"El documento original se contiene páginas en mal estado"

agreements, procedures, practices, other documentation/communications);

v) All aspects related to inspection mechanisms, procedures, rules and practices, including the use of the "log book", reports and acceptance/rejection tests, adjustments and changes of designs or schedules, practices during partial or total suspension of works, procedures for partial or final payments and the use of guarantees and quality or function bonds;

vi) If required, arrangements for subcontracted interventions should also be spelled out (applicability, relations between contractors, subcontractors, UNHCR, implementing partners);

vii) Conditions for compliance and resolution should also be given (cancellation of contract, claims, arbitration).

Tender documents are finally completed with a collection of the technical drawings/blue prints, showing the location, characteristics and technical specifications of the water system which are added as an annex to the main body of the documents. In view of the large amount of information that should be contained in these drawings, it is necessary to be careful in the choice of their scale and layout to avoid cluttering and difficulties in reading them. As a minimum, this set of drawings should include:

i) the topographic and hydraulic profiles of the pipeline;

ii) a detail of each system component (main or branch lines, intakes, pumping stations, break pressure tanks, treatment plant structures, storage facilities, distribution standposts) and of any sections of the pipeline requiring special attention or construction methods (river crossings, valves boxes, interconnections, etc.);

iii) a general plan view of the system, showing its layout and its relative position as referred to appropriate landmarks or camp infrastructure;

iv) a "key plan" of the system, showing, schematically, the relative arrangements for the tanks, control valves, branchlines, standposts and other service connections.

Project Implementation

14. A project is ready for implementation once its final design has been achieved and approved and adequate funding has been secured for it. To initiate construction works, some initial steps, depending on the implementation arrangements and the institutional set up of the assistance programme, need to be taken. It is necessary to emphasize the need to follow designs and plans as closely and accurately as possible, as well as the inspection, acceptance and rejection mechanisms, specially if UNHCR's implementing partners are themselves undertaking the construction works (no contractors' involvement). It will be necessary to carry out further discussions with successful contractors, to make sure every single contractual detail (as suggested by the tender documents) is agreeable to all parties involved; the results of these discussions will be recorded and included in the final *contractual document*, which, after approval by a Contracts' Committee if necessary, is to be signed by the contractor and UNHCR or the implementing partner, as appropriate. This document will be based on the general contractual norms forming part of the tender documents, the time frames for construction and on the technical specifications and drawings of the future system (See 6.57; 12.13).

15. During construction works, UNHCR and the implementing partners will collaborate with the contractor in all matters related to the organization of the work site, storage/warehouse and other logistic needs, the organization of refugee labour or other community inputs, etc. and any other aspect considered important for the timely and effective completion of the project. It should always be clear, however, that the ultimate responsibility for these activities belongs to the contractor (See 6.36; 11.15; 11.18).

16. During construction, close supervision is necessary to ensure that each system component is being built in accordance with plans and specifications and on time (according to contractual time

frames). At the project site, the contractor will make daily reports on his activities, achievements and use of materials in a *log book* (a sturdily bound notebook having all its pages numbered). The inspector, an engineer with adequate professional background and expertise, working on behalf of UNHCR or the implementing partner, will periodically review this book and annotate there his comments and instructions, or the results of relevant discussions with the contractor or his crews. On the basis of this book and other relevant information, the inspector will prepare periodical reports on the works' progress, the problems encountered, and propositions on how the project should continue. This report should provide enough information to allow the estimation of partial or periodical payments, in accordance with achievements and contractual rules; for this purpose, it may also be necessary for the inspector to present a financial statement to substantiate his recommendations.

17. Once the project is considered completed, the contractor should hand over to UNHCR or the implementing partner a *financial statement* showing clearly the costs in cash or in kind for each system component. This statement is to be certified by the supervisor.

18. The contractor will also hand over a *final report* to UNHCR or the implementing partner containing at least:

i) A brief history of the project and its implementation phase;

ii) Technical details and plans, with necessary comments, of all system components;

iii) Comments on technical aspects relevant to operation and maintenance requirements, life expectancy of installations, special care required by them, possibilities for extension of the system or its services, etc.;

iv) Hand over note, concerning the system and its installations, with a clear sheet of instructions for operation and maintenance, for the use of caretakers (See 11.7).

v) A complete set of *"as built plans"* for all structures, buildings, pipe lines and other system components, where all modifications to the initial designs should be made to reflect the real characteristics of the resulting structures and installations (See 10.22).

19. All these reports, technical information, guidelines and drawings should be collected to be used as the basis of the technical documentation required for future operation, maintenance and control purposes (See 2.11; 11.3; 10.23).

From Emergency to General Programmes in the Water Sector

20. In a refugee camp, operation and maintenance activities are long-term responsibilities of camp managers (See 2.8; 5.2; 11.2; 11.5; 11.15; 11.18), the water committee, relevant refugee groups and relevant staff (caretaker and his crew). Adequate funding for all these activities and their requirements should be secured through their inclusion within the general assistance programme in accordance with the standard formats for *project submission* and with the *technical project description* of the activities to be carried out and their expected results (See 12.7). Care should be taken to spell out every single activity requiring funds or other inputs and some allowance should be made for unforeseen or additional requirements. In this context, close attention should be given to the estimation of materials, labour, expertise, logistic and technical support required for their inclusion in working plans, time schedules and budgets (See 8.9; 8.25; 11 7; 11.16).

21. Maximum involvement of local authorities and specialized government departments in the construction operation and maintenance of camp infra structure should be sought at the early stages of project implementation. Water supply operation and maintenance activities at a refugee camp offer a good opportunity to trigger this involvement; efforts should be made to promote the eventual integration of refugee services into existing national programmes, especially if a durable solution to the refugee problem is not at hand

Budgets

22. UNHCR's budget structure defines a project in terms of the fund (annual programme, emergency fund, trust funds...) the type of assistance (emergency, care and maintenance, local settlement...) and the caseload (beneficiaries) This definition is the basis of a system of symbols and codes to enter or retrieve budgetary information for programming or project management purposes. This system is called the FMIS budget structure (See the UNHCR Handbook, Chapter 4). Within this structure, water supply activities are grouped under *"sector D - Water (Non-agricultural)"* which requires the allocation of project activities to six different codes:

D.01 Plan/survey/research/evaluation

D.03 Water system development/construction

D.21 Water system operations

D.97 Training/orientation/seminar, etc.

D.98 Other water activities (specify)

D.99 Sector support/management

The first code includes all project activities and requirements for the obtention of basic data (e.g. hydrogeological or topographical surveys, water quality studies, etc.) and for the design of the system or any of its components (See 5.1); the cost of activities undertaken during the needs assessment and project preparation (See 12.1; 12 8) as well as those to cover the costs involved in sector evaluations (comparison between objectives and achievements; corrective measures) should, therefore, be included under this code. The second code (D.03) comprises the cost of all those activities related to the construction of the water system or any of its components. It should include the costs of repairs to the system's infrastructure and extensions of existing facilities (See 3.9). The third code (D.21) should cover all those activities related to the operation and maintenance of the water supply system and its components and which, at least during the emergency operations, should necessarily be covered by the assistance programme (See 11.2). The nature of operation and maintenance activities depends on the system's technological approach and should be reflected in the camp's operation and maintenance plan (See 11.7), which should also identify its logistic needs to ensure their appropriate coverage under this code (See 11.16). The next code (D.97) should cover those activities related to on-the job training to those responsible for operation and maintenance activities within the sector, including individual or refugee groups and counterpart staff (See 2.9; 11.3; 11.6). Code D.98 may cover any water sector activity which should be depicted in budgetary and other programming and financial documents for any particular reason; the type of activities under this code should, of course, be identified. Water tanker operations or the coverage of household water storage needs (See 8.9) may be examples of budgetary lines under this code. Code D.99 should include all staff and technical support costs (expertise, specialized equipment, etc) related to day-to-day operation, maintenance and management of the water system, including in-kind payments to refugee workers.

23. The FMIS budget structure requires two additional budget specifications after the sector and the activity codes to complete the specification of any budgetary line. These codes define the line's item and sub-item. A list of item and sub-item codes is presented in Chapter 4 of the UNHCR Handbook and in other FMIS documentation. This list should be consulted to ensure the appropriateness of the coding.

