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**WATER AND SANITATION  
FOR HEALTH PROJECT**



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**WATER AND SANITATION  
ALTERNATIVES FOR SOUTHERN  
ITALY DISASTER RELIEF,  
DECEMBER 1980**

**WASH FIELD REPORT NO. 25**

**DECEMBER 1981**

The WASH Project is managed  
by Camp Dresser & McKee  
Incorporated. Principal  
Cooperating Institutions and  
subcontractors are: Interna-  
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Institute, University of North  
Carolina at Chapel Hill,  
Georgia Institute of Tech-  
nology—Engineering Experi-  
ment Station.

Prepared for:  
Office of Health  
Development Support Bureau  
U.S. Agency for International Development  
Order of Technical Direction No.13

WASH FIELD REPORT NO. 25

ITALY

WATER AND SANITATION ALTERNATIVES  
AND  
SOUTHERN ITALY DISASTER RELIEF, DECEMBER 1980

Prepared for Office of Health  
Development Support Bureau  
United States Agency for International Development  
Under Order of Technical Direction No. 13

Prepared by:

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December 1981

Contract No. AID/DSPE-C-0080  
Project No. 931-1176

## I. SUMMARY AND CONCLUSIONS

### The Problem Addressed

The earthquake has left many refugees, perhaps 50,000, in temporary shelters without proper sanitary facilities. Many small groups of twenty to seventy people are living in schools or warehouses without excreta disposal, bathing and washing facilities. These people generally have access to adequate supplies of piped water. Many small groups, perhaps a single family, are in temporary shelters lacking both water and sanitary facilities.

The sanitation needs identified during a recent field investigation by an AID representative, which are addressed in this study, include communal excreta disposal, bathing and laundry facilities, and individual family excreta disposal and water supply treatment. Electrical power supply was reported to be readily available as was communal potable water supplies. However, we understand existing water distribution systems are not being adequately disinfected but that supplies of chlorine were available in Italy and being shipped to the area. We have included some information on chlorine test kits.

### Alternative Methods

Specific alternatives addressed include:

- I) Communal Excreta Disposal Facilities.
  - a) Semi-permanent field erected facilities with flush toilets discharging effluent to a septic tank and cesspool. Such construction could include shower and/or laundry facilities.
  - b) Field-erected ventilated improved pit latrines.
  - c) Field erected chemical toilets.
  - d) Prefabricated mobile flush toilets with and without various combinations of shower and laundry facilities.
  - e) Prefabricated mobile chemical toilets.
  - f) Prefabricated OXFAM sanitation unit.
- II) Individual Home Water Supply Treatment Methods.
  - a) Silver-impregnated ceramic water filter.

- b) Chlorine or iodine disinfectant tablets.
- c) Ceramic filter/triocide combination.
- III) Individual Laundry and Shower Facilities.
  - a) Semi-permanent field erected shower/laundry combinations.
  - b) Prefabricated mobile shower/laundry combinations.  
(see Id)
- IV) Chlorine residual comparator test kits for public water supplies.

Criteria

Criteria considered in the development of alternatives included:

1. How the completed facility meets objectives of preventing disease and comforting refugees.
2. Acceptability according to local customs.
3. Suitability to conditions at sites. (General assumptions had been made as to such conditions. These must be verified on a site by site basis).
4. Speed of installation.
5. Amount of operation and maintenance required.
6. Organization and installation programs considering:
  - A. Availability of materials equipment and labor.
  - B. Difficulty of installation.
  - C. Acceptability to Government Offices coordinating program.
7. Cost
  - A. First cost
  - B. Continuing cost.

## Conclusions

1. Satisfactory sanitary facilities are certainly readily available. Information has been obtained about a wide range of prefabricated facilities available in Italy, in nearby countries of Europe and in the USA. Not all manufacturers could be contacted or even identified in the available time so total available stocks could not be identified.
2. Field construction of latrines, satisfactory showers and laundry facilities can certainly be done with local resources relatively quickly.
3. Recommendations as to specific purchases for installation and whether field erected or prefabricated facilities are more suitable require further investigations:
  - A. To determine conditions at site.
  - B. To establish the availability of specific equipment, materials and construction labor at stated time.
  - C. To determine acceptability of proposed facilities to people who will use them.
  - D. To ensure coordination with several levels of government and other donors.
4. Information gathered between 4 p.m. December 9 and noon December 12 is attached in "Facility Description Sheets". Judgements as to the suitability of the facilities described are included.
5. A principle recommendation is that further judgements leading to the purchase of materials and installation of facilities should be made in or near Naples. The services of a sanitation expert and an experienced consulting engineer, who speaks Italian, should be obtained for this purpose. To obtain these services from the USA would probably require two individuals.
6. It is also recommended that chlorination equipment and chlorine be provided and used, to the end that all piped water contains residual disinfectant, as determined by chlorine residual testers, which should also be provided.

## II. ALTERNATIVES

### Alternative I (a) (i)

TYPE OF FACILITY: Field erected communal sanitation facility with flush toilets and effluent disposal to a septic tank and cesspool. Also includes shower and laundry facilities.

PERSONS SERVED: Assume 10 to 20 people per water closet, shower head and wash tub, optimal usage.

CAPITAL COST:  
(December 1980 \$) Facility with 4 water closets, showers and wash tubs: about \$15,000  
Facility with 12 water closets, showers and wash tubs: about \$45,000

To estimate capital cost of other size facilities, assume \$3,750 per toilet, shower wash tub combination.

Cost includes concrete slab on grade, ceramic water closets, hand washing basins, plumbing, electric space heaters, lights, shower assemblies, insulated superstructure, hot water heater, wash tubs, folding table excavation for septic tank and cesspool.

Costs assume electricity and an adequate piped water supply under pressure are available at the construction site and the appropriate labor, materials and construction equipment are available in the area.

SUPPLEMENTARY COST REQUIREMENTS: None unless assumptions stated above are invalid.

TRANSPORTATION COSTS: Allowance for local delivery of building materials included in cost estimate.

MAINTENANCE REQUIREMENTS: Must be cleaned and inspected daily. Fixture repairs as required. Local labor costs will depend upon size and number of facilities.

SUPPLIERS: From local resources.

ADVANTAGES: 1) Provides a semi-permanent facility.  
2) Can be constructed quickly using local resources.

- 3) Provides a high degree of wastewater treatment.
- 4) Provides employment for area residents.
- 5) Provides a central location for sanitation tasks.
- 6) Provides a very satisfactory means of excreta disposal.

DISADVANTAGES:

- 1) Must be cleaned and maintained daily.
- 2) Must be inspected regularly to insure cleanliness.
- 3) Both 1 & 2 require some basic infrastructure with responsibility and resources.
- 4) A large communal facility may not be readily accessible to all patrons at night or during inclement weather.
- 5) Cannot be relocated to a new site.
- 6) Sullage water to be disposed on the ground nearby. Requires adequate drainage to prevent standing water.
- 7) Estimated two weeks construction time starting after administrative arrangements completed.
- 8) Requires standard design drawings and specifications. Will add two to four weeks of preparation time if not available.

Alternative I (a) (ii)

TYPE OF FACILITY: Field erected communal sanitation facility with flush toilets and effluent disposal to a septic tank and cesspool. Does not include shower or laundry facilities.

PERSONS SERVED: Assume 10 to 20 people per water closet, optimal usage.

CAPITAL COST: Unit with 4 water closets: about \$8,000  
(December 1980 \$) Unit with 12 water closets: about \$24,000

To estimate capital cost of other size facilities, assume \$2,000 per toilet.

Cost includes concrete slab on grade, ceramic water closets, hand washing basins, plumbing, electric space heaters, lighting, insulated superstructure hot water heater and excavation for septic tank and cesspool.

