This somewhat dismal picture does not, however, reflect on the productivity of the USAID locomotives. The continuing decline in total railway tonnage would partially explain the decreased kilometers per wagon per day. The decrease in the days per wagon cycle from 31 to 26 days (an improvement of 16 percent from 1989 to 1991), indicates faster throughput times over the line as well as within terminals. Increased kilometers between failures, as shown in Tables 1.5 and 1.6, has likely contributed to this improvement. The decrease in wagon loadings is a direct reflection of the falling traffic levels, as shown in Table 1.2.

#### **1.4 Wagon Performance**

There have been improvements in several wagon productivity indicators during the past three years, as shown in Table 1.9.

#### **1.5 Environmental Impacts**

In the project paper, the Initial Environmental Evaluation concluded that there would be "no significant or long-term environmental consequences" due to the project. This conclusion is still valid.

**Table 1.5**

**COMPARATIVE PERFORMANCE INDICATORS  
USAID LOCOMOTIVES AND ZR FLEET**

Month	<u>Locomotive Availability</u>		<u>Kilometers/Failure</u>	
	ZR	USAID	ZR	USAID
1992	%	%		
March	66	76	10736	17084
February	66	80	10573	13745
January	65	84	8277	15584
1991				
December	68	88	10448	10577
November	59	76	7871	11378
October	60	72	7907	7888
September	60	73	6736	6884
August	59	72	6572	6902
July	59	79	5238	6703
June	59	70	5099	4471
May	59	71	7080	7952
April	60	74	4710	6905
March	59	75	3269	6815
February	60	75	4685	6927
January	55	76	4721	8372

Source: ZR

**Table 1.6**

**LOCOMOTIVE AVAILABILITY AND RELIABILITY  
USAID UNITS VS. ALL ZR UNITS  
(1991-1992)**

<u>Locomotive Availability</u>		<u>Kilometers/Failure</u>	
ZR	USAID	ZR	USAID
61%	76%	6298	9212
25% improvement		46% improvement	

Source: Table 1.5

**Table 1.7**

**LOCOMOTIVE AVAILABILITY FOR THE PERIOD  
1988 - 1991 BY REBUILD YEAR**

<b>Rebuild Year</b>	<b>Availability Percentages</b>	
	<b>Total ZR Fleet</b>	<b>USAID Rebuilt Units</b>
1988/89 (10 units)	58%	80%
1990 (9 units)	55%	73%
1991 (2 units)	59%	75%
1991 (4 units)	N/A	N/A

Source: ZR

Note: The units rebuilt in 1991 are the U15C units - all other units are the U20C units.

**Table 1.8**

**ZR LOCOMOTIVE PRODUCTIVITY INDICATORS**

<b>Indicator</b>	<b>1988/89</b>	<b>1989/90</b>	<b>1990/91</b>
Serviceable units per day	38	41	43
Kms per unit per day	234	202	192
Gross tonnes per unit per day	788	842	806
Gross tonnes kms per unit per day	183,000	179,000	112,000

Source: ZR

**Table 1.9**

**ZR WAGON PRODUCTIVITY INDICATORS**

<b>Indicator</b>	<b>1986/87</b>	<b>1987/88</b>	<b>1988/89</b>	<b>1989/90</b>	<b>1990/91</b>
Wagon cycle (days)	24	25	31	32	26
Wagon availability (%)	88	88	88	90	91
Km per day	71	69	66	46	37
Net tonnes per wagon	38	39	40	42	40
Wagon Loadings	106,215	109,317	145,095	169,529	107,128
Loaded/empty ratio	7:5	10:6	13:7	9:6	8:6
Annual net tonne kms	574,000	613,884	626,340	423,108	308,686

Source: ZR

## Chapter 2.0

### FINANCIAL RESULTS OF ZAMBIA RAILWAYS

Table 2.1 shows the ZR Profit and Loss Account from 1985-1991, according to ZR financial records. The operating ratio, calculated by dividing operating costs by revenues, is also shown in Table 2.1. Balance Sheets and Statement of Sources and Uses of Funds are shown in Appendix B.

Table 2.1

#### ZAMBIA RAILWAYS PROFIT AND LOSS ACCOUNT (THOUSANDS OF KWACHAS)

	84/85	85/86	86/87	87/88	88/89	89/90	90/91
<b>Revenues</b>							
Psgr	9.8	13.0	17.3	26.7	44.4	39.8	83.1
Goods	93.5	184.9	369.7	449.5	555.4	1317	2968
Other	4.3	10.8	20.0	38.1	43.5	94.4	259.4
<b>Total</b>	<b>107.6</b>	<b>208.6</b>	<b>407.0</b>	<b>514.3</b>	<b>643.3</b>	<b>1451.2</b>	<b>3310.5</b>
<b>Operating Expenses</b>							
Admin.	30.4	96.0	128.8	225.9	351.4	509.3	942.5
Running	42.0	73.4	90.6	127.3	162.3	410.0	1384.0
Mtce.	31.8	34.3	94.1	97.7	101.3	166.8	531.8
Handling	5.2	(32)	31.2	35.0	15.3	36.5	84.3
Catering	1.5	0.9	.4				
Finance							219.6
<b>Total</b>	<b>110.9</b>	<b>172.6</b>	<b>345.1</b>	<b>485.9</b>	<b>630.4</b>	<b>1122.6</b>	<b>3162.2</b>
<b>Net Income</b>	<b>(3.3)</b>	<b>36.0</b>	<b>61.9</b>	<b>28.4</b>	<b>12.9</b>	<b>328.6</b>	<b>148.3</b>
<b>Operating Ratio</b>	<b>1.03</b>	<b>.83</b>	<b>.85</b>	<b>.94</b>	<b>.98</b>	<b>.77</b>	<b>.96</b>

Source: ZR Financial Statements

Based on the data shown in Table 2.1, no sustained improvement can be seen in the operating ratio since the first USAID rehabilitated locomotives were completed during 1988.

Several other financial ratios are typically used by analysts to evaluate a company's performance, such as working capital ratio, debt-service ratio and debt-equity ratio. However, the rehabilitation project has had minimal impact on the capital structure, and the accounting treatment of the liability to repay the loan to Zambia Railways has not yet been determined by ZR finance staff.

Return on assets is also another useful indicator of railway viability, yet any change in this indicator during the past six years on ZR could not be attributed to the relative success of the USAID rehabilitation program. Only when all elements of the World Bank's program for revitalization of ZR are completed, such as track, signalling and telecommunications improvements, can a comprehensive evaluation of these several financial indicators have real meaning.

The primary benefit from the improved utilization of locomotives will be the reduced hire charges paid to Spoornet. However, as significant reductions in locomotives hired have only begun during late 1991 and early 1992, the impact of these cost savings will not yet be reflected in the financial statements.

Estimates have been made of asset valuation on replacement cost basis by the World Bank in their report SADCC Transport Corridors - Study of Financial Strategy. These estimates have been modified to reflect current locomotive ownership and have been used to approximate the current ZR financial position.