Annex A: Refugee Water Supply Inventory Forms

A 1 REFUGEE WATER SUPPLY

- INVENTORY FORM -

Date: ___/___/___

Country: _____ Camp:_____

Location: _____ _____ _____

State/province District Locality

Source Name	Sketch Location Map	Present Use
Location By Coordinates Latitude: _____ Longtitude:_____ Elevation:_____ (metres above sea level)	Drafted By: ..... Date: ...../ .../.....	o Unuse o Unprot o Aband o Protec o Other _____ _____

Measurement device:	Observations:
p Altimeter	_____
p Theodolite	_____
p Estimate	_____

p Other (specify)	_____
_____	_____
_____	_____

TYPE OF SOURCE:

p Surface water	p Groundwater	p Other specify):
Lake	p Spring	p _____
Pond	p Sump	p _____
Swamp	p Dug well	p _____
River	p Tube well	p
Creek	p Infiltration	p
Other (specify):	p Other (specify).	p
_____	_____	

DESCRIPTION OF EXISTING WATER SUPPLY AND WATER USE (actual or potential) of this source within the system: (use additional pages, if required)

_____

A 2

REFUGEE WATER SUPPLY

Source: _____

- INVENTORY FORM -

Date: __/__/__ Camp: _____ Identification (name or number)

_____

Elevation (metres above sea level)

____

Description of source:

Type: _____

Type of water catchment structures (if any) (include drawings, sketches, etc. as annexes):

_____

Description of existing water supply and water use (actual or potential) of this source within the system:

_____

Water quality and quantity:

Description of general conditions and factors affecting water quality and quantity. Include, as annexes, laboratory or field records on quality tests and a summary of volumes/yields measurements with significance for productivity and reserve calculations:

_____

A 3

REFUGEE WATER SUPPLY

SURFACE WATER SOURCES

INVENTORY FORM

Date: __/__/__ Source
name: _____

(metres

Camp: _____ Elevation above _____
Type: _____

Sea level)

YIELD ASSESSMENT CHART				
Measurement Number	Date	Flow Measurement (Litres per Second)	Measuring Device	Perform
1				
2				
3				
4				
5				
6				

WATER QUALITYASSESSMENT CHART*														
		Physical Characteristics						Chemical Character						
		(specify units of measure)						(milligrammes per l						
Ana-lysis Num-ber	Date	Colour	Odour	Turbi-dity	Suspd-solids	PH	Elec Conduct	Alka-linit	Total Hardn	- HCO3	-2 CO3	- Cl	-2 SO4	

Description of potential or present use (include possibilities and constraints for further development)

Include, as annexes, all laboratory or field analysis reports, including bacteriological data.

A 4

REFUGEE WATER SUPPLY

SURFACE WATER SOURCES

INVENTORY FORM

Date: __/__/__
name: _____

Spring

Camp: _____
Type: _____

Elevation

(metres above _____

Sea level)

YIELD ASSESSMENT CHART

Measurement Number	Date	Flow Measurement (Litres per Second)	Measuring Device	Perform
1				
2				
3				
4				
5				
6				

WATER QUALITY ASSESSMENT CHART*														
		Physical Characteristics						Chemical Character						
		(specify units of measure)						(milligrammes per l						
Ana-lysis Num-Ber	Date	Colour	Odour	Turbi-dity	Suspd-solids	PH	Elec Conduct	Alka-linit	Total Hardn	- HCO3	-2 CO3	- Cl	-2 SO4	

Hydrogeological setting (include a hydrogeological sketch, if possible, as an annex):

Description of potential or present use (include possibilities and constraints for further development):

Include, as annexes, all laboratory or field analysis reports, including bacteriological data.

A 5

REFUGEE WATER SUPPLY

LARGE DIAMETER WELL SOURCE

-INVENTORY FORM-

Date: __/__/__ Camp: _____ Well number: ____

Well name: _____

Construction Date: __/__/__

Elevation (metres above _____ Sea level)

Constructor: _____

WELL LOG

Depth (metres)	Geological Log (graphic)	Design Log (graphic)	Geolog. Log Descriptive	Design Log Descriptive	Pumping Tests

					Type: pconstant pstep Yield drawdown Date:__/__/__Static water level Rate of extraction:_____Dura Flow measurement device: _____ Level measurement device:____ Reference point for Measurement (datum):_____ Dynamic water level:_____ Specific capacity:_____ Safe yield:_____ Other observations:_____ _____ _____ _____

Description of casing and filter elements:

_____

Description of well head design (including apron, sanitary seals, drains):

Observations:

Pumping test measurements should be included as annexes.