Costs assume an adequate piped water supply under pressure and electricity are available at the construction site and the appropriate labor, materials and construction equipment are available in the area.

SUPPLEMENTARY COST REQUIREMENTS: None unless assumptions stated above are invalid.

TRANSPORTATION COSTS: Allowance for local delivery of building materials included in cost estimate.

MAINTENANCE REQUIREMENTS: Must be cleaned and inspected daily. Fixture repairs as required. Local labor costs will depend on the size and number of facilities.

SUPPLIERS: From local resources.

ADVANTAGES:

- 1) Provides a semi-permanent facility.
- 2) Can be constructed quickly using local resources.
- 3) Provides a high degree of wastewater treatment.
- 4) Provides employment for area residents.
- 5) Provides a very satisfactory means of excreta disposal.

DISADVANTAGES:

- 1) Must be maintained daily to keep clean and operating properly.

- 2) Must be inspected regularly to insure cleanliness.
- 3) Both 1 & 2 require some basic infrastructure with responsibility and resources.
- 4) A large communal facility may not be readily available to all patrons at night or during inclement weather.
- 5) Cannot be relocated to a new site.
- 6) Requires standard design drawings and specifications. Will add two to four weeks of preparation time if not available.
- 7) Estimated one to two weeks construction time starting after administrative arrangements completed.

Alternative I (a) (iii)

TYPE OF FACILITY: Field erected communal sanitation facility with flush toilets and effluent disposal to a septic tank and cesspool. Includes showers but no laundry facilities.

PERSONS SERVED: Assume 10 to 20 people per water closet and shower head.

CAPITAL COST: Unit with 4 water closets and 4 showers:  
(December 1980 \$) about \$11,000.  
Unit with 12 water closets and 12 showers:  
about \$33,000.

Cost includes concrete slab on grade, ceramic water closets, hand washing basins, plumbing, electric space heaters, lighting shower assemblies, insulated superstructure, hot water heater, and excavation for septic tank and cesspool.

Costs assume an adequate piped water supply under pressure and electricity are available at the construction site and the appropriate labor, materials and construction equipment are available in the area.

SUPPLEMENTARY COST REQUIREMENTS: None unless assumptions stated above are invalid.

TRANSPORTATION COSTS: Allowance for local delivery of building materials included in cost estimate.

MAINTENANCE REQUIREMENTS: Must be cleaned and inspected daily. Fixture repairs as required. Local labor costs will depend on size and number of facilities.

SUPPLIERS: From local resources.

ADVANTAGES:

- 1) Provides a semi-permanent facility.
- 2) Can be constructed quickly using local resources.
- 3) Provides a high degree of wastewater treatment.
- 4) Provides employment for area residents.
- 5) Provides a very satisfactory means of excreta disposal.
- 6) Requires standard design drawings and specifications. May add two to four weeks preparation time if not available.

- 7) Estimated one to two weeks construction time starting after administrative arrangements completed.

DISADVANTAGES:

- 1) Must be maintained daily to keep clean and operating properly.
- 2) Must be inspected regularly to insure cleanliness.
- 3) Both 1 & 2 require some basic infrastructure with responsibility and resources.
- 4) A large communal facility may not be readily accessible to all patrons at night or during inclement weather.
- 5) Shower drainage to be disposed on the ground nearby. Requires adequate drainage to prevent standing water.
- 6) Cannot be relocated to a new site.

Alternative I (b)

TYPE OF FACILITY: Field erected communal sanitation facility using a ventilated improved pit latrine. System does not use water.

PERSONS SERVED: Assume 10 to 20 people per water closet, optimal usage.

CAPITAL COST: Unit with two ceramic pedestals: about \$1,500  
(December 1980 \$)

Cost includes concrete slab on grade, two ceramic pedestals, electric space heaters, lights, insulated superstructure and pit below. Design allows unit to be relocated when pit is full.

Costs do not include wash basin.

Costs assume electricity, appropriate labor, materials and construction equipment are available in the area.