Asset values were classified into three groups in the Bank study: Rolling Stock, Permanent Way and Other Assets. The modified values of assets taken from the Bank study, adjusted by existing locomotive holdings (the Bank study included the value for 71 locomotives - current holdings are 68 units) are shown in Table 2.2.

**Table 2.2**

**REPLACEMENT COSTS OF RENEWABLE ASSETS  
ZAMBIA RAILWAYS  
(millions of Kwachas)**

<b>Asset Category</b>	<b>Total Ownership Costs</b>		<b>Annual Depreciation</b>	
	<b>1988/89 Values</b>	<b>1990/91 Values</b>	<b>1988/89 Values</b>	<b>1990/91 Values</b>
Rolling Stock	1739	16120.5	68.3	633.1
Permanent Way	526	4876.0	27.5	254.9
Other Assets	1196	11086.9	23.1	214.1

Source: World Bank Financial Strategy Study (1988/89 values based on exchange rate of \$1 = KW 8.63; 1990/91 values based on exchange rate of \$1 = KW 80)

If the 1990/91 Profit and Loss statement were restated incorporating the depreciation at replacement cost, the result would appear as in Table 2.3. Instead of a net income of 148.3 million Kwacha, the Railways actually incurred a loss of 65.8 million Kwacha.

**Table 2.3**

**1990/91 PROFIT AND LOSS STATEMENT  
INCORPORATING DEPRECIATION AT REPLACEMENT COST  
(millions of Kwachas)**

Revenue	3310.5
Costs	3162.2
Depreciation (Repl. Cost)	214.1
Net Income	(65.8)

Source: World Bank Financial Viability Study and Table 2.1.

**2.1 Outlook for Zambia Railways**

Zambia Railways faces a difficult future, with decreasing traffic, declining copper production and a local currency subject to dramatic and frequent devaluations.

In the World Bank's study of Corridor Viability in the Southern Africa Region (1990), estimates were made of tariff increases needed to break even, assuming constant traffic, and traffic increases needed to break even, assuming constant tariffs. For Zambia Railways these percentages were 15 percent for needed traffic growth and 12 percent for tariff increases, based on analysis of 1988/89 figures.

Since 1988/89, tonnage has decreased by 22 percent, and a tariff increase, on the order of 70 percent was implemented in 1990. With the railway operating in an environment of decreasing mineral production, increasing road competition and a rapidly declining currency, further tariff increases will likely erode the existing traffic base, placing the railway in a more difficult position. In this declining traffic scenario, which will likely continue for the foreseeable future, the most prudent action for ZR management would be to critically evaluate their existing traffic, and identify commodities which are being carried at a loss. As a result of this analysis, selective tariff adjustments could be made. This would be a more positive managerial approach to bringing the railway to financial viability than large across-the-board increases which may further erode the traffic base in favor of road competition.

There was no apparent impact on the USAID rehabilitation project from the World Bank's decision to halt their project disbursements.

## Chapter 3.0

### BENEFITS OF THE USAID PROJECT

The primary benefits from improved availability of the units rehabilitated by USAID would be from reduced requirements for hiring Spoornet locomotives. The benefits as computed in the project paper were based on the economic cost differential between rail and road transport, and applying this cost savings to traffic that would not be diverted to road, if ZR had sufficient locomotive availability. The Consultant does not consider this an appropriate technique, as ZR has typically hired additional motive power when sufficient numbers of ZR units were not available. During the past decade, traffic has been diverted from rail to road, but this has occurred even when ZR has had sufficient power from hired units. It seems, therefore, that traffic diversion must be as a result of price or levels of service competition. The "null alternative" is hiring units from outside.

Since the rehabilitation of the 25 locomotives by USAID has been completed, the number of Spoornet locomotives on Zambia Railways has decreased by 14 locomotives, from a daily average of 22 in 1991 to 8 as of April 1992. Part of this reduction has been due to traffic decreases, and part can be considered to be attributable to the increased availability of the 25 rehabilitated units. As the total tonnage moved by ZR decreased by 15 percent from 1991 to 1992 (see Table 1.2), 15 percent of the reduced need for Spoornet locomotives can be attributed to traffic decreases. Therefore, the cost of hiring 12 Spoornet locomotives can be attributable to the increased ZR locomotive availability.

The current hire cost of a Spoornet unit is 2,876 Rands per day (US \$1,027). Therefore, the annual cost of hiring 12 units is US \$ 4,498,260. The economic analysis of rehabilitation of 25 locomotives is shown in Table 3.1. A discount rate of 15 percent was used in these calculations over a ten year period. In addition to the capital cost for USAID to rehabilitate the units (a total of \$ 10.2 million), the cost to maintain these units must be included, as the Spoornet hire cost incorporates a maintenance value. The average cost to maintain a ZR locomotive was found to be Kwacha 2,170,826 per year, per unit. This is US \$ 27,129 at the mid-1991 rate of exchange. This annual maintenance cost is multiplied by the number of rehabilitated units on hand each year during the analysis period. These numbers of units, by year, were shown in Table 1.4.

The years in which the funds were spent by USAID, as shown in the Project Implementation Reports, were taken as the years of capital investment. Based on the original amount of \$10 million, 57 percent was spent in 1987, 11 percent in 1988 with the remaining 32 percent spent in 1989. The final \$225,000 was spent during 1991. The annual maintenance costs were taken in the year the units entered service, and the benefits of Spoornet hire charges were taken beginning in 1991, the first year in which there was a significant reduction in the number of Spoornet locomotives. The period of analysis was taken to begin in 1987, the year of first expenditure, extending for a 10 year period to 1997.

**Table 3.1****ECONOMIC ANALYSIS OF USAID REHABILITATED LOCOMOTIVES  
(millions US Dollars)**

<b>Year</b>	<b>Capital</b>	<b>Maintenance</b>	<b>Total Costs</b>	<b>Local Hire Savings</b>	<b>Net Benefits</b>
1987	5.7		5.7		(5.7)
1988	1.1	.054	1.154		(1.154)
1989	3.2	.271	3.471		(3.471)
1990		.515	.515		(.515)
1991	.227	.678	.905	4.5	3.595
1992		.678	.678	4.5	3.822
1993		.678	.678	4.5	3.822
1994		.678	.678	4.5	3.822
1995		.678	.678	4.5	3.822
1996		.678	.678	4.5	3.822
1997		.678	.678	4.5	3.822
			IRR		16%
			Cost/Benefit Ratio		1.06
			Net Present Value		.573

Source: Consultant's Analysis

Results from the analysis are positive, but only marginally so. A rate of return of 16 percent would be acceptable, but the analysis presumes that the availability rates of the rehabilitated locomotives will remain high enough to preclude the necessity to hire additional power from other regional railways during the 10 year period. Because of the alarming frequency and nature of failures of USAID rehabilitated units, and the lack of acceptable follow up maintenance at ZR, existing availability rates may not be able to be sustained.

## **Chapter 4.0**

### **RECOMMENDED IMPROVEMENTS IN WORKSHOP PRACTICES**

In order to sustain the benefits of any rehabilitation or vehicle procurement program, the ZR must analyze all of the maintenance and operational variables, define these variables and bring them under constant study and control. The direct inputs required to achieve this objective are the definition of corporate policy and goals, the development of a professional cadre in all areas, group review of work practices, methods, safety and environmental conditions that promote consensus and high level support for improved efficiency. This could be accomplished by establishing departmental incentives and performance recognition, ongoing training programs including apprenticeships and a pay grade system within each job classification. These are the basis for improvements to better workshop operations and overall railway performance.

With regard to the USAID rehabilitation project, there should be established definitive life cycle goals to which the locomotive must be designed. A plan should be developed that creates a dedicated work team that would continue through the life of the project. A pilot program would be a desirable approach in developing a typical model for analyzing production, work stations, and back shop and subassembly tasks in order to streamline the entire rehabilitation process. Each production unit would be incorporated into a computer program that tracks material, budget, man hours, and maintenance schedules. This system would serve as a ZR network database that has an interactive calendar and scheduler program. Source and vendor inspections would be conducted by a qualified and responsible person on site in order to allow a more comprehensive examination of each component, using such means as non-destructive testing (NDT), cyclic or metallographic testing. Sole source procurement would be recommended for OEM parts including warranties. Field service would be provided as needed. A USAID technical consultant should be hired to oversee the program and act as liaison to assist in expediting external inputs that are critical to the program.

In the opinion of the Consultant, the current availability rates of the USAID rehabilitated units cannot be sustained without the taking of further strong actions by ZR mechanical staff. Specifically, these actions include the following:

- It is necessary that the periodic maintenance schedules be strictly followed. Light duty locomotive cycles, as experienced on ZR, should not delay the scheduled shopping. In Africa, the long lead times for OEM parts and precision rebuild services as well as high shipping costs make it more important that maintenance is applied on time.
- The practice of long idling cycles are very damaging to the power assemblies. This practice produces carbon buildup, acid formation in the lube oil, ring seating problems and lubrication starvation of the cylinder walls because of low rpm of the engine. The Zambian climate permits safe shutdown of the engines as long as the batteries and the charging systems are maintained. Distilled water should be used and a regular battery maintenance record should be maintained. The characteristic of good preventive maintenance is a lack of component and part failures, controlled stability and performance that adheres to prescribed objectives.

- A review of the type of failures and their frequency indicates that the process of strict maintenance is out of control. Oil handling and spectroanalysis should be rigidly applied. It may be preferable to contract a private laboratory to test oil because of more comprehensive testing capability, including fuel analysis. Compressor oil has to be checked on a regular basis. The Consultant recommends that all compressors have filter kits applied along with geared oil pump modifications. There is often a dust problem in this environment and inertial filters should be changed more frequently than GE recommendations. Class H insulation or epoxy dipped coils should be specified for ZR locomotives. Finally, a statistical process control method should be introduced to constantly track fleet maintenance and operations.

**Appendix A**

**LOCOMOTIVE KILOMETERS**

**Table A.1 Daily Kilometers per Locomotive**

<b>Month</b>	<b>Daily Kilometers</b>
1992	
February	203
January	206
1991	
December	212
November	216
October	218
September	219
August	223
July	207
June	200
May	209
April	176
March	198
February	201
January	205

Source: ZR

## Appendix B

### BALANCE SHEETS AND STATEMENTS OF SOURCES AND USES OF FUNDS

**Table B.1 Zambia Railways Balance Sheets  
for Years Ending 1987 -1991  
(millions of Kwachas)**

	1991	1990	1989	1988	1987
<b>Employment of Capital</b>					
Fixed Assets	2620	1461.5	948.8	628.7	561.7
Other	104.9	64.6	61.1	52.8	47.0
Current Assets	1597.3	1068.1	588.7	448.6	310.5
Less:					
Current Liab.	797.4	1493.9	555.5	376.7	278.7
Net Current Assets	799.8	(425.8)	33.2	71.9	31.8
Exchange Losses	241.8	792.7	127.9	44.6	54.1
<b>Total</b>	<b>3766.5</b>	<b>1893.0</b>	<b>1171.0</b>	<b>798.0</b>	<b>694.6</b>
<b>Capital Employed</b>					
Share Capital	197.8	197.8	197.8	197.8	197.8
Pending	2317.6		(26.4)	89.2	20.9
Reserves	(811.4)	(356.2)	48.0	50.9	22.4
Deficit on Shareholders Fund	1704.0	(158.4)	219.4	337.9	241.1
Gov of Zambia	586.4	466.5	331.3		
Long Term Loans	1476.1	1584.9	620.3	460.1	453.5
<b>Total</b>	<b>3766.5</b>	<b>1893.0</b>	<b>1171.0</b>	<b>798.0</b>	<b>694.6</b>

Source: ZR

**Table B.2**  
**Zambia Railways Sources and Uses of Funds**  
**for Years Ending 1987 -1991**  
**(thousands of Kwachas)**

	<b>1991</b>	<b>1990</b>	<b>1989</b>	<b>1988</b>	<b>1987</b>
<b>Sources of Funds</b>					
Operations	385355	(293958)	53697	69164	102484
Other	499153	508004	352225	87762	89294
<b>Total</b>	<b>884508</b>	<b>214046</b>	<b>405922</b>	<b>156926</b>	<b>1911778</b>
<b>Uses of Funds</b>					
Assets	758924	334602	386400	107997	152950
Other	13808	70351	10184	8753	3011
<b>Total</b>	<b>(772732)</b>	<b>(404953)</b>	<b>(396584)</b>	<b>(116750)</b>	<b>(155961)</b>
<b>Increase in Working Cap.</b>	<b>111776</b>	<b>(190907)</b>	<b>9338</b>	<b>40176</b>	<b>35817</b>

Source: ZR

## Appendix C

### ZAMBIA RAILWAYS - LOCOMOTIVE LOAD TEST RESULTS

**Zambia Railways Limited  
Record of Load-Tests Done on USAID Locomotives  
After Release from Workshops - Ex Overhaul**

Loco No.	Date Released	H.P. at Release	Dates Other Load Tests Done and H.P.	
051	29.10.88	H.P. 2095 -3% N I L	A. 25.05.89	1916 H.P.
			B. 23.03.90	1867 H.P.
			C. 15.09.90	1968 H.P.
			D. 13.09.90	1978 H.P.
			E. 06.11.90	1914 H.P.
			F. 26.11.90	2054 H.P.
			G. 01.12.91	1850 H.P. -14%
057	18.12.88	H.P. 1947.2 -10%	A. 20.08.90	2057 H.P.
			B. 31.08.90	1991 H.P.
			C. 19.10.90	2008 H.P.
			D. 25.01.91	1958 H.P.
			E. 04.02.92	1900 H.P.
			F. 12.03.92	1850 H.P. 14%
206	06.01.89	H.P. 1986 -8%	A. 19.08.89	1985 H.P.
			B. 24.09.91	2008 H.P.
			C. 19.06.91	2003 H.P.
			D. 10.10.91	1890 H.P. -13%
060	16.02.89	H.P. 1957 -9%	A. 24.07.90	1918 H.P.
			B. 29.01.91	1965 H.P.
			C. 25.08.91	1958 H.P.
			D. 01.03.92	1992 H.P. -8%
062	23.03.89	H.P. 1944 -10%	A. 28.11.89	1963 H.P.
			B. 04.09.90	1950 H.P.
			C. 23.10.90	1914 H.P.
			D. 08.11.90	1913 H.P.
			E. 28.12.90	2008 H.P.
			F. 27.03.91	1908 H.P.
			G. 27.07.91	1980 H.P. -8%

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**Appendix C (Continued)**

<b>Loco No.</b>	<b>Date Released</b>	<b>H.P. at Release</b>	<b>Dates Other Load Tests Done and H.P.</b>	
065	18.06.89	H.P. 1944 -10%	A. 23.09.89 B. 10.12.90 C. 21.12.90 D. 11.03.91	1985 H.P. 1916 H.P. 1865 H.P. 1977 H.P. -9%
203	04.09.89	H.P. 1926 -11%	A. 02.06.90 B. 21.04.91 C. 03.09.91 D. 17.01.92	2008 H.P. 1890 H.P. 2149 H.P. 1842 H.P. -15%
072	28.08.89	H.P. 1972 -8%	A. 18.04.91 B. 09.06.91 C. 04.08.91	1932 H.P. 1936 H.P. 1958 H.P. -9%
202	27.10.89	H.P. 1909 -12%	A. 18.01.90 B. 18.07.90 C. 04.09.91	2008 H.P. 1892 H.P. 1958 H.P. -9%
305	04.12.89	H.P. 1506	A. 12.09.90 B. 08.02.91 C. 05.09.91	1517 H.P. 1437 H.P. 1550 H.P.
068	30.01.90	H.P. 1928 -10%	A. 23.04.90 B. 01.10.90 C. 23.01.91	2076 H.P. 2008 H.P. 2057 H.P. -5%
070	05.02.90	H.P. 1937 -10%	A. 22.06.90 B. 05.12.90	1913 H.P. 1926 H.P. -11%
209	12.04.90	H.P. 1945 -9%	A. 25.02.90	2008 H.P. NIL
201	21.05.90	H.P. 1957 -9%	N I L	

1.0

**Appendix C (Continued)**

<b>Loco No.</b>	<b>Date Released</b>	<b>H.P. at Release</b>	<b>Dates Other Load Tests Done and H.P.</b>	
208	05.07.90	H.P. 1951 -9%	A. 01.06.91 B. 24.04.91	1985 H.P. 2002 H.P. -7%
205	08.10.90	H.P. 1916 -11%	A. 07.04.91	1858 H.P. -14%
059	21.10.90	H.P. 1957 -9%	A. 13.08.91	1958 H.P. -9%
053	21.11.90	H.P. -8%	A. 01.05.91	1988 H.P. -8%
207	24.12.90	H.P. 1972 -8%	A. 31.12.90 B. 14.04.91 C. 13.09.91	1922 H.P. 2028 H.P. 1240 H.P.
204	03.02.91	H.P. 1917 -11%	A. 16.04.91 B. 02.10.91	2003 H.P. 1900 H.P. -12%
052	18.03.91	H.P. 1985 -8%	A. 07.10.91 B. 28.11.91	2054 H.P. 1850 H.P. -14%
304	10.04.91	H.P. 1455	N I L	
	19.05.91	H.P. 1455	N I L	
302	11.07.91	H.P. 1486	A. 13.04.92 B. 30.03.92	1557 H.P. 1511 H.P.
306	09.08.91	H.P. 1465	A. 08.02.91	1435 H.P.

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**Appendix D**

**ZAMBIA RAILWAYS - ROUTING OF TRAFFIC**

**Table D.1 Zambia Railways - Traffic by Major Routes  
(thousands of tonnes)**

<b>Routing</b>	<b>90/91</b>	<b>89/90</b>	<b>88/89</b>	<b>87/88</b>	<b>86/87</b>	<b>85/86</b>
Local	2162	2342	2627	2909	2835	2899
Exports						
Zaire	21	35	32	30	30	30
South	47	129	87	145	152	110
Tazara	369	339	364	405	424	450
Mozambique				1	2	2
Total Exports	437	502	483	581	608	592
Imports						
South Africa	195	284	175	352	339	278
Tazara	154	312	396	211	203	242
Zaire						
Zimbabwe	46	80	77			
Mozambique						
Total Imports	395	677	648	563	542	520
Transit						
South/Zaire	290	250	345	288	300	340
Zaire/South	125	162	194	283	295	210
Zaire/Tazara		4	11	5	5	10
Tazara/Zaire	7	7	9	5	5	9
Tazara/Zimbabwe	1		1			
South/Malawi	6	12	38			
Zimbabwe/Tazara	12	3				
Zimbabwe/Zaire		124	51			
Total Transit	441	570	649	581	605	569
Total Traffic	3435	4091	4407	4634	4590	4580

Source: ZR

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**Appendix E**

**PERFORMANCE OF ZR LOCOMOTIVES**

**Table E.1 ZR Locomotives - Average Daily Units Available and Available Kilometers Between Failures**

Month	1985		1986		1987	
	Units/ Day	Km/ Failure	Units/ Day	Km/ Failure	Units Day	Km/ Failure
Jan	-	-	44	2837	42	4141
Feb	-	-	43	3319	42	4698
Mar	-	-	34	3417	43	4606
Apr	43	2847	44	2609	42	5324
May	42	2817	43	4037	43	4697
June	40	3110	43	3116	43	5148
July	38	3007	40	3049	39	4402
Aug	41	3489	42	3170	39	5912
Sept	42	2536	42	4056	42	4588
Oct	44	2764	41	4353	37	4000
Nov	48	2608	41	4207	38	3765
Dec	47	2187	42	4612	38	4297
Average	42	2818	41	3565	40	4631

Source: ZR

## Appendix F

### AVAILABILITY OF USAID REHABILITATED LOCOMOTIVES 1985 - 1987

**Table F.1 Availability Percentage of USAID Rehabilitated  
Locomotives 1985 - 1987**

<b>Month</b>	<b>1990</b>	<b>1989</b>
Jan	60%	85%
Feb	75%	80%
Mar	67%	78%
Apr	69%	72%
May	65%	92%
June	79%	80%
July	73%	88%
Aug	80%	81%
Sept	80%	70%
Oct	71%	89%
Nov	76%	71%
Dec	84%	68%
<b>Average</b>	<b>73%</b>	<b>80%</b>

Source: ZR

## **Appendix G**

### **LIST OF INDIVIDUALS CONTACTED**

#### **Zambia Railways**

B. Hibajene	Corporate Planning Manager (Projects)
J.S. Mwitangeti	Senior Corporate Planning Officer
G.M. Bwalya	Senior Corporate Planning Officer (Commercial)
B. Chang'andu	General Manager - Workshops
D. Chabuka	Technical Manager - Motive Power
D. Siwila	Acting Chief Mechanical and Electrical Engineer
E. Ntalasha	Chief Traffic Manager
C. Ndyamba	Director Corporate Planning
S. Sivagnana	Finance Manager
Mrs. George	Chief Management Accountant

#### **USAID**

Fred Winch	Mission Director
Sue Gale	Project Manager
Peter Downs	Project Development Officer
Val Mahan	General Development Officer
Bruno Kosheleff	Assistant Director