A 6

REFUGEE WATER SUPPLY

BOREHOLE SOURCE

- INVENTORY FORM -

Date: ../../.. Camp: ..... Borehole number: .....

Borehole name: .....

Drilling Date: ../../..

Elevation (metres above ..... sea level)

Driller: ..... Rig/drilling technique: .....

BOREHOLE LOG

Depth (ms) GRAPHIC	Geological Log(graphic)	Design Log (graphic)	Geolog. Log Descriptive	Design Log Descriptive	Pumping Tests

					Step drawdown: Date ../../.. Static water lev Number of steps: ..... Pumping rates: .... Constant yield: Date ../../.. Static water lev Observation wells:**..... Rate of extraction (l/sec) ..... Duration: ..... Flow measurement device: ... Level measurement device: .... Dynamic water level: ..... Specific capacity (l/sec per met ..... Storage coefficient/ Specific yield: ..... Transmissibility: ..... Safe yield: ..... Observations:***..... ....

Description of casing: diameters: ..... Material: .....

Description of screens: diameters: ..... Material: .....

Slot openings: .....

Description of gravel pack: .....

Description of well head design (include description of apron and sanitary seal): .....

.....

Observations: .....

.....

.....

* Pumping test measurements must be included as annexes.

** If measurements made in observation wells, add location maps, design log, pumping test data and any other relevant information as annex.

*** Laboratory or field water quality analysis reports should be added as annexes.

A 7

REFUGEE WATER SUPPLY

BOREHOLE SOURCE

- INVENTORY FORM -

Borehole Number: ..... Elevation above ..... (metres sea level) Camp: .....

STATIC WATER LEVELS RECORD

Date	Measurement	Reference Point	S.W.L.	Date	Measurement Device	Reference	S.W.L.	Date	Measure Device
_/_/_				_/_/_				_/_/_	

_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_
_/_/_				_/_/_				_/_/_

PHYSICO-CHEMICAL WATER QUALITY ASSESSMENT CHART

Ana-		Physical Characteristics						Chemical Characteristics						
lysis		(specify units of measure)						(milligrammes per litre)						
Num-b	Date	Colour	Odour	Turbi-dity	Suspd Solids	pH	Elec. Conduct	Alkali-	Total Hardn	- HCO3	-2 CO3	- Cl	-2 SO4	- NO
1	_/_/_													
2	_/_/_													
3	_/_/_													
4	_/_/_													
5	_/_/_													

6	_/_/_													
7	_/_/_													
8	_/_/_													
9	_/_/_													
10	_/_/_													

BACTERIOLOGICAL WATER QUALITY CHART

Analysis Number	Date	Total Coliforms MPN/100m	Escherichia Coli MPN/100ml	Analysis Number	Date	Total Coliforms MPN/100ml	Escherichia Coli MPN/100ml	Analysis Number	Da
1	_/_/_				_/_/_				_/
2	_/_/_				_/_/_				_/
3	_/_/_				_/_/_				_/
4	_/_/_				_/_/_				_/
5	_/_/_				_/_/_				_/
6	_/_/_				_/_/_				_/
7	_/_/_				_/_/_				_/
8	_/_/_				_/_/_				_/
9	_/_/_				_/_/_				_/
10	_/_/_				_/_/_				_/

Annex B: Approximate Daily Water Requirements in Refugee Emergency Situations

(Only for indicative purposes, actual values depend on many variables that should be assessed by specialists)

1. Human consumption

a) Minimum " survival" allocation. 7 litres per capita

b) Minimum refugee camp allocation. 15-20 litres per capita

2 Services, at camp level (Additional to human consumption)

a) Out-Patient Health Centres. 5 litres per patient

b) In-Patient Health Centres. 40-60 litres per patient

c) Hospital (with laundry facilities). 220-300 litres per bed

d) Schools (Toilet requirements not included). 2 litres per student

e) Schools (water-flushed toilet system). 10-15 litres per student

f) Feeding Centres 20-30 litres per patient

g) Camp Administration. (Staff accommodation not included) 5 litres per capita

h) Staff accommodation. 30 litres per capita

i) Mosques. 5 litres per visitor

3. Livestock

a) Bovine cattle (4-5 times weight of ingested dry food). 25-30 litres per head

b) Horses, mules (3-4 times weight of ingested dry food). 20-25 litres per head

c) Goats and sheep (2-3 times weight of ingested dry food). 15-20 litres per head

d) Pigs (2-2.5 times weight of ingested dry food). 10-15 litres per head

e) Chicken. 10-20 litres per 100

4. Agricultural Crop Requirements

* "Rule of Thumb" for irrigation. 1 litre per second per hectare

a) Vegetable gardens. 3-6 litres per square meter

b) Maize. 2.5-5 litres per square meter

c) Rice. 3-5.5 litres per square meter

d) Tomatoes. 2.5-5 litres per square meter

e) Onions. 2.54 litres per square meter

Annex C: Guidelines on Water Quality

Table 2. Inorganic constituents of health significance

Constituent	Unit	Guideline Value	Remarks
arsenic	mg/l	0.05	
asbestos	—	no guideline value set	
barium	—	no guideline value set	
beryllium	—	no guideline value set	
cadmium	mg/l	0.005	
chromium	mg/l	0.05	
cyanide	mg/l	0.1	
fluoride	mg/l	1.5	natural or deliberately added; local or climatic conditions may necessitate adaptation
hardness	—	no health-related guideline value set	
lead	mg/l	0.05	
mercury	mg/l	0.001	
nickel	—	no guideline value set	
nitrate	mg/l (N)	10	
nitrite	—	no guideline value set	
selenium	mg/l	0.01	
silver	—	no guideline value set	

sodium	—	**no guideline value set**

Table 3. Organic constituents of health significance

Constituent	Unit	Guideline Value	Remarks
aldrin and dieldrin	µg/l	0.03	
benzene	µg/l	10 /a	
benzol[a]pyrene	µg/l	0 01 /a	
carbon tetrachloride	µg/l	3 /a	tentative guideline value /b
chlordane	µg/l	0.3	
chlorobenzenes	µg/l	no health-related guideline value set	odour threshold concentration between 0.1 and 3 µg/l
chloroform	µg/l	30 /a	disinfection efficiency must not be compromised when controlling chloroform content
chlorophenols	µg/l	no health-related guideline value set	odour threshold concentration 0.1 µg/l
2,4-D	µg/l	100 /c	
DDT	µg/l	1	
1,2-dichloroethane	µg/l	10 /a	
1,1-dichloroethane /d	µg/l	0.3 /a	
heptachlor and heptachlor epoxide	µg/l	0.1	
hexachlorobenzene	µg/l	0.01 /a	
gamma-HCH (lindane)	µg/l	3	
methoxychlor	µg/l	30	
pentachlorophenol	µg/l	10	

tetrachloroethene /d	µg/l	10 /a	tentative guideline value /b
trichloroethene /d	µg/l	30 /a	tentative guideline value /b
2,4,6-trichlorophenol	µg/l	10 /a,c	odour threshold concentration 0 1 µg/l
trihalomethanes		no guideline value set	see chloroform

a/ These guideline values were computed from a conservative hypothetical mathematical model which cannot be experimentally verified, and values should therefore be interpreted differently. Uncertainties involved may amount to two orders of magnitude (i.e. from 0.1 to 10 times the number).
b/ When the available carcinogenicity data did not support a guideline value, but the compounds were judged to be of importance in drinking-water and guidance was considered essential, a tentative guideline value was set on the basis of the available health-related data.
c/ May be detectable by taste and odour at lower concentrations.
d/ These compounds were previously known as 1,1-dichloroethylene, tetrachloroethylene, and trichloroethylene respectively.

Table 4. Aesthetic quality

Table 5. Radioactive constituents

Annex D: Recommended Format for Technical Specifications for Water Well Construction

Key:

A = Number of wells to be drilled

B = Location of drilling sites

C = UNHCR's implementing partner for the project

1. General Clauses

1.1. Subject of the Contract

The subject of the contract comprises the construction of (A) water wells for potable water supplies for refugee settlements in (B).

