VILLAGE HYDRO SPECIFICATIONS

SRI LANKA

1. A village hydro system

A village hydro system is an isolated water-driven power supply intended to provide a village with energy for various applications such as the following:

- electricity for lighting and appliances (radio, TV, computer, etc), in homes and public buildings such as schools and clinics
- electrical or mechanical power for local service and cottage industries
- electrical or mechanical power for agricultural value-adding industries and labour saving activities
- electricity for lighting and general uses in public spaces and for collective events

The electricity provided can be either in the form of 230 volt AC line connections to users, or in the form of DC batteries. In the latter case the hydro installation is used to charge the batteries, which are either carried to a charging point by users or carried by service personnel. In some cases batteries remain stationery and are line-charged.

The three elements comprising a village hydro system are:

- civil works: these consist of diversion works, channels and piping to convey river, stream or spring water to the power generation equipment, the power house building and water exit channel
- power generation equipment: this consists of a turbine, a drive system linking the turbine to a generator and/or mechanical devices, a generator, a generator controller and switchgear
- power distribution system: this usually involves distribution of electrical power and consists of either a battery charging system or a line system. A line system usually transports electricity first by one or more main distribution lines to central points, then by sub-distribution lines and consumer service connections to consumption points.

2. Loan assistance

In order for a scheme to be eligible for IBRD loan assistance, it must fulfill the four conditions of:

- design for optimised cost and performance, and financial viability
- use of equipment of approved reliability, efficiency, and durability
- use of approved installation and construction techniques
- suitable operation, maintenance and management procedures, and management viability

The specifications listed here are a guide to fulfillment of these conditions, and are intended for use by suitably qualified and experienced engineers. They are presented in the form of check-list tables. They are intended to be applied in four stages:

- during the design stage, when the scheme exists only as a proposal on paper
- during detailed estimating and construction
- during a commissioning test

- once the scheme is operational, in particular at the end of a first year of operation

At each stage the specification check-list can be used as part of a procedure to approve finance permitting the next stage to take place. At the final stage, it is recommended that the check-list is used to approve final payment to the contractor of a sum withheld to underwrite a year's warranty agreement.

At each stage, the check-list will act as a tool to list improvements necessary before approval is given. It is therefore always used twice, first to detect problems, then again to check that they have been suitably resolved.

3. Contents

The specifications are divided into the following sections:

Intro	Introduction
Gen	General Requirements
Civ	Civil works
Mech	Mechanical components
Elec	Electrical components
Bat	Battery distribution
Line	Line distribution

Notes are appended which provide additional guidance to use of the specifications.

4. Associated documents

The specifications aim to provide a fast and practical system for checking and promoting the viability of schemes being considered for credit assistance. They do not attempt to provide comprehensive guidance to design calculations, or to operation, maintenance, management, and fault finding procedures. The specifications should therefore be used in conjunction with other texts. In the case of design calculations, one useful text is the *Micro-hydro design manual* available from IT Publications, 103 Southampton Row, London WC1B 4HH. Sample survey forms, and sample operation and maintenance manuals can be requested from Development and Consulting Services, PO Box 8, Butwal, Nepal. The specifications for electrical components and line distribution can be used in conjunction with the *Electrical Guidelines for Micro-Hydro Installations*, which can be requested from ITDG. Guidance to contracting can be found for instance in *Conditions of Contract for Minor Works* obtainable from the Institution of Civil Engineering, UK.

5. Full and reduced specifications

Regulations governing construction standards, electricity distribution practice, and other topics are already in force. Where such regulations are relevant to practices addressed in this document, they should be recognised as the full specifications and be followed in all cases unless appropriate permission is given to allow use of the reduced specifications presented here.

6. How to use the draft check-list specifications

The draft specifications have a small column provided for handwritten recommendations. These recommendations are to be made at each stage of the scheme design and implementation (the commentator would use the reverse side of the page for longer comments, using the reference number given for each specification). A summary table is provided at the end of each section which can serve as a log of recommendations and approvals relevant to each of the six sections.

7. Development of the specifications

The specifications will require progressive revision as they are implemented. Accordingly they are provided on disc or by email so that the text can be processed further without difficulty.

It is recommended that full page check-list forms, as shown below, are prepared and placed in a ring-binder together with the text of the specifications. Each ring-binder can be associated with a particular scheme and contain relevant documents such as a feasibility study and maintenance schedule. A check-list form can be interleaved with each page of the specifications, so that comments can be written on a facing page, as illustrated in the figure below.

8. Departures from specifications

The specifications provide guidance to best practice. If a scheme is designed or operated in a way which results in better and safer performance than would result from exact obedience to the specifications, the engineer responsible can accept the alternative practice. In this case it is essential that a clear description of the alternative practice is given on the check-list form and the reasons for its acceptance. It is recommended that in such cases a second opinion is sought and a second checker's comments are included on the form.

This kind of flexible approach to application of the specifications is encouraged, because it will assist progress (provided that careful notes are made and discussed) toward more cost-effective approaches to village hydro. Revisions can then be made to the specifications which accomodate new practices.

9. Disclaimer

Whilst the authors have made every effort to ensure that the information presented here is correct and will provide safe and effective performance of village hydro schemes, all parties must rely upon their own skills and judgment when making use of it. The authors do not assume any liability to anyone for any loss or damage caused by any error or omission in this work, whether such error or omission is the result of negligence or any other cause. Any and all such liability is disclaimed.

Scheme name				
Scheme name:	**Proposal**	**Construction**	**Commissioning**	**Warranty completion**
Date: Recs by:				

Facing pages:

	Check that operators know how to reset expansion joints after works are carried out on the penstock.
C10. Protection of PVC and HDPE penstocks	1. PVC and HDPE .... b. **Expansion/....** 2. If **PVC** ....
C11. Penstock supports and anchors	1. Anchors .... 2. Supports ... 3. **Anchors** should .....
C12. Powerhouse floor	1. **Size**. The floor area must be sufficiently large to allow the turbine and generator to be accessed from all sides and dismantled, and to allow heavy equipment to be moved around. Machinery must be positioned to allow access from all sides. 2. The floor must be **sloped** so that all water drains toward the tailrace of the turbine. 3. The floor surface should be **above ground** level to prevent flooding in heavy rain.
C13. Powerhouse door	1. The door must **open outwards** for safety reasons. 2. **Size**. The door must be sufficiently large to allow passage of heavy machinery. 3. The door should be **lockable**.
C14. Powerhouse windows	1. The **window area** should be 1 m^2 for every 10 m^2 of floor area, in order to ensure adequate ventilation and light. 2. The windows should not be glazed but have instead **wire meshes** or grills to allow ventilation. These should be strong enough to ensure security. 3. An underground powerhouse will require commensurate provision for light and ventilation.

Scheme name *xxxxx*				
Specification in brief	**Proposal**	**Construction**	**Commissioning**	**Warranty completion**
C10. Protection of PVC	*1. not yet checkable*	*1. OK, buried* *2. Open trenches well prepared*	*OK*	*OK*
C11. Penstock supports and anchors	*1. One anchor. Calculations checked. Recommend 20% larger.*	*3. Anchor keyed to large underground rock*	*OK*	*OK*
C12. Powerhouse floor ***1.size and access*** ***2.sloped*** ***3.above ground level***	*1. Area OK but generator too close to wall for proper access Rec reposition generator* *3. OK*	*2. No sloping or provision for drainage*	*all OK*	*all OK*
C13. Powerhouse door ***1. open outwards*** ***2. size*** ***3. lockable***	*not checkable*	*not checkable*	*1. OK* *2. OK* *3. OK*	*1. OK* *2. OK* *3. Key lost and lock forced. Rec new lock*
C14. Powerhouse windows ***1. area*** ***2. wire meshes***	*1. Not checkable* *2. mesh type not specified.*	*1. Not quite as large as specified but acceptable because roof ventilation very adequate* *2. OK*	*1. OK* *2. OK*	*1. OK* *2. mesh removed and replaced with rattan. Rec replace with stronger mesh*
Date: Rec by:	*xx* *xx*	*xx* *xx*	*xx* *xx*	*xx* *xx*