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TECHNICAL SPECIFICATION		Rev. 0	07 Nov 96

CHAD DEVELOPMENT PROJECT

TECHNICAL SPECIFICATION

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1.0 SCOPE

- 1.1 This Specification covers the design and manufacture of a factory built, skid mounted, transportable, sewage treatment unit(s) which will be used for the treatment of sanitary waste from operations camps and facilities in Chad and Cameroon, Africa. Skid mounted components may be designed for modular assembly and installation. The treatment plant shall be prefabricated in the factory of the supplier and shall be shipped complete with all equipment specified herein.
- 1.2 Not included in this specification are the upstream sewer piping and lift station and downstream discharge piping.
- 1.3 A pound sign (#) indicates that ESSO review/approval is required before design and/or construction is finalized or equipment is purchased.
- #1.4 Alternative designs and specifications are encouraged as long as the design or specification is equivalent to the requirements specified. Alternative designs and specifications require ESSO's approval.
- 1.5 The treatment system shall be suitable for outdoor installation in a tropical climate and shall be of a design with proven operability and durability in environmental conditions equal to or more severe than the design operating conditions.
- 1.6 Data sheets are supplied with this specification.

2.0 SUMMARY OF ADDITIONAL REQUIREMENTS

- 2.1 Table 1 lists the codes, specifications, standards and publications which shall be used with this Specification.



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TABLE 1

SPECIFICATIONS	
CCS	
2-1-1	Equipment Noise Level Data Requirements
4-1-2	Structural Steel Design, Fabrication and Erection
4-2-1	Design Loads for Structures
9-4-201	Production Tanks, Nominal Capacities Below 2,000 bbl.
10-19-1	Packaged Equipment
15-1-5	Packaged Equipment Instrumentation
16-3-1	Wiring Methods and Material Selection
16-9-1	AC Motors
16-101-1	Electrical Requirements for Packaged Mechanical Equipment
20-1-1	Inspection of Equipment and Materials
CODES AND STANDARDS	
SSPC	
SP 6	Surface Preparation Specification No. 6 Commercial Blast Cