690 0076

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MEMORANDUM

TO: A. Ruiz P.E., Evaluation Team Leader

FROM: J.F. Smith P.E., Chief Engineer, REDSO/ESA

SUBJ: Evaluation: Project 690-0076, Southern Perimeter Road

DATE: 23 May 1983

1. The attached engineering assessment is self-explanatory in content and purpose. Its inclusion in the subject evaluation should be as previously discussed; i.e., intact, unaltered and in lieu of table-of-content breakdown. The latter, because of incompleteness, spawned by time constraints, and its nature (and intention) as a lead-in tool for Phase II evaluation use.

2. It is strongly recommended that the previously-adopted table-of-contents be retained since its extensive inclusions were purposely designed for both Phase I and Phase II use to ensure the necessary evaluation completeness. Incomplete or blank T of C sections, resulting from our Phase I evaluation, are normal for a two-phase effort and should not be deleted. Rather, such sections should be designated for Phase II completion.

3. It is requested that the attached engineering assessment not be altered without my concurrence and that any other engineering inclusions be coordinated with me before finalization.

JFS:CAR

Attachment

SOUTHERN PERIMETER ROAD
(690-0076)

PHASE I EVALUATION
TITLES I, II & III
(ENGINEERING REVIEW)

J.F. Smith, P.E.

I. GENERAL:

A. Justification/Background:

1. This review is generated from the writer's seconded position as engineering representative on a team assembled for the SPR evaluation. Its purpose, which will be more specifically identified in Section I.A.2, has genesis in the extraordinary circumstances surrounding the Project and collateral evaluation criteria.

2. Original concepts envisaged a one-month evaluation effort for the engineer with subsequent reduction to two weeks as an accommodation to his available time. Although no engineering scope-of-work has been defined, it was initially considered that Title II would receive primary attention, with Titles Nos. I and III occupying secondary positions of priority. The former had been completed in the not-too-recent past and the latter had been the subject of intensive scrutiny in late 1982 and early 1983. Such consideration was negated, however, by the initial Maseru-review of project scope and related conditions which were both unique and germane.

3. Preliminary team meetings established a fundamental precept which prescribed an intensive, in-depth evaluation based, in great part, upon the following general dictates:

a. The evaluation was described by Mission officials as being the first combined external evaluation of Titles Nos. I, II and III.

b. A total project cost (current) of $41.5M, of which $34M is U.S. dollar funded, demanded maximum effort due to the large grant involvement.

c. Previous, and thoroughly-investigated project distress, which culminated in the cancellation of one participant's contract, suggested strongly that the evaluation would receive wide-spread attention, and therefore, merited an all-inclusive approach.

d. Extensive overlapping of Titles I, II and III prevented isolation of one as an entity for evaluation, thereby creating a review scenario embracing all three.

4. From I.A.3 above, it was justifiably concluded that a conflict, involving available time vs work requirements, existed. Following a maximum extension of individual time schedules and reaffirmation of evaluation needs, the solution most nearly satisfying all parameters was adopted; i.e., a two-phase evaluation with the current team representing Phase I. It was recognized that such an approach would enhance engineering efforts primarily with somewhat lesser, but significant, benefit to economic input and relatively low, but potentially higher, impact upon socio-environmental review.

5. Accordingly, a table of contents was compiled which, due to its extensive inclusions, was adopted not only as the table of contents for a combined Phase I and Phase II evaluation report, but also as a detailed guideline/checklist for evaluators of both phases. This T of C drew from personal experience, the Agency's manual on evaluation, excerpts from similar evaluation reports, and awareness of problems/conditions unique to this project. It is, therefore, extensive but compatible with conditions established by I.A.3 above and is attached.

6. With T of C adoption, it was intended that carefuly-orchestrated, sectionalized writing would lead into Phase 2 completion of appropriate, incomplete or omitted sections with minimum back-tracking. This is still envisaged for all but the more detailed engineering input where varying amounts of investigative overlap must necessarily occur.

7. Through interviews, contract file and document review, and field investigation, each engineering or construction implication escalated to proportions which were no longer compatible with the reporting intent as cited immediately above in I.A.6; i.e., expansion by "Pandora's Box" concept precluded follow-up and subsequent reporting within available time frames, fragmented report writing was viewed as diluting the import of subject matter, and Phase II evaluation was predicted as possibly suffering a detrimental impact by having to excessively backtrack for clarification or further data accumulation.

8. As a means of maximizing Phase I effect and minimizing Phase II overlap and confusion, it was a team consensus that an alternate form of engineering/construction submittal was more appropriate for this initial evaluation phase. The selected option took the form of this report.

9. Note that recommendations, appearing throughout this review, are intended as a partial list for guidance only and are not intended as either a complete list or as constraint upon the Phase II evaluation team.

B. Purpose

1. Although Phase I evaluation efforts permitted some engineering conclusions and recommendations, it is believed that Phase II will provide greater opportunity for pragmatic appraisal. This is most evident from awareness that the Phase II team will be assembled with an adequate time frame commensurate with the in-depth demands of previously-cited evaluation considerations.

2. Equally, it is believed that Phase II efforts will be most effective through maximum coordination with Phase I results. Such an obvious conclusion, however, belies the difficulty surrounding actual data transfer. Since time constraints prevented more than a minimum-depth engineering approach, information gathered evolved into a wide-ranging, but fragmented, pattern. It becomes the purpose of this report, therefore, to transmit the contents of such a pattern in a manner which will accomplish the following:

a. Allow the Phase II team to continue the evaluation with minimum delay in assessing specific Phase I accomplishments.

b. Permit the Phase II team to readily isolate previous efforts related to document review, persons interviewed and other sources of information which led to stated conclusions and recommendations.

c. Identify major problem areas, both contractual and physical, and delineate status of evaluation efforts to date.

d. Underscore the need for an in-depth project appraisal through detailed completion of the previously-adopted, extensive table of contents.

3. Recommendations (General):

a. That the Phase II team be assembled following the generation of base-line economic data which is being discussed elsewhere in the Phase I report. Such timing will allow combined disciplines to complete the evaluation process. Team assembly is estimated as occurring 90-120 days (minimum) after the start of base-line data accumulation.

b. That the Phase II team continue the use of the T of C as developed in Phase I.

c. That the Phase II team be composed of:

i. Team Leader - Civil Engineer - David Gephart
ii. Transportation Economist
iii. Socio-Anthropologist Specialist (as required)
iv. Environmentalist (as required)

d. That the engineering input be programmed for a minimum of one month and, for the team leader, an additional two weeks be allowed for finalizing the report and review with Mission personnel.

e. That Titles I, II and III be the subject of audit and investigation by RIG/A and RIG/II respectively. Although both offices participated in a similar Title I exercize, following the PRCH contract cancellation, a follow-up including all three Titles is recommended on a schedule to be coordinated with USAID/Lesotho.

f. That USAID/Lesotho review contract files, prior to Phase II evaluations, for chronological inclusion of, but not necessarily limited to, the following:

i. PID
ii. PP
iii. RFP's and IFB's
iv. Scope of Work (all)
v. Contracts (all)
vi. Amendments (all)
vii. Reports (all)
viii. Correspondence (all incoming/outgoing including copies between non-Agency participants)
ix. Invoices
x. Previous evaluation reports
xi. Inserts giving location and nature of related classified material
xii. Other (including back-up data)

II. EVALUATION

A. Title I (Design)

1. The common denominator between Titles I, II, and III is the highway/drainage design effort required of PRCH in their Title I contract. This included, in part: highway/drainage design, contract document preparation, specifications for construction, and quantity/cost estimates. Although SOW details cite contractual obligations, it must also be accepted that there are fundamental operations, inherent to a given engineering exercise; i.e., survey to highway design, hydraulic/watershed calculations to drainage design, field alignment review to computerized design practice, quality control (testing) to construction implementation, documentation/calculation/approvals to design changes, quantity/cost revisions to any changes, etc.

2. Since many of the problems in Titles II and III, disclosed during the Phase I evaluation, were directly related to Title I contract execution, the absolute need for further Phase I examination was apparent.

3. PRCH's Title I contract required, in part, full highway/drainage design including quantity/cost estimates for the entire length of the project's approximate 247 km. from Mohale's Hoek to Qacha's Nek. The design was reportedly finished (although unseen by the Phase I team) but quantity/cost estimates were preliminary only. Since the design indicated a highway standard higher than desired, and since rough cost estimates implied a construction price (approximately $120M) vastly more expensive than available funds allowed, PRCH was paid for the work and their efforts scrapped.

4. Recommendations

a. That a comparison be made in the Phase II evaluation between the design standards recommended by the feasibility study, those envisaged by the PP, PRCH contract standards, and those produced by PRCH which resulted in the wasted exercise.

b. That the comparison, cited immediately above, establish what approved modifications took place, if any, and if the initial PRCH design followed design requirements previously approved.

c. That actual drainage calculation existence be determined to validate structures/pipes as purchased and constructed.

d. That quantity/cost back-up data be located to determine the extent and accuracy of submitted estimates.

5. PRCH was then requested to prepare a lower-standard design, by contract modification, and this led to the following:

a. A lower-standard design, including quantities and costs for "the cut-off" from Mount Moorosi to Mphaki (approximately 38 km.)

b. Approved PP revision.

c. Revised PRCH contract which gave birth to Titles II and III.

6. Title II was established with Nello Teer Inc. (NT) as the construction contractor (after a bid procedure not reviewed by the Phase I team), PRCH as the A&E for construction management and a design represented by II.A.5.a. above.

7. Title III was established as a force account operation, with PRCH as the supervisory group and no specific roadway/drainage design. The latter was to be developed by the PRCH/Title III group on a turn-key basis, ahead of construction, and incorporate previously-designed (See II.A.3 above) drainage features.

8. Recommendations

a. That PRCH's "lower-standard" design be reviewed in Phase II for compliance with the requested, local GS-3 standards.

b. That payment for PRCH's second design also be reviewed in conjunction with recommendations made in II.A.4 above.

c. That quantity/cost back-up data be located (if existing) by MOW/USAID, for Phase II review, relative to conditions which will be discussed under Titles II and II of this report.

9. Generally, it was concluded that, due to the unavoidable relationship between the design of Title I and implementation of Titles II and III, there should be heavy emphasis placed upon further review of PRCH's Title I contract and its product. Equally concluded, was that such emphasis might require further audit/investigation by RIG/A and RIG/II respectively as a follow-up to their earlier efforts.

B. Title II (Implementation)

1. Per the request, noted in II.A.5 above, PRCH completed a low-standard design covering the 38 km. cut-off from Mount Moorosi to Mphaki. There have been, however, major implementation issues which make design validity highly suspect.

2. On 17 May 1983, NT reported that 37.5% of the first 15 km. out of Mount Moorosi had required design-alignment relocation. PRCH verbally confirmed the extent of this realignment. Reasons for the changes, offered by both PRCH and NT with general agreement by MOW, reflect an intended reduction in rock excavations and improved alignment geometrics.

3. Collaterally, although alignment changes were intended to reduce rock excavation and although all parties agree that rockex would indeed have been higher by following the PRCH design alignment, actual rockex quantities have virtually doubled. Original PRCH estimates, which NT bid against, called for 129,000 CM. Projected quantities reflect a minimum of approximately 270,000 CM.

4. It is to be noted that in June 1982, invoices were presented for approximately 80,000 CM of rockex, or about 62% of the BOQ amount. This was an obvious indicator of things to come. In September 1982, the invoiced quantity was approximately 140,000 CM, or about 109% of BOQ amounts. Although the over-run might have been foreseen, no correspondence can be found which would have notified any participants of impending quantity/cost increases. There was, therefore, no opportunity for decision-making re funds or alternatives. Thus, although all parties were aware of the situation, no one had apparently taken official action prior to NT's claim for additional time and money.

5. Directives for alignment changes were issued to NT by PRCH. Since PRCH is the authorized professional representatives of MOW, this practice, per se, does not warrant criticism. Collateral implications, however, make the procedure questionable. The PRCH Resident Engineer advised the evaluation team that his limit of authority to make changes, without MOW approval, was $10,000. Since each of the realignment directives was issued without accompanying cost revisions, there was no control exercised over authorization maximums. Additionally, as alignment changes accumulated, so did rockex over-runs and associated cost increases. The evaluation team is aware that over-runs in rockex were initiated by incorrect PRCH Title I estimates. This does not, however, negate the apparent and repeated practice by PRCH (Title II) of exceeding their limit-of-change authority. Equally, it is concluded that MOW did not exercise adequate control of the A&E in monitoring the changes or the resulting cost/quantity implications. A further conclusion is that no accumulation of rockex totals were developed for over-run considerations, except those presented as invoice amounts by NT.

6. Complicating the extensive realignment situation is the realization that such revisions were found necessary on the second PRCH (Title I) design. The necessity of having to compensate PRCH for two Title I designs has already been questioned and the Title II necessity for extensive changes to the second design makes the initial PRCH effort even more suspect. The situation implies strongly that GA funds paid for something that either wasn't delivered or was faulty to the point of being partially unusable. This scenario is further complicated by being the target of claims for additional time and money by NT. These claims have been submitted as follows:

a. Claim No. 4: Rock excavation and type of construction methods imposed. M309,271 plus 10 days.

b. Claim No. 5: Price increases for blasting. M93,204.99 (no time increase).

c. Claim No. 6: Delay due to over-run of rock excavation. M762,551 plus 4.5 months.

d. Claim No. 7: Delay due to roadway realignment. M5,805,025 plus 6.16 months.

Certainly, the NT claims will be settled for a lesser amount by negotiation but any increase further reinforces the apparent inadequacy of PRCH's original design or the alignment changes or both.

7. A review of the original (second) design and field implementation also disclosed:

a. Title I rockex quantities were estimated has having an average of 5M overburden. This was reported by PRCH as having been determined from interpretation of actual subsurface investigation in the field and from induced seismic probes. Subsequently, during Title II implementation, the average overburden was found to be only about one meter (1 M). Although this error accounts for a large portion of the rockex over-run, field measurements suggest that, even with an overburden adjustment for depth, a rockex over-run of approximately 35-40% would still occur.

b. Realignment locations evidenced extensive rockex, and other works, prior to the decision for realignment. This was most apparent through the designed SW approach to the Quthing River Bridge where NT reported verbally to the evaluation team that an estimated 38,000 CM of rock had been removed before being abandoned in favor of a new location. Although contract rates vary between the approximate unit costs of $9.00 - $11.00 per CM, due to interpretations to exchange rates, expanded funds for abandoned work still total $342,000 - $418,000. Discounting contractor inflation in estimating quantities, considerable loss was apparently incurred. It is noted that PRCH and NT both cite an overall savings of approximately $200,000 by realigning the approach section but such a savings in no way voids the previously expended funds on an abandoned alignment. The evaluation team has concluded that proper Title I design practice should have recognized the alternate alignment prior to Title II contracting.

c. On-site inspection presented an opportunity to review actual field locations of the PRCH design vs realignment sections. In each case, the realighment appeared justified either due to reduced rockex or factors related to horizontal or vertical geometrics. Since the necessity for such changes was apparent, the team concluded that the design had been computerized and that, although PRCH (Title I) had employed ground reconnaissance during preliminary design stages, no such ground effort was made later, with the computer printout in hand. It is stressed, however, that this is a conclusion based upon experience and judgement, but unprovable.

d. The first Title I (PRCH) design criteria included a maximum 10% gradient which could be increased to 14% but not in lengths exceeding 200 M. The lower-standard, revised design, adopted for Title II, reflected GOL G-3 criteria which allows grades up to 14% for 1000 M. This adopted criteria, however, appears to have been exceeded in the vicinity of Km 16 (±) with a grade and distance estimated at 15% and 2 km respectively. Although provisions are being considered for escape roads, projected bus and truck traffic suggest an undesirable configuration.

3. Additional evaluation considerations resulted in the following:

a. Currently there are no "as-built" drawings which reflect implementation changes. PRCH states that these will be prepared.

b. There are no scheduled staff meetings between PRCH and NT or PRCH and MOW. Such meetings are ad hoc and sporadic.

c. Alignment changes were apparently of arbitrary selection without cost analysis of alternatives.

d. The NT contract completion date of August 1983 is now projected to early-mid 1984, coinciding with time-extension claims. The team suggests that such an extensive time-increase request might be influenced by NT's lack of other contracts.

9. It was stated that NT's construction equipment had experienced past heavy usage and might be excessive for the project. Additionally, interviews indicated extensive repair efforts. In view of NT's lack of work elsewhere, it must be speculated that NT may be using Title II as an equipment rehabilitation exercise. The obvious response is that Title II's lump-sum characteristics suggest such NT action only reflects a lower profit and is, therefore, of no evaluation interest. Conversely, however, if NT's price includes equipment rehabilitation for future works, it represents a funding consideration for Title II that is inappropriate and one to be avoided in the future.

10. NT claims were reviewed and discussed with NT, PRCH and USAID/Lesotho. Significantly, of the seven claims, four are directly related to PRCH's design, directives, or alledged non-actions. This suggests that PRCH must not only respond as the MOW's representative but also in defense of their operational role. NT's claim data is impressive in volume, but its appropriateness and relevance was indeterminable.

11. Recommendations

a. That the Phase II evaluation team expand the Phase I team's review of PRCH's Title I design sequence and results, and the implications of Title I product upon the subsequent implementation problems of Title II. An

expanded, in-depth review should encompass, in part, payments vs contract requirements, over-payments or payments for inappropriate/unusable products, ramifications of design inaccuracies regarding subsequent necessary charges and associated costs, quantity/cost over-runs vs original estimates, field-change procedures, documentation, et al.

b. That RIG/A and RIG/II be programmed into further project review relative to evaluation findings and USAID/Lesotho's scheduling.

c. That non-conformance to adopted design criteria be reviewed.

d. That MOW require "as-built" drawings to be immediately emphasized by PRCH and that they be maintained.

e. That MOW/USAID/Lesotho require scheduled staff meetings between PRCH and NT, PRCH and MOW, with Mission participation when appropriate.

f. That Phase II evaluation further address the lack of alternative comparisons by cost prior to realignments, or other change, selection.

g. That the subject of NT's equipment fleet repair vs Title II need vs future NT use be reviewed further.

h. That MOW/USAID-Lesotho carefully review PRCH's claim-rebuttal data, prior to negotiations, and pragmatically assess both the most applicable approach and settlement-potential goal.

i. That because of the "Pandora's Box" nature of Phase I evaluation review efforts, the Phase II team be guided by the need to assess, in greater-than-normal depth, this highly-sensitive project.

j. That MOW exert greater control over Title II operations. This may be in the form of more frequent field trips, greater demands for documentation and procedural conformance, increased participation in meetings, closer and more timely scrutiny of invoices/quantities/costs, and other means as required.

12. It was concluded that an assessment of Quthing River Bridge conditions warranted an isolated review. After the initial PRCH design, which was paid for in Title I, NT proposed a redesign at their (NT) expense. This was admittedly for their convenience and appropriate authorization was given for the NT submittal.

13. PRCH was contracted to review the NT redesign with payment to be made by NT. PRCH's initial fee request was for $37,500 and was later negotiated downward to $31,750, of which $15,000 was for professional insurance. Since A&E firms normally carry such insurance, PRCH was querried as to why an additional payment was required for this service. Their response cited a $250,000 deductable clause in their current insurance and the need for a $15,000 payment for that range of coverage. No response was received to the follow-up querry, "If you normally operate with a deductable insurance clause, why do you treat this situation differently since, in all cases, you are doing similar engineering reviews?"

14. Prior to redesign by NT, the originally-designed PRCH structure was laid out in the field. Subsequently, NT was authorized by PRCH to engage Matrolab Ltd., from Johannesburg, RSA, for bridge site borings.

15. The structure was designed for pre-stressed concrete beams, with a 40 M center span between piers and two 20 M spans between piers and abutments. Although local geology strongly implied underlying strata of unweathered sandstone or basaltic bedrock, the nature of the structure suggested a design-need for extensive and conclusive exploration of subsurface conditions.

16. Matrolab Ltd. was commissioned for only four borings, one each at two pier and two abutment locations. Although possibly an unnecessary precaution, it is felt that a minimum of two borings at each of the four locations would have been appropriate insurance against changes in subsurface conditions.

17. PRCH reported that: (a) cores were taken from each location and delivered to their site office; (b) the cores were then shipped to PRCH/NYC; (c) PRCH/NYC did the core analysis and subsequent design; and (d) Matrolab Ltd. provided no post-drilling service either in the form of analysis or reporting. There was no drilling/analysis report submitted by PRCH, as far as can be determined from interviews or file review.

18. The NT redesign was endorsed by PRCH, approved by MOW and implemented. Its location differed from the PRCH design to accommodate roadway realignment discussed earlier in this report section. This relocation involved a 10° rotation around abutment "B" (NE end) which remained fixed. The rotation was in a downstream direction with abutment "A" being repositioned by approximately 20 M and each of the two piers correspondingly lesser distances. Borings were not taken at the new abutment and pier locations but rather, design proceeded on the apparent assumption that there was no change in subsurface formation. Since considerable savings were envisaged at the time, the cost of new bridge borings might have been considered as insurance money, well-spent.

19. In conjunction with the above discussion on bridge-approach alignment changes, the following issues were raised regarding the PRCH Title I bridge design effort:

a. Why did the Title I design not recognize the eventual bridge relocation which resulted in savings, estimated by NT, of approximately $300,000? (NOTE: Neither interviews nor file review answered this question.)

b. Before adopting the new bridge location and approach realignment, was any cost analysis made of alternative solutions which might have salvaged work already accomplished? (NOTE: PRCH acknowledged during interviews that no such comparative analysis had been made.)

20. Claims, generated by NT and reflecting bridge revisions, were submitted in their claim No. 3 for M838,073.84 plus five months time extension. During the evaluation's brief review of claims and back-up data, as discussed in II.B.10 above, the bridge claim was included with those pertaining to the roadway. Comments contained in that paragraph are, therefore, applicable to NT's bridge claim.

21. NT reported a projected shortfall of funds approaching $1.25M. PRCH could not confirm this amount.

22. Recommendations

a. That a further Phase II evaluation review be made regarding judgement in selection, and adequacy of alignment, of the PRCH Title I bridge design.

b. That the issue of having no cost comparison of alternatives prior to bridge and approach change adoption receive further review.

c. That a copy of PRCH's professional insurance policy be a part of the contract file, since payment of a premium was justified by its inclusion; additionally, that the payment itself be questioned further since services performed by PRCH were those normally performed under such coverage, including the deductable consideration.

d. That the PRCH analysis and report, covering borings at the bridge site, be obtained for the contract file.

e. That the necessity of revising the Title I design be reviewed. (Why did Title I design not recognize both the realignment potential and a lesser-cost structure as proposed by NT?)

f. That updated progress schedules be submitted by NT and that revised schedules be required as any change in rate-of-progress indicates.

g. That early consideration be given by MOW and USAID/Lesotho to project-completion alternatives considering the projected shortfall of funds.

C. Title III (Force Account)

1. By contract amendment, the original PRCH contract was expanded to include construction management/supervision over a force-account implementation program.

2. Following the cancellation of PRCH's Title III contract in mid-1982, an interim management team from MOW was on site until the arrival of NT personnel on 1 January 1983. NT, by contract, had, therefore, become the construction contractor on Title II and the management/supervisory authority on Title III. Phase 1 evaluation efforts attempted to focus upon appropriate facets with consideration given to the relatively-short NT presence and the dead issue of PRCH departure. The intricacies of overlapping responsibilities (PRCH and NT), inherited problems, and the unavoidable connection between Titles I and III made it impossible to isolate either Titles or the participants.

3. Under Title I, the first (high-standard) PRCH design began at Mohale's Hoek and covered approximately 247 Km to Qacha's Nek. When this design was considered both too high-standard and too expensive, the total project was fragmented into four sections with three different design/implementation concepts:

a. Mohale's Hoek - Quthing (58 Km). In order to reduce total costs, this section was deleted from the project but retained the first (high-standard) PRCH Title I design for construction, which was envisaged in conjunction with another donor).

b. Quthing - Mount Moorosi (44 Km). This section became one of the two Title III, force-account construction sections. PRCH and later NT, were contracted for management/supervision services and were to produce highway designs as part of a turnkey operation. Drainage design was to be taken from the first, high-standard design, produced by PRCH in Title I.

c. Mount Moorosi - Mphaki (38 Km). NT was contracted for construction of this section with PRCH assuming the role (by contract) of management/inspection). This was the only Title II portion of the project.

d. Mphaki - Qacha's Nek (107 Km). This was the second of two Title III sections and was included in the force-account/PRCH-NT management scheme discussed in II.C.3.b above.

4. No PRCH design for Title III could be found through file/plan review. Subsequently, MOW and USAID/Lesotho confirmed that PRCH had not completed any design for Title III and such failure was one factor considered in their contract termination.

5. During the PRCH period, Kms 22-37 (approximate) were rough-graded with no design. The MOW, while acting as interim managers, produced a design for this section which was inherited by NT who, in turn, are reportedly working on a design for the balance of Title III. The evaluation team did not, however, find any evidence of such NT effort.

6. Although NT has been in-country since 1 January 1983, no special effort was made to assess their operational performance to date. Start-up time and delays attributable to a change in management firms, combined to allow only a brief construction period prior to this Phase I evaluation. It is felt to be more appropriate that the Phase II team examine NT's Title III performance. Currently, the NT expatriate staff includes: Project Superintendent (Manager), Project Engineer, Project Financial Manager, Equipment Superintendent, Maintenance Superintendent, Quarry Superintendent.

7. Title III camp facilities, which were to have been completed under PRCH, are still incomplete although NT claims continuing efforts. During the evaluation, it was noted that Title III expatriates are, at least in part, being housed and messed at the Title II camp. This suggests a review of accounting procedures since both Titles, and their respective contracts, are intended as separate entities. Additionally, the incomplete status of plumbing and electric facilities in particular, and housing in general, suggests that the M400,000 (approximate), spent to date, might have been more carefully managed. This was reviewed with the NT financial manager but the complexities of having both GOL and AID accounts combined with two administrators (PRCH and NT), led to the conclusion that this issue would be better served if handled by others.

8. Title III design procedures, involving a turnkey approach have been accepted by all parties as providing a low-cost acceptable solution. It is questioned, however, why the apparently, more expensive contractor/A&E concept has been promoted for Title II. This rationale should be reviewed in light of the projected funding shortfall.

9. The engineering evaluation briefly touched upon the areas of procurement, maintenance and training. Time constraints and the expertise of other team members, suggested that procurement and training be reviewed by others. These will, therefore, be discussed elsewhere in the report. Maintenance (training, capability, operations) requires an in-depth review on a schedule which provides adequate time, and a field operation, sufficiently advanced to allow fair assessment. Although covered briefly elsewhere in the Phase I report, a thorough review is warranted by the Phase II team.

10. Records of site meetings were requested from NT and none were available. Subsequently, records of February and April meetings, held at MOW/Maseru were found in USAID files. The team concluded that operational/ management problems might be relieved if MOW increased the frequency of site visits and established a schedule for formal (as opposed to ad hoc) meetings on site.

11. Title III construction deficiencies were given a low priority due to combined time constraints and the belief that NT should have adequate (more) time to become operationally effective and straighten out their inheritance. Additionally, past internal reviews by REDSO/ESA and Mission personnel during the PRCH contract-cancellation phase, and collateral audit/investigation by RIG/A and RIG/II respectively, were felt to be sufficient pending the arrival of a team for Phase II evaluations.

12. It was found, however, that extensive embankment construction had occurred without benefit of adequate compaction and testing. NT claimed to be aware of this condition and the areas involved, and cited their intention to take appropriate measures.

13. A review of project drainage was necessarily restricted to field operations since no design data was available. As discussed earlier in this report, drainage for Title III was intended to be as included in the original Title I, high-standard design. Spot checks were made during the time available, and no major deviations from planned pipe sizes were noted. Since the team received NT reports that cited procurement errors by the previous PRCH management team, however, Phase II evaluation procedures should include a detailed plan-in-hand review of drainage facilities in place and a review of stockpiled pipe.

14. Particular attention was focused upon NT construction practices as are currently being applied to drainage installations. There were found to be instances of creating artificial channels rather than using the original, combining two channels into one, and elevating entire culverts above and adjacent to the normal channel. Additionally, there were instances where pipes were laid upon fill sections which ranged from one to five meters in depth. It is recognized that there must occasionally be innovative measures taken to satisfy specific, and unusual, conditions but it appears that NT may

have violated good and proven drainage practices with their construction methods. It is also recognized that there may be extenuating circumstances, which were not revealed, related to PRCH design/procurement, which influenced NT's operation. The entire drainage program for Title III should be the subject of an in-depth review by the Phase II team.

15. Of particular interest was the placement of a single-barrel, structural-plate, CMP arch at Six Penny Crossing, station 26+500 (±). This pipe measures 4.46M along its greatest horizontal axis, 3.67M through its longest vertical axis, and has been placed on fill, approximately 5M above the existing stream channel and approximately 25-30 meters to the side of that channel! The current embankment section effectively serves as a dam with major up-stream ponding occuring. NT plans on filling behind the dam with approximately 10,000 CM of material and, in doing so, create an artificial channel between that embankment and in-situ formations. This methodology will also require filling the newly-created channel bottom with an estimated 2M (deep) of fill at the culvert invert and day-lighting in the existing channel, approximately 70-100M upstream. Extensive scouring must be anticipated at both inverts and in the artificial channel. The result can only result in serious and continual problems for culvert and embankment (roadway) maintenance. Original design placed the pipe in the original channel and, with its relocation, virtually all axioms of drainage design have been broken.

16. During the NT interviews, the Six Penny Culvert installation was questioned. It was explained by NT that PRCH had ordered incorrect quantities of pipe sections and relocation, as described immediately above, to a higher point in the embankment was necessary to make the reduced pipe length fit the narrower fill section. Interviews also established that additional structural plate sections could be delivered from RSA in 2-4 weeks. It was an apparent NT decision to relocate the pipe, as described, rather than order more sections and make the more desirable installation. For evaluation purposes, this must be regarded as an NT error of judgement which compounded the initial PRCH procurement error.

17. This evaluation is dwelling at great length upon the Six Penny Crossing problems because of their significance and wide-ranging implications. It will be an evaluation recommendation to reposition the culvert back to its intended, and correct, location in the natural stream channel. This will now involve extensive effort, some delay and a cost factor. Delays will be negligible for the project over-all, but may effect culvert completion by several weeks. There will certainly be cost implications to be resolved with NT and arguments can be generated by both sides regarding responsibility. Regardless, the relocation is considered vital for adequate drainage and minimizing future maintenance.

18. If MOW/USAID endorse the recommendation to relocate the Six Penny Culvert, other factors are recommended for consideration prior to making the move.

a. Pipe-arch configurations are usually selected where headroom is limited and where a hydraulic advantage at low-flow is desired. The Six Penny Crossing, however, is in an area where high-volume and high-rate-of-flow values are suggested. This does not negate the use of a pipe-arch under such conditions but does imply a need to review the appropriateness of its choice and inherent trade-offs.

b. Under the imposed load of such fill depths as may be encountered above the natural channel, any CMP must be capable of withstanding differential settlements and dynamic shocks without failure. Unless specific conditions dictate otherwise, a full-round section is preferable under high fills, rather than the pipe-arch configuration. This general axiom stems from special design problems for pipe-arches not found in round or vertically-elongated pipes; i.e., pipe-arches generate corner pressures greater than fill pressures and these become the practical limiting design-factors, rather than stress in the pipe wall.

c. It was noted that, in its present location, no camber was allowed for settlement. Since embankments exert greater loads at the center of the fill than at the toe-of-slope, such camber is vital under higher fills. Equally, proper "bedding" in stable, but relatively-yielding material, is recommended.

d. In the absence of design data, and considering size of conduit, depth of fill, pipe-arch configuration, etc., a competent review should be made of the physical properties of the pipe-arch currently on site. If structural plate and its corrugation size have not been carefully selected for prevailing conditions, none of the previously-cited practices will prevent ultimate failure.

19. Recommendations

a. That the Phase II evaluation team review the NT staff for adequacy, and field operations for progress and quality.

b. That an in-depth review be made of materials control and testing procedures/frequency.

c. That NT's design requirement be enforced.

d. That MOW/USAID maintain closer control over all operations through more frequent site visits, more on-site meetings to resolve issues, and enforcement of contract requirements.

e. That the Phase II evaluation team review the NT contract for adequacy and compliance.

f. That implications of NT's inherited problems be analyzed in the Phase II evaluation and, for future reference, "cause and effect" conclusions be documented.

g. That camp completion be stressed.

h. That the "turnkey" approach for design/construction, currently being used on Title III, be closely analyzed for possible future, similar programs.

i. That a thorough review of procurement and training procedures be made in Phase II.

j. That MOW, USAID, NT records, files and as-built plans be reviewed by all parties for completeness of inclusions. This should be followed by a Phase II evaluation review.

k. That uncompacted embankments be identified for testing and reconstruction if required.

l. That the entire Title III drainage program be reviewed by MOW/USAID engineers. In-place culverts should be checked against design requirements; stockpiled sizes and physical properties should be checked against designs; design data should be reviewed if available; and field operations should be closely inspected for adherence to proven practices and procedures.

m. That the single-barrel culvert at approximately 26+500 (Six Penny Crossing) be relocated back to the natural stream channel with full consideration being made of the II.C.14, 15, 16, 17 and 18 discussions.

III. EPILOGUE:

A. Comments:

1. It is recognized that the complexities of planning, designing and executing a project of such magnitude, under difficult conditions must unavoidably include errors along the way. Such realistic cognizance should reinforce the "lessons learned" and "future considerations" conclusions but, in no way, condone poor contract compliance or errors of judgement by those whose areas of expertise have been engaged at high cost.

2. Unquestionably, the attention, previously generated by this project, will be remembered since drastic, unfavorable actions are more often recalled than relatively smooth operations. For this reason, and in the professional spirit of objective evaluation, all facets of the three Titles should be given thorough consideration when measuring overall project impact upon future programs and their methods of execution.

3. Accordingly, this engineering assessment must be accepted in its intended, and unavoidable light, and not as a full messianic outlet from some technical wilderness; i.e., time constraints and the absolute belief that circumstances, surrounding the project and its evaluation, dictate a full-depth approach which can only be accomplished by continuing the evaluation through second phase efforts. In that light, this Phase I submittal (engineering assessment) represents the first of two investigative periods and is the lead-in, or preliminary, tool to be used in Phase II.