SUPPLEMENTARY COST REQUIREMENTS: None unless assumption stated above is invalid.

TRANSPORTATION COSTS: Allowance for local delivery of building materials included in cost estimate.

MAINTENANCE REQUIRED: Must be cleaned and inspected daily. Local labor costs will depend on the number and location of installed units.

SUPPLIERS: From local resources.

ADVANTAGES:

- 1) Simple to install.
- 2) Can be built quickly using local resources.
- 3) Very inexpensive.
- 4) Provides employment for area residents.
- 5) Provides a satisfactory means of excreta disposal.
- 6) Can be relocated when pit is full.

DISADVANTAGES:

- 1) May be unacceptable for people accustomed to flush toilets.
- 2) Must be cleaned and inspected daily which requires an infrastructure with responsibility and resources for cleaning and inspection.

- 3) Does not provide hand washing facilities.
- 4) Requires standard design drawings and specifications. May add two weeks preparation time if not available.
- 5) Will require 2 to 5 days construction time.

Alternative I (c)

TYPE OF FACILITY: Field erected chemical toilets. Effluent to a steel tank with appropriate chemical dosage.

PERSONS SERVED: Assume 10 to 20 people per water closet, optimal usage.

CAPITAL COST: Unit with two ceramic flush toilets:  
(December 1980 \$) about \$2,500.

Costs include steel tank on grade, fill material, concrete slab over tank, two flush toilets, electric heater, lights, vent pipe and insulated superstructure.

Costs do not include wash basins.

Costs assume electricity, appropriate labor, material and construction equipment are available in the area.

SUPPLEMENTARY COST REQUIREMENTS: Chemical dosage. Initial chemical requirement: 50 lbs of caustic soda.

TRANSPORTATION COSTS: Allowance for local delivery of building materials included in cost estimate.

MAINTENANCE REQUIRED: Empty tank every 2 to 4 months. Refill tank with appropriate water and chemical mixtures.

SUPPLIERS: From local resources.

ADVANTAGES:

- 1) Can be built quickly using local resources.
- 2) Satisfactory method of excreta disposal.
- 3) Relatively inexpensive.
- 4) Provides employment for area residents.

DISADVANTAGES:

- 1) Requires daily cleaning and inspection.
- 2) Requires handling tank contents every two to four months. Caustic solution is hazardous.
- 3) A suitable disposal site is required for tank contents.
- 4) Recurring chemical cost.
- 5) Does not provide hand washing facilities.
- 6) Requires an infrastructure with responsibility and resources for cleaning, inspection.

- 7) Cannot be relocated to a new site.
- 8) Requires standard design drawings and specifications. May add two weeks preparation time if not available.

Alternative I (d)

TYPE OF FACILITY: Prefabricated mobile communal sanitation facilities containing various combinations of waterflushed toilets, wash basins, showers and laundry with connection to septic tank and cesspool. (Trailer or skid mounted units).

PERSONS SERVED: 20-100 persons served, male and/or female. (assuming 10-20 persons per toilet).

CAPITAL COSTS: (December 1980 \$) Costs vary considerably among manufacturers and place of origin. Most are fabricated only upon order requiring 2-20 weeks. Square footage (150-300) unit costs range from \$35-\$75 for these trailer structures without significant cost variance for different combinations of interior equipment. Typical examples include:

- a) 2 toilets, 2 showers, 3 basins and 3 urinals, heat, light and ventilation: \$9,000 (UK)
- b) 2 toilets, 2 showers, 3 basins, 1 washer, 1 dryer, heat, light and ventilation: \$12,000 (US)
- c) 8 toilets, 8 showers, 3 urinals, 10 basins, heat, light and ventilation: \$19,000 (US)
- d) 6 toilets, 6 showers, 4 basins, 2 water heaters: \$26,500 (Italy) (5 available now, more in 15 days)
- e) 4'x4'x7' single toilet wash basin and shower, vented with translucent roof \$1,385 (UK).
- f) 8 showers with instantaneous electric water heaters \$8,250 (UK).

Note: Costs for on-site preparation: Concrete supports varying with structure size: \$500 to \$1,000.

Excavation into rock varying with "number of persons served" storage requirements: \$500 - \$2,500.

No excavation-steel tank: varies with size requirements. Estimated costs range from \$300 for 325 gal to \$1,000 for 2000 gal.

SUPPLEMENTARY REQUIREMENTS: Water and electrical supply (220V, 50HZ); periodic emptying of stored waste water or reconnect to different receptacle.

TRANSPORTATION COSTS: Estimated shipping costs US-Naples: at \$1.50/ft<sup>3</sup>: \$2,000 - \$3,600 per unit.

Quoted transport from Mulano-Napoli: \$1,500/unit.

UK - Naples, \$1,100-\$2,200 per unit.

MAINTENANCE REQUIRED: Trained attendant to clean and inspect daily at local labor rate of \$30/day. Number of attendants depends on size, number and location of facilities.

SUPPLIERS:

CO.RI.MEC, S.P.A.  
Milano, Italy  
Dr. Domenico Braghuri  
Tel: 011-59-6822040  
6886345  
(5 available now, 10 per 2 weeks)

Porta House, Inc.  
Oakland, CA, USA  
James Dodge, President  
Tel: 415-638-0100  
Telex: 330403

International Building Systems, Inc.  
P.O. Box 565  
Cockeysville, MD 21030  
Tel: 301-628-1600  
Mr. William H. Ryan, President

PORTA-KAMP Manufacturing Co., Inc.  
Houston, TX 77008  
Mr. Sid Prichard, Sales Manager  
Tel: 713-869-3293  
TWX: 910-881-1551

PORT-A-SILO  
Huntington, York  
England  
Mr. Williams, Export Manager  
Tel: 44-904-21951  
Telex: 57484, Answer Back: PORTA G  
(18 available now)

Hallam Group of Nottingham ltd.  
Langley Mill  
Nottingham, England  
Mr. Keith Henshaw  
Telex: 37426 Hallam G  
Tel: (44) 7737-66141

SUPPLIERS  
(Cont.)

AUSTIN-HALL LTD.  
Grosvenor Works  
Leeds Road  
Huddersfield HD21YR  
England  
Tel: 44-484-37355  
Telex: 517006  
Mr. Elvin Chappell, Production Manager

NOTE: Italian National Association of Construction Abroad (ANCE) are providing disaster assistance coordination in the field for supply of portable sanitation and other facilities. Contact:

Mssrs: Miglietti, Fossi (Engineers)  
Mr: Altieri, Director General  
Tel: (6) 848-8316 or (6) 84881

ADVANTAGES:

- 1) Semi-permanent facility provided.
- 2) May be available immediately.
- 3) Provides acceptable environment for use by local populations.
- 4) 90% of area's electrical power supply operable.
- 5) Does not require preparation of standard design or on site construction time.
- 6) Trailer mounted units permit easy facility relocation to serve changing needs.

DISADVANTAGES

- 1) Collection of stored waste required.
- 2) High water use requirements.
- 3) Requires attendant to maintain proper use of sanitary facilities.
- 4) Shower and laundry effluent discharged on the ground. Adequate drainage required to prevent standing water.

Alternative I (e)

TYPE OF FACILITY: Prefabricated individual portable chemical toilets. Requires regular chemical addition and emptying.

PERSONS SERVED: 20 persons for 9 days (reaching 75% tank capacity).

CAPITAL COSTS: These portable units (2.3x1.2x1.2m/230 lbs) are normally plastic or plastic laminated wood containing plastic toilet cover. They are vented, heated with a translucent roof. Separate urinal and flush<sub>3</sub>pedal are options. Tank capacities of 3-5.5m<sup>3</sup>.  
December 1980 \$)  
Costs range from \$750-\$1,125 per unit.

SUPPLEMENTARY REQUIREMENTS: Addition of diluted manufacturer - supplied chemicals, perhaps light and portable heater. (220V, 50HZ) to insure use in night and cold temperatures.

TRANSPORTATION COSTS: Some units knock down for transport reducing shipping costs.

MAINTENANCE REQUIRED: Under heavy use, daily cleaning and attendant to monitor; Collection and disposal of stored wastewater no less than weekly.

SUPPLIERS: Portsanser GMBH (United is manufactured in U.S.A. About 1000 units are available from factory inventories as of 1. December 1980).  
Banhofstrasse 125  
5620 Velbert 1  
West Germany  
Tel:(49)2124-517000  
Telex: 8597504 PSS D

Austin-Hall Ltd.  
Grosvenor Works  
Leeds Road  
Huddersfield HD21YR  
England  
Tel: (44) 484-37355  
Telex: 517006  
Mr. Elvin Chappell, Production manager

ADVANTAGES: 1) Light weight and portable.  
2) Flexible numbers of single units; for households or public sites.

DISADVANTAGES:

- 1) Require chemical addition.
- 2) Require regular emptying and disposal.
- 3) Chemical handling requires considerations.

Alternative I (f)

TYPE OF FACILITY: Prefabricated Sanitation Unit using squatting plates, pipework to large nylon-reinforced butyl rubber bags for detention and biological treatment prior to discharge in soakaway. (OXFAM sanitation unit)

PERSONS SERVED: 1000 people at very low water use  
200 people with flush toilets.

COST: About 6,000 English pounds without required modifications described below.

SUPPLEMENTARY COST REQUIREMENTS: Construction of more substantial latrine superstructure in light of cold weather.

Construction of enclosure for nylon bags to prevent freezing.

Soakaway construction.

Modification of toilets to seat type.

Site grading (5% of unit capital cost).

Hook up to water, and electricity (for heat).

Full time attendant for latrine area cleanliness.

TRANSPORTATION COSTS: 250 English pounds sea freight.

1075 English pounds air freight.

Road freight would be most reasonable but not costed in time.

MAINTENANCE REQUIREMENTS: Frequent cleaning of latrine area.

Regular desludging and disposal of sludge approximately once every eight to ten weeks.

SUPPLIES: IMI Marston Ltd. (Manufacturers)  
Fordhouses,  
Wolverhampton, WV10 6QJ  
TLX: 337411 Marson G  
Telephone: 902-783361  
Contact: Mr. Booth

OXFAM  
274 Banbury Road  
Oxford OX2 707  
TLX: 83610  
Telephone: 865-56777

ADVANTAGES:

Prepackaged technology which can be rapidly mobilized in Europe... 10 units available at OXFAM, 3 available from Marston, 4 can be made up quickly.

Above ground construction allows use on level rocky soil.

Staff available from OXFAM to assist program.

DISADVANTAGES:

Developed for warm climates, requiring extensive modification and additional cost to prevent freezing, which will increase cost to at least those of other alternatives.

Developed in different culture context (Southeast Asian) e.g. squatting plates, which may not work in Italy.

Alternative II (a)

TYPE OF FACILITY: Complete silver-impregnated ceramic candle gravity filtration unit without disinfectant.

PERSONS SERVED: Family-size, (3-5 persons)

CAPITAL COSTS: 201 swiss francs (Katadyn), 36.00 English Pounds (Portacel Ltd), other manufacturers' costs unknown.

All costs ex-works.

SUPPLEMENTARY COST REQUIREMENTS: None

TRANSPORTATION COSTS: Not known, clearly lower for Katadyn than British units.

MAINTENANCE REQUIREMENTS: Scrubbing of filter with brush when filter clogged. Replacement of filter candles on order of once every six months. Katadyn units contain three candles, 34 Swiss Francs each to replace.

SUPPLIERS: Katadyn  
P.O. Box 154  
CH 8304  
Wallisellen, Switzerland  
Tel: 1830-3677  
Contact: Peter Gutt

Portacel Ltd.  
Cannon lane  
Tonbridge  
Kent TN91PP  
England  
Tel: 732-364411  
Telex: 95467

C.M. Wales Ltd.  
Findrassie  
Nether lane  
Nutley  
Sussex TN223LA  
(not contacted)

Doulton Industrial Products  
Stone  
Staffordshire ST15 OPU  
(not contacted)

Assume (but could not check) several other manufacturers in Europe.

ADVANTAGES:

- 1) Easy to use.
- 2) Filter does not affect taste of water.

DISADVANTAGES:

- 1) Risk of subsequent recontamination of water after passage through filter (e.g. dirty cup).
- 2) Risk of contamination if filter is cracked.
- 3) Availability uncertain, although suspected fairly large number of manufacturers in Europe. Katadyn have 75 in stock plus other models, Portacel have 300 in stock plus other models.
- 4) Slow filtration rate, approximately 24 liters/day for Katadyn, TRK. For larger flow rate (large groups), suggest Katadyn KFT equipped with bicycle-type pump at 482 Swiss Francs --- yields 4 liters/minute when pumped.
- 5) Requires distribution to individual families and instruction on use.

Alternative II (b)

TYPE OF FACILITY: Chlorine (Halazone) or Iodine (Globaline) disinfectant tablets.

PERSONS SERVED: Individuals

CAPITAL COST: Approximately 2 English Pounds/thousand Halazone tablets (Boots' estimate) (use is 3 tablets/litre of unfiltered water).

SUPPLEMENTARY REQUIREMENTS: Prior removal of suspended matter highly desirable (e.g. settling).

TRANSPORTATION COSTS: Not known, varies across Europe.

MAINTENANCE REQUIREMENTS: Shelf Life, approximately 12-18 months, although highly variable.

SUPPLIERS: Assume (but could not check) numerous across Europe. Suggest check with military authorities. Two manufacturers in England:

The Boots Co., Ltd.  
Nottingham, NG2 3AA  
England  
Tel: 602-5611

Wilkinson & Simpson Ltd.  
57 Queensway  
Team Valley Trading Estate  
Tyne & Wear NE11 0N5  
Tel: 632-872164

ADVANTAGES: 1) Easily transported and readily available disinfection technology.  
2) Easy to use.

DISADVANTAGES: 1) Taste.  
2) Requires 10-30 minute contact time after addition of tablets.  
3) Cannot insure complete disinfection if suspended particles present in water.  
4) Requires distribution to individual families and instruction on use.  
5) Expensive.  
6) Chlorine tablets ineffective against cysts.

- 7) Iodine tablets involved toxicity concerns for pregnant women and hyperthyroids if used long-term.
- 8) Generally unsuitable as long-term solution.

Alternative II (c)

TYPE OF FACILITY: Ceramic filter/triocide disinfectant combination for water treatment.

PERSONS SERVED: Family (2-5 persons)

CAPITAL COST: \$30 for 3 filter/triocide disinfectant cartridges alone (without container which could be manufactured locally).  
\$50 for cartridges and US made container.  
Possibility exists for combination of export of triocide (only made in US) to Europe at approximately \$15/unit for use with European ceramic filter, with some saving in cost.

SUPPLEMENTARY COST REQUIREMENTS: Potential local pottery industry if only ceramic filter/triocide cartridges supplied. If whole units supplied, no supplementary costs/requirements.

TRANSPORTATION COSTS: Unknown at present time.

MAINTENANCE REQUIRED: Brushing of filter candle when too clogged for further flow. As with other ceramic filters, varies with water quality, but on order of once a week. Candles must be replaced if cracked, on the order of once every six months. Disinfectant good for 2-3 years.

SUPPLIERS: (Triocide Units)  
Water Technologies Corporation  
3931 Varsity  
Ann Arbor, MI 48104  
Contact: L. L. Davis  
Tel: (313) 971-3800  
Water technologies can supply complete units, ceramic filter/triocide cartridges, or simply triocide disinfectant for use with European ceramic filters.

ADVANTAGES: 1) Provides residual iodine to protect against subsequent recontamination of water after filtration.  
2) Does not affect taste significantly unless high iodine residual required.

- 3) Easy to use.
- 4) No contact time required.
- 5) Potential for local manufacture of outer container.

DISADVANTAGES:

- 1) No triocide available in Europe, must be shipped from US.
- 2) Lead time on complete units from Water Technologies is 30 days to produce 100/day, 90 days to produce 1-2,000/day.
- 3) Lead time on triocide disinfectant alone much shorter, some organization time still required for coordination of ceramic filter and disinfectant separate manufacture and assembly.
- 4) Requires distribution to individual families and instruction on use.

Alternative III (a)

TYPE OF FACILITY: Field erected shower and laundry unit both individual and joint construction.

PERSONS SERVED: Assume 10 to 20 people per shower unit and wash tub.

CAPITAL COST: Unit with 6 shower heads and wash tubs:  
(December 1980 \$) about \$12,000  
Separate shower facility with 6 shower heads:  
about \$5,500  
Separate laundry with 6 wash tubs:  
about \$7,000

Costs assume slab on grade, showers, plumbing hand washing basins, electric heaters insulated superstructure and hot water heater for showers.

Laundry costs do not include washing machines.

Costs assume an adequate piped water supply under pressure is available at the construction site and the appropriate labor, materials and construction equipment are available in the area.

SUPPLEMENTARY COST REQUIREMENTS: None unless assumptions above are invalid.

TRANSPORTATION COSTS: Allowance for local delivery of building materials included in cost estimate.

MAINTENANCE REQUIREMENTS: Must be cleaned daily. Shower fixture and plumbing repairs as required. Local labor costs will vary according to the size and number of facilities.

SUPPLIERS: From local resources.

ADVANTAGES:

- 1) Provides a semi-permanent facility.
- 2) Can be constructed quickly using local resources.
- 3) Provides employment for residents.

DISADVANTAGES:

- 1) Must be maintained and cleaned daily.
- 2) Must be inspected regularly to insure cleanliness.

- 3) Both 1 & 2 require some basic infrastructure with responsibility and resources.
- 4) Sullage water will be disposed on the ground nearby. Requires adequate drainage to prevent standing water.
- 5) Cannot be relocated to a new site.
- 6) Requires standard drawings and specifications. Will add two to four weeks of preparation time if not available.
- 7) Estimated one to two weeks construction time starting after administrative arrangements completed.

#### Alternative IV

TYPE OF FACILITY: Chlorine comparator test kits for measurement of chlorine residual.

PERSONS SERVED: Any size population using public water supply.

CAPITAL COST: About \$32 (Lamott Chemical, US).  
About 40 English Pounds (Wilkinson & Simpson Ltd.). (The higher priced model is more precise than necessary and should only be considered if simpler kits are depleted).

SUPPLEMENTARY COST REQUIREMENTS: Reagent supplies after initial stock is depleted (200 tablet kits). Kit includes reagents for 200 tests additional reagents available in Europe, US cost 3-4 dollars/100 tablets.

TRANSPORTATION COSTS: Not Known.

MAINTENANCE REQUIRED: No maintenance, but diligent personnel required for tests.

SUPPLIERS: Presumably several in Europe, not checked in time available. Wilkinson & Simpson Ltd. in UK stock both simple Lamott and more expensive Lovibond units.

Wilkinson & Simpson Ltd.  
57 Queensway  
Team Valley Trading Estate  
Gateshead  
Tyne L Wear NE 110 NS  
Tel: 4632-872164

Lamott Chemical Co.  
Box 329  
Chestertown, MD  
Tel: (301) 778-3100  
Contact: Lawson Cording

ADVANTAGES: 1) Allows measurement of chlorine residual (safety) of public water supply without highly trained personnel.

DISADVANTAGES: 1) Relatively expensive compared to more approximate methods.