The contractor will carry out the drilling work and provide the proper tools, machinery, implements, materials and labour for due construction of the wells, their development and pump testing. He will also

provide the casing and screen materials according to the quality specifications given hereunder.

1.2. Information supplied by (C)

(C) will supply all available information about the possible hydrogeological conditions at each drilling site. It should be clear that this information does not hold (C) responsible for the locally different conditions at the specific drilling site or for the particular problems the contractor may face while carrying out his work.

1.3. Drilling Sites

(C) will indicate the drilling sites and provide the required permits for the use of the land where the contract is to be carried out.

The contractor will be responsible for all damages occurring outside the allocated land.

The contractor will clear all debris of any kind, and leave the land, as far as it is possible, in the original condition, once the well has been finished, developed and pump-tested.

1.4. Abandoned Well

If the contractor is not able to finish the drilling or has to abandon the well due to loss of tools or any other accident or contingency, he should remove the casing or drive pipes already placed in the hole and refill it with clay or concrete, at his own expense. All material extracted from such holes, after refilling them will be considered the property of the contractor.

In this case, (C) will not pay for any of the work carried out, and will authorize in advance the drilling of a new hole, at a site near the abandoned one.

2. Technical Specifications

2.1. Boreholes

2.1.1. Information concerning each borehole

The contractor will supply a detailed borehole log, in which all relevant information on drilling velocity, well casing and other well construction operations will be recorded.

The contractor will also annotate all information pertaining to the appearance of water filtrations and aquifer, types of rock found and rock sampling details.

2.1.2. Casing and diameters

The drilling of each hole will be carried out according to the characteristics specified in the Appendix of these specifications, using the proper drilling tools, drive pipes, casing pipes, gravel packs and sanitary protection (See 2.5), based on the real characteristics of the aquifer formations. The casing pipe and sanitary protection (seals) should isolate the aquifers from other formations, which are considered improper for the exploitation of wholesome water.

The well design is to be authorized by (C) before the casing pipes and screens are introduced into the well.

2.1.3. Pipes and screen filters

The contractor will supply all pipes, screen filters and fittings for the proper casing of the wells at the agreed price.

2.1.4. Drilling equipment and depth of drilling

The contractor will use drilling equipment capable of drilling down 25 per cent deeper than indicated in Appendix I (See below). The use of cable tool, rotary or down the hole hammer (air percussion) rigs is acceptable.

The depths indicated in the Appendix are tentative and should only be regarded as a guide.

If the real characteristics of the wells being drilled justify any change in these specifications, the contractor will request the authorization of (C) for such changes to be made.

These communications will be made verbally and shall be properly recorded by (C).

In every case, if the actual characteristics of the well differ from those indicated in the Appendix I (See below), and once these changes have been authorized by (C), a proper price adjustment will be made according to the final depth of the well, and the unit price rendered by the contractor in his original proposal.

2.2. Well Completion and Test Pumping

2.2.1. Pumping tests

The contractor will have a pumping unit capable of discharging 50 per cent more water, at the well's pumping water level, than the maximum yield indicated for each well in the Appendix. Once the well construction is finished, the well will be developed by hydraulic surging (by means of a packer piston, compressed air of dry ice treatment). Immediately after this operation is completed, the well will be cleaned and the pumping unit introduced into the well. The contractor will communicate (3 days in advance) the date the pumping test is to be carried out.

The test pumping of the well will be performed according to 2.2.1.1.

2.2.1.1. Pumping test

The test will consist of continuously pumping the well at the maximum yield specified in Appendix I for the respective well (or at any other previously defined rate, according to the results of the drilling work, between the contractor and (C). The duration of this test will be 48 hours. The measuring of the dynamic water levels will be performed according to the logarithmic time-scale schedule normally used for test pumping water wells.

2.2.1.2. Other specifications

The contractor will evacuate all the pumped water in such a way that no impoundments are produced at distances less than 200 m from the well. The contractor will provide all the necessary elements for this purpose.

The contractor will provide all necessary implements (weirs, pipes, gauges, etc.) for the proper measurement of discharge rates and water levels.

2.2.2. Well yield

After the pumping tests have been carried out, (C) will decide the recommended yield for each well, according to the test results, appropriate hydrogeological techniques and the actual needs

2.3. Well Plumbness and Alignment

2.3.1. Tests

The well will be tested for plumbness and alignment by means of a 12 metre long, and perfectly straight, steel pipe that will be introduced along the whole well. The external diameter of this will, at the most, be 13 mm less than the well casing inside the diameter. This pipe will be supplied by the contractor.

2.3.2. Minimum requirements

Such a test pipe, as described in 2.3.1. should easily move through the whole well. The loss of plumbness of the well's axis should never be more than 2/3 the smaller inside diameter of casing. If these minimum requirements are not met by the well, the contractor will, if possible, correct the defects. If not, (C) will reject the well and no payments will be made for its drilling and completion. This test should normally be made before pump testing the well.

2.4. Protection of the Water Quality, Disinfection and Sampling

2.4.1. The contractor will take maximum care to avoid the physical, chemical or bacteriological contamination of the well water, during the construction operations. In any case, where water is polluted due to the contractor's neglect, he will be obliged to carry out all the necessary operations, at his own cost, in order to extract such pollution from the well.

2.4.2. Well sterilization

Once the well has been completed and tested, the contractor will sterilize the well with a chlorine solution yielding at least 50 mg/l of active chlorine in all parts of the well.

The chlorine solution may be prepared for this purpose, by dissolving calcium hypochlorite, sodium hypochlorite or gaseous chlorine in water. The chlorine solution should stay in the well for at least four hours, at the specified concentration.

2.4.3. Rock samples

The contractor will keep a complete record of the rock samples taken during the drilling operations, in properly packed and identified sample bags, and will make them available to (C) upon his request. The contractor will take at least one sample every three metres of drilling, unless a change in rock formations is spotted by the driller. In such cases, additional samples should be taken. The minimum weight for each sample should be 500 grammes. For each rock sample that has not been taken, the contractor will be fined a penalty amounting to 1 per cent of the total value of the well and this will be deducted from the final payment. If the total amount of samples not taken is more than 15 per cent of the specified number, the well should be started again and (C) will not make any payments for the work already done.

2.4.4. Water samples

The contractor will take two water samples for laboratory analysis, after completion of the long duration pumping test. One sample will be used for physical and chemical analysis. It should be put in a clean and properly sealed plastic or glass container. Its volume should not be less than 5 litres. The other sample will be used in a bacteriological analysis. It should be collected in triplicate, in sterilized, properly sealed and protected containers. The volume of such containers should not be less than 100 millilitres. The samples will be handed to (C) as soon as the samples have been taken.

2.4.5. Sand particle content in pumped water

The water drawn out of the well will be acceptable if it has a sand particle content of less than 5 grammes per cubic metre. In case this maximum limit is not kept, the contractor will make all necessary adjustments to the well structure, at his own expense, in order to meet this specification.

2.5. Finishing Works

2.5.1. Temporary lid

The contractor will pay close attention to the due protection of the well's mouth against the entrance of water or any other pollutants while drilling or after the completion of the well. For this purpose, he will provide a lid to be placed at the well's mouth at any time the drilling rig is not in operation. This lid will also be placed after the well has been completed.

2.5.2. Artificial filter packs

An artificial properly graded gravel pack will be placed in the annular space between the hole wall and the outer face of the casing according to Annex 1. Proper techniques should be used for the accurate placing of this pack on the site. The gravel to be used should be clean, well-rounded and the grains should be hard and of alluvial origin and in size between 0.5 and 2.5 cm diameter. This gravel has to be approved by (C).

2.5.3. Sanitary protection seal

All the wells that have been completed and tested with success, should have a proper sanitary seal protection built of concrete.

This protection will be placed from 3.5 metres below the ground to 0.25 metres above the ground and will occupy all the annular space between the hole face and the outer face of the casing.

Appendix I

Characteristics of the Water Wells

Tentative Specifications (see 1.2 Technical Specifications)

WELL SITE LOCATIO	DRILLING DIAMETE mm	DIAMETE OF CASING mm	MAXIMUM DEPTH OF DRILLING mm	LENGTH OF CASING m	LENGTH OF SCREEN m	MINIMUM EXPECTE YIELD lps	MAXIMUM EXPECTE YIELD lps	REMARK

lps: litres per second m: metre mm: millimetres