**Appendix H**

**EVALUATION OF PROCUREMENT PROCEDURES**

**REGIONAL TRANSPORT DEVELOPMENT PROJECT**

**ZAMBIA COMPONENT**

Project No. 690-0231

**FINAL EVALUATION**

**PROCUREMENT RELATED ISSUES**

**I. SCOPE OF EVALUATION**

This element of the evaluation was undertaken to assess procurement related issues. Specifically, these issues were:

- a) the impact of the project design on project implementation;
- b) the impact of using A.I.D. Regulation I versus Host Country Contracting;
- c) the impact of competitive versus proprietary procurement;
- d) the strengths and weaknesses of the Project Implementation Plan;
- e) A.I.D. Project Management;
- f) the processing of Project Documentation;
- g) the impact of following A.I.D. regulations and procedures;
- h) the impact of RIG's investigation of two suppliers;
- i) the impact of SGS inspection;
- j) the procurement aspects which resulted in the most significant management time by A.I.D. and Zambia Railways;
- k) following the implementation schedule and ZR/GOZ established procedures and good commercial practice;
- l) Procurement tracking and arrival accounting;
- m) Inventory procedures and storage facilities security;
- n) Efficiency of payment procedures and adequacy of financial controls;

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## II. RESOURCES

This part of the evaluation is based on the review of project files at USAID/Zambia and Zambia Railways. Interviews/Discussions were held with G. Silungwe-Sr. Overseas Buyer-Zambia Railways, Mr. Chugh-Sr. Engineer-Zambia Railways, Jim Harmon-former CMO-USAID/Zambia, Sue Gale-USAID/Zambia, and Tom Nelson, G.E, all of whom were involved in the Project. Meetings were also held with Mr. Ng'andu-Purchasing Manager-Zambia Railways, Mr. Sikazwe-Director of Purchasing-Zambia Railways, and Lt. Col. Simumba-Managing Director-Zambia Railways.

## III. FINDINGS

### A. Design

The Zambia Component's specific purpose of improving the capacity and efficiency of Zambia Railway's has, indeed, been met. However, this success resulted from the reactive project implementation by USAID/Zambia and Zambia rather than the design. Unlike the simplistic approach described in the Project Paper, USAID and the Railways found themselves faced with a highly management intensive project to implement.

The Project Paper envisioned one \$5 million spare parts purchase to overhaul 12 locomotives in three years. By the project's end and after four Project Paper Amendments, one major procurement of \$7 million, another of \$3 million and five emergency purchases totaling \$604,583.19 for locomotive spare parts and the overhaul of 25 locomotives will have been accomplished in seven years. The major parts purchases consisted of six contracts for the \$7 million and five contracts for the \$3 million which had to be supplemented by five emergency procurements.

The initial implementation schedule indicated that the procurement would be started in November 1985, three months after the grant was to have been signed and assuming that the Conditions Precedent were met in November 1985 as well. It also showed that one proprietary contract was to have been executed in February, 1986, that the parts were to have been shipped three months later in May, 1986, and that they were to have arrived in Kabwe at Zambia Railway six months later in November, 1986.

In reality the Agreement was not signed until September 1985 and the Conditions Precedent were not met until February 1986. The initial parts requirement was received by USAID/Zambia in December, 1985. The list was sent to AID/W Office of Procurement for specification review and issuance of the tender once the CP's were met in January 1986. After a series of communications between USAID/Zambia, REDSO/ESA and AID/W, FA/OP determined that negotiated procurement was the most appropriate method to use and issued the Request for Quotation on June 2, 1986 with a closing date of July, 31, 1986 sending it to 8 firms. Amendment no. 1 to this RFQ was issued on June 11, 1986 to include a list of additional parts that Zambia Railways submitted on May 23, 1986. The RFQ contained a requirement that the quote cover at least eighty percent (80%) of the parts. At the closing date only one responsive quote was received. The Regional Commodity Management Officer and the

Regional Legal Advisor reviewed the RFQ and after consultation with FA/OP, a second amendment was issued deleting the restrictive clause and extending the closing date to October 31, 1986. Six quotes were received and evaluated. ZR requested USAID approval of the proposed contract awards on December 1, 1986. The approval was granted on December 12, 1986 in PIL no. 7 and Zambia Railways issued six orders on December 30, 1986. Details of the contracts are contained in Attachment 1, however, it must be noted that none of the quotes provided for a single shipment within three months of award. Rather the number of partial deliveries ranged from one to as many as eight and the shipping dates ranged from six to twelve months. Attachment 1 shows what the actual number of deliveries and the dates of the shipments and receipt by ZR.

Further, the design failed to take into consideration the time it would take to have the Direct Letters of Commitment issued which was predicted on the receipt by Zambia Railways of the respective performance guarantees. These original L/COMs were issued as follows for the first major procurement: a) American Equipment Company on March 25, 1987; b) General Electric on March 25, 1987; c) Kessler on April 10, 1987; d) Myron Snyder also on April 10, 1987; e) ARBACO on April 20, 1987; and f) Westinghouse Air Brakes on April 21, 1987.

The Project Paper Background Section briefly described the organization and management structure of Zambia Railways. However, it lacked any institutional and administrative analyses of Zambia Railways. Thus, the USAID Project Personnel were required to seek their ZR counterparts and instruct them on the A.I.D. procedures and regulations. This did not have a negative impact on the project but it did place a management burden on the USAID Project Personnel as well as those of ZR.

The design called for the use of A.I.D. Regulation I rather than Host Country Contracting Procedures. This was based on the supposedly similarity of the spare parts procurements of the Project to one undertaken under the ZAMCAMP program and because the chief form of assistance to Zambia had been through Commodity Import Programs. There was no further discussion of the similarities or the types of goods procured under the CIPs in the Project Paper. However, in a telex of June, 1985, it was stated that the "rationale for the CIP approach was to accomplish the project objectives while placing a minimal management burden on USAID/Zambia and the Regional Offices. It appears that the CIP mechanism was chosen in order to avoid having to perform an assessment of Zambia Railways procurement and financial capabilities which in essence would have resulted in some type of administrative and institutional analysis. This facilitated the design but had the opposite impact on project management. This was because the first tier beneficiary of the Regional Transport Development Project, Zambia Railways, had no knowledge of or experience with A.I.D. Regulation I and had never been a recipient of an allocation under any of the Commodity Import Programs. And, even though the Regional Commodity Management Officer was to draft the solicitation document, some education on A.I.D.'s way of doing business had to be done by USAID/Zambia Project personnel. Fortunately, the steps in carrying out host country

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contracting and A.I.D. Regulation I are similar and thus, did not have a negative impact on the actual procurements.

As regards the strengths of the Project Implementation Plan, none were found. However, the weaknesses were numerous. The first was the assumption that even one procurement of locomotive spare parts would be easy and not management intensive. Spare parts procurements of any kind are inherently difficult procurements. The sheer magnitude of the types of parts to be purchased and the fact that these were for locomotives that had been bought over ten years ago, impacting on the parts availability, made this an even more onerous endeavor. The time envisioned for availability of the parts for shipment was not researched and utterly unrealistic. The premise that proprietary procurement would be approved left those charged with project implementation with increase administrative responsibilities when approval was not granted. Overall, the Implementation Plan was oversimplistic to the point of deceptive as to the extent of participation by all parties.

#### B. Project Management

The overall opinion of the Zambia Railway personnel involved in project implementation was that the method of procurement was useful and the only problem area was the Cargo Preference requirement. Their involvement in the preparation of the solicitation was limited since A.I.D. personnel actually prepared them. Zambia Railways had only to provide the parts lists and evaluate the quotes received. That A.I.D. was able to provide additional funds to cover all the parts in the first tranche, approved another major parts purchase which allowed more locomotives to be overhauled and adjusted project implementation actions to resolve problems as they arose were commended by Zambia Railway personnel interviewed. They saw the working relationship as more than adequate however they did note that from time to time A.I.D. personnel were not available to answer their questions. The processing of documents was viewed as more or less handled on a timely basis. This took into account that this was before the age of the facsimile equipment and they had to heavily rely on telex communications between the railway and USAID/Zambia. USAID/Zambia had to rely on cable, telex and the diplomatic pouch for its communications with USAID/Zimbabwe, AID/W, and REDSO/ESA. It was also found that an initial discussion with USAID/Zimbabwe's Controller as to what specific documents, etc would be needed to obtain the Letters of Commitment.

In general, it appears from the files reviewed that project documentation was processed efficiently and A.I.D. approval was granted in a timely manner. Two instances of the contrary must be noted. The first was when ZR submitted their initial list of spare parts to be purchased, some of which was illegible to the Mission. USAID/Zambia transmitted this list to AID/W for specification review and RFQ issuance. AID/W had to request clarification from the Mission who in turn had to go back to ZR. This could have been avoided if the Mission had reviewed the list before sending it to AID/W. The second instance was similar in that illegible copies of the ZR's purchase orders were

sent to USAID/Zimbabwe Controller for L/COM issuance. They were returned for legible copies and L/COM issuance was slightly delayed.

All A.I.D. regulations and procedures were followed by USAID and Zambia Railways. Further the lessons learned by these entities during the first major parts procurement were put to use in effecting the second major purchase. On the other hand there was a problem with two of the suppliers complying with the technical specifications (supply of faulty components) which resulted in RIG investigations. Discussions were held with the Assistant United States Attorney in Boston regarding filing of civil fraud suits. However the Department of Justice declined to pursue a civil fraud case against one of the suppliers, and discussions regarding the second supplier are still continuing. It cannot be said that these investigations assisted in the achievement of project objectives but they will serve as lessons learned and could be of benefit to the other country components of this Regional Project.

### C. Project Implementation

Section A above described many of the problems that arose in the implementation of the first major procurement due to the deficient design. The Mission acted quickly to revise the implementation schedules and Zambia Railway/Government of Zambia established procedures were used. One of which was the GOZ requirement that SGS inspect incoming shipments as regards conformity to the technical specifications, quantities and price. In reality SGS was only able to make quantity and price inspections and even with this, some items were short shipped. As regards quality inspection SGS was never given the technical specifications of each part to verify nor do they have in house personnel capable of performing the highly technical evaluation required for these types of spare parts. It appears that SGS limited its inspection to a mere box count as some items were shortshipped. Thus, their inspections, in no way, could have detected the defective and used parts supplied by two of the contractors. It must be noted, however, that their certificate does claim that they do perform quality inspection.

The details provided by Zambia Railways concerning their inspection process of each parts received was remarkable. High level quality assurance testing was performed by the technical personnel and the contractor's were promptly informed of any discrepancies and defects. The inventory procedures were adequate and the majority of the recommendations made by the Price Waterhouse evaluation were implemented by ZR. Zambia Railways has its own security force and their efforts to safeguard not only the A.I.D. funded spares but the entire workshop area is noteworthy.

The payment procedure allowed for payment of ninety percent (90%) of the contract price upon shipment and the balance upon inspection and acceptance. The number of partial shipments increased the workload but overall was found to be efficient. That Zambia Railways did not approve release of the ten percent (10%) until a parts were inspected and accepted by their technical engineers provided adequate financial control and ensured the proper use of project funds. There were, however, a couple of instances where ZR was remiss in advising USAID that the funds could be released.

The overhaul of the locomotives could not be achieved until the parts were received. Thus, the bulk of the management time of Zambia Railways and USAID Project Personnel was spent on acquiring these parts. The first major procurement from solicitation to arrival accounting and inspection and acceptance took up a lot of the concerned parties' time, a lot more than the initial project design indicated. The delays in delivery of parts, non-performance as well as non-delivery on the part of some of the suppliers, the temporary loss of some shipments in the port of Dar Es Salaam, the late receipt of shipping documents, compounded by the supply of defective parts by two of the contractors served to increase the amount of management time that had to be spent by the Mission and ZR personnel.

#### D. Conclusion

In spite of the deficient design and all of the obstacles with which the Mission and ZR personnel were confronted, the parts were purchased, twenty five locomotives were overhauled and the anticipated increase in rolling stock availability is being achieved and surpassed. Above all, the lessons learned from the Zambia experiences are being used by A.I.D. personnel in the region implementing the other ongoing components of the overall project.

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**ATTACHMENT 1**

**SUMMARY OF SPARE PARTS ORDERS**

**ZAMBIA REGIONAL TRANSPORT DEVELOPMENT PROJECT**

690-0231-01 - AMERICAN EQUIPMENT- \$158,385.90

P.O. ISSUED: 12/30/86  
DELIVERY DATE: 6/30/87  
PERFORMANCE GUARANTY REC'D: 2/18/87  
L/COM REQUESTED: NF  
L/COM ISSUED: 3/25/87  
L/COM AMEND. 1 REQUESTED: 5/15/87  
L/COM AMEND. 1 ISSUED: 6/6/87  
PARTS SHIPPED: 7/24/87  
PARTS RECEIVED BY ZR: 1/28/88

COMMENTS: L/COM A-1 extended shipping date to 8/31/87. One shipment. No major problems.

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690-0231-01 - WESTINGHOUSE AIR BRAKE CO. - \$451,271.73

P.O. ISSUED: 12/30/86  
DELIVERY DATE: 8/31/87  
PERFORMANCE GUARANTY REC'D: 3/5/87  
L/COM REQUESTED: 4/8/87  
L/COM ISSUED: 4/21/87  
PARTS SHIPPED: B/L NOT FOUND AT USAID  
PARTS RECEIVED BY ZR: 1/26/88

COMMENTS: L/COM TERMINAL SHIPPING DATE WAS 8/31/87. NO PROBLEMS.

690-0231-01 - ARBACO - \$220,949.84

P.O. ISSUED: 12/30/86  
DELIVERY DATE: 5/31/87  
PERFORMANCE BOND REC'D: 4/20/87  
L/COM REQUESTED: 4/20/87  
L/COM ISSUED: 4/21/87  
PARTS SHIPPED: 8/29/87  
PARTS RECEIVED BY ZR: 1/28/88

COMMENTS: Bank confirmation of performance guarantee received on 3/31/87 but could not be released to exchange control formalities. Performance Bond was sent instead. ZR found that Piston Main and Master Controls were not new and advised USAID via telex of 11/23/88. Resulted in RIG investigation. No criminal proceedings could be brought against them,

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690-0231-KESSLER - \$1,248,230.86

P.O. ISSUED: 12/30/86  
DELIVERY DATE: 8/31/87  
PERFORMANCE BOND REC'D: 3/24/87  
L/COM REQUESTED: 4/1/87  
L/COM ISSUED: 4/10/87  
PARTS SHIPPED: a. 6/25/87  
b. 8/21/87  
c. 10/21/87  
d. 2/26/88  
PARTS RECEIVED BY ZR: 8/26/88

COMMENTS: L/COM A-1 issued 12/10/87 extending shipping date to 1/15/88. L/COM A-2 issued 3/10/88 extending shipping date to 3/1/88. L/COM A-3 issued 5/25/88 extending shipping date to 6/30/88 and authorizing 8 partial shipments. L/COM A-4 issued 8/17/88 increasing value. Items not shipped in containers and poorly packed. Some items damaged and 20 boxes lost. Also they shipped many incorrect items, i.e. car battery instead of a locomotive battery.

690-0231-01-MYRON SYNDER - \$101,718.30

P.O. ISSUED: 12/30/86  
DELIVERY DATE: 8/31/87  
PERFORMANCE GUARANTY REC'D: NF  
L/COM REQUESTED: 4/1/87  
L/COM ISSUED: 4/10/87  
PARTS SHIPPED: a. 8/29/87  
b. 10/12/87  
c. 12/9/87  
d. 2/28/88-air  
e. 9/30/88-air  
PARTS RECEIVED BY ZR: 12/6/88

COMMENTS: No copies of L/COM amendments were found in USAID files. However, Synder requested the following extensions: on 8/13/87 to 9/30/87, on 9/29/87 to 10/31/87, to 12/31/87 with and increase of 5 shipments with last one by air, and to Jan. 15, 1988 due to weather problems. Also found telex of 12 Aug 88, in which ZR Purchasing and Supplies Manager waived SGS requirement but was not clear for which shipment. This order was also subjected to a RIG investigation and the parts in question were ordered from G.E. as part of an emergency order.

690-0231-01-GENERAL ELECTRIC - \$4,321,000

P.O. ISSUED: 12/30/86

DELIVERY DATE: 9/1/87

PERFORMANCE GUARANTY REC'D: 2/26/87

L/COM REQUESTED: NF

L/COM ISSUED: 3/25/87

PARTS SHIPPED:

- a. 7/31/87
- b. 8/24/87
- c. 9/10/87
- d. 9/25/87
- e. 1/11/88
- f. NF

PARTS RECEIVED BY ZR: 9/8/88

COMMENTS: Did not find in USAID file copies of the request for the initial L/COM or the shipping documents covering the sixth shipment. On 8/30/87, G.E. requested an extension of delivery date to 11/1/87. AID approved the amendment on 9/9/87 and L/COM A-1 was issued on 9/21/87. L/COM A-2 was issued on 10/27/87 incorporating P.O. A-1. On 11/16/87, G.E. requested another delivery extension to 1/31/88. L/COM A-3 was issued on 12/10/87 extending expiration date to 1/15/88. Although not found in the file, it appears that another L/COM amendment was issued because a sixth shipment was made sometime after the January, 1988 final delivery date.

690-0231-87-02-AMERICAN EQUIPMENT CO. - \$138,456.85

P.O. ISSUED: 8/18/88  
DELIVERY DATE: 9 MONTHS FROM RECEIPT OF OPERABLE L/COM  
PERFORMANCE GUARANTY REC'D: 9/9/88  
L/COM REQUESTED: 9/15/88  
L/COM ISSUED: 9/21/88  
PARTS SHIPPED: a. 6/2/89  
b. 11/30/89  
PARTS RECEIVED BY ZR: 9/8/90

COMMENTS: P.O. A-1 issued on 11/21/88 changing some of the part numbers. P.O. A-2 issued to increase total due to raise in freight costs. P.O. A-3 issued 8/3/89 to extend ship date to 11/30/89. L/COM issued allowing up to 3 shipments to be delivered no later than 6/30/89. L/COM A-1 issued on 10/24/88 to incorporate requirement for Form 11. L/COM A-2 issued on 12/6/88 to incorporate P.O. amendment of 11/21/88. L/COM A-3 issued 8/2/89 to incorporate P.O. amendment of 6/21/89. L/COM A-4 issued 8/10/89 to extend ship date to 11/30/89. L/COM A-5 issued 12/1/89 to increase total.

690-0231-87-02-GENERAL ELECTRIC-\$2,210,782.80

P.O. ISSUED: 8/16/88

DELIVERY DATE: 9 MONTHS FROM RECEIPT OF OPERABLE L/COM

PERFORMANCE GUARANTY REC'D: NF

L/COM REQUESTED: 9/15/88

L/COM ISSUED: 11/30/88

PARTS SHIPPED:

- a. 1/24/89
- b. 6/1/89
- c. 8/25/89
- d. 8/28/89 - AIR
- e. 1/31/90
- f. 5/8/90

PARTS RECEIVED BY ZR:

- a. 6/9/89
- b. 7/18/89
- c. INCORRECT INFO PROVIDED
- d. 9/8/89 - AIR
- e. INCORRECT INFO PROVIDED
- f. INFO NOT PROVIDED

COMMENTS: P.O. A-1 issued 6/27 to allow air freight of items 982 and 983 COD to ZR. P.O. A-2 issued 11/21/88 to correct some part numbers and increase the prices for some items. P.O. A-3 issued 9/27/89 to extend delivery date to 1/31/90 and correct several part numbers. P.O. A-4 issued 12/28/89 to extend delivery to 5/31/90, include replacement spares due to obsolescence and reduce total to \$2,152,245.99. Original L/COM issued with delivery date of 8/31/89. L/COM A-1 issued 8/2/89 to incorporate P.O. amendments 1 and 2 and to allow 4 partial shipments. L/COM A-2 issued 9/27/89 to extend delivery to 1/31/90. It also appeared that P.O. and L/COM were further amended to allow for the 5/90 delivery but no copies of these documents were found in the USAID files.

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690-0231-87-02-ARBACO -\$96,364.86

P.O. ISSUED: 8/16/88  
DELIVERY DATE: 9 MONTHS FROM RECEIPT OF OPERABLE L/COM  
PERFORMANCE GUARANTY REC'D: 8/17/88  
L/COM REQUESTED: 8/18/88  
L/COM ISSUED: 9/7/88  
PARTS SHIPPED: 5/31/89  
PARTS RECEIVED BY ZR: 2/11/92

COMMENTS: P.O. A-1 issued 9/12/88 deleting item 1583. P.O. A-2 issued 8/10/89 to extend shipping date to 10/15/89. P.O. A-3 issued 1/30/90 extending shipping date to 1/31/90 and reducing total. Original L/COM provided for shipment by 5/31/89. L/COM A-1 issued 10/24/88 to include Form 11 requirement. L/COM A-2 issued 8/30/89 extending shipping date to 10/15/89. L/COM A-3 issued 1/19/90 extending shipping date to 1/31/90. ARBACO failed to ship items 2, 67, 218, 227, 289, 359, 379, 504, 1050, and 1965. USAID files did not contain any information concerning the later shipment(s).

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690-0231-87-02-KESSLER -\$511,910.08

P.O. ISSUED: 8/16/88  
DELIVERY DATE: 9 MONTHS FROM RECEIPT OF OPERABLE L/COM  
PERFORMANCE GUARANTY REC'D: NF  
L/COM REQUESTED: 11/26/88  
L/COM ISSUED: 11/30/88  
PARTS SHIPPED: a. 5/23/89  
b. 7/27/89  
c. 8/3/89 -AIR  
d. 11/15/90  
e. 4/28/90  
PARTS RECEIVED BY ZR: 5/8/90

COMMENTS: In their letter of 11/10/88 Kessler advised ZR of price increase. The former Mission Director sent a letter to Kessler encouraging them to on 6/8/89. P.O. A-1 issued 7/2/89 to increase quantities and total. P.O. A-2 issued 10/5/89 to extend shipping date to 11/30/89 and increase quantities. P.O. A-3 issued 3/29/90 to extend shipping date to 3/19/90, delete items 136, 258, 280, 1045, 1072, 1426, 1462, 1490, 2055, and 2072, decrease the total and authorize five sea and one air freight shipments. Original L/COM shipping date was 8/31/89. L/COM A-1 issued 5/2/89 to authorize four shipments including one air shipment of bearings. L/COM A-2 issued 8/30/89 increasing

value, including P.O. A-1, and authorizing four partial shipments, one of which would be by air. It appears that at least one more L/COM amendment was issued to authorize the later shipments although not found in Mission's files.

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690-0231-87-02-WABCO-\$34,450.16

P.O. ISSUED: 8/16/88  
DELIVERY DATE: 9 MONTHS FROM RECEIPT OF OPERABLE L/COM  
PERFORMANCE GUARANTY REC'D: NF  
L/COM REQUESTED: 8/26/88  
L/COM ISSUED: 9/7/88  
PARTS SHIPPED: 6/21/89  
PARTS RECEIVED BY ZR: 1/6/90

COMMENTS: P.O. amended 10/17/88 to correct some part numbers, include freight, insurance and handling charges, and increase value. Original L/COM authorized maximum 3 partial shipments and latest shipping date of 6/30/89. L/COM A-1 issued 10/24/88 adding requirement for Form 11. L/COM A-2 issued 11/15/88 incorporating changes contained in P.O. A-1. One shipment made with Transportation Waiver.

## EMERGENCY PROCUREMENTS

### I. G.E. - \$221,004.99

Zambia Railways requested quotations from Myron Synder, G.E., ARBACO, WABCO, and Kessler on 6 May 88 for 15 line items of locomotive spare parts. On 8/12/88 ZR requested AID approval of emergency procurement of the parts due to short shipments and incorrect supply of parts ordered under RFQ 86-01 as well as to cover unforeseen items. A waiver of competition and authority for single source procurement was approved by USAID on 11/25/88. ZR issued P.O. on 12/15/88 to General Electric for delivery within 3 months of receipt of L/COM via air freight in the amount of \$221,004.99. Signed copy was sent to USAID on 12/29/88 who sent it via courier to USAID/Harare on 12/30/88. L/COM was issued on 1/9/89. Two shipments were made on 2/3/89 and 4/26/89.

### II. G.E. - \$29,578.20

On 3/15/89 ZR requested AID approval of emergency procurement of the parts due to technological changes which affected the gaskets, o-rings, seals, circuit breakers, switches, etc. A waiver of competition and authority for single source procurement was approved by USAID on 3/23/89. ZR issued P.O. on 4/5/89 to General Electric in the amount of \$29,548.20. Signed copy was sent to USAID on 4/7/89 who requested L/COM issuance by USAID/Harare on 4/21/89. L/COM was issued on 5/2/89 with latest shipping date of 12/8/89. This was subsequently amended to extend shipping date to 2/8/90. One shipment was made on 6/25/89 and it appears that another was made later on but there were no copies of the shipping documents in the files.

### III. G.E. - \$45,000.00

On 12/15/89 ZR requested AID approval of emergency procurement of the locomotive spare parts. A waiver of competition and authority for single source procurement was approved by USAID on 1/2/90. ZR issued P.O. on 2/23/90 to General Electric in the amount of \$45,000.00. USAID requested Harare Controller to issue the L/COM on 3/20/90. L/COM was issued on 3/29/90 with latest shipping date of 6/15/90. One shipment was made on 7/25/90.

### IV. G.E. - \$225,000

On 11/30/89 ZR requested AID approval of emergency procurement of the parts to replace the defective parts from Myron Synder and ARBACO. A waiver of competition and authority for single source procurement was approved by USAID, however, the although the memo was dated 2/12/90, the actual date of signature was not indicated. Supplement no. 3 to the Project Paper was signed on 10 Jan 90 increasing the life of project funding by \$225,000 and extending the PACD to 8/31/91. ZR issued P.O. on 2/26/90 to General Electric in the amount of \$225,000. USAID requested Harare Controller to issue the L/COM on 3/20/90. L/COM was issued on 3/29/90 with latest shipping date of 6/15/90. One shipment was made on 6/9/90.

#### IV. G.E. - \$129,000

On 11/26/89 ZR requested AID approval to use residual funds to purchase additional locomotive spare parts. The detailed list of parts was submitted to USAID on 6 May 91. A waiver of competition and authority for single source procurement was approved by USAID, however, although the memo was dated 12/4/90, the actual date of signature was not indicated. ZR issued P.O. on 8/21/91 to General Electric in the amount of \$129,000. USAID requested Harare Controller to issue the L/COM on 8/8/91. L/COM was issued on 8/21/91 with latest shipping date of 10/31/91. L/COM A-1 was issued on 10/7/91 to extend the shipping date to 3/15/92. L/COM A-2 was issued 2/26/92 to authorize air shipment of the parts.\* On 3/6/92 ZR requested another L/COM extension of the shipping date to 4/15/92\*\* No information concerning this latest request was found in the files and the shipment was to take place after this portion of the evaluation was done. **MISSION NEEDS TO VERIFY WITH ZAMBIA RAILWAY THAT THESE PARTS WERE RECEIVED, INSPECTED AND ACCEPTED.**

Note By Mission Project Manager:

\* Only partial air shipment was requested by ZR and this was granted in L/Com Amendment A-2 of 2/26/92.

\*\* G.E. had stated that they could not find a vessel to ship the spares before the final shipment date of 3/15/92. However, the spares were shipped on the Vessel Ashley Lykes Vogage 120 on March 26/27, 1992, well within the amended L/Com date of April 15, 1992 (L/Com Amendment No. 3).

On arrival of the parts at Zambia Railways in Kabwe, Mission will verify that Zambia Railways are satisfied with the parts.

S. Gale, Project Manager  
5/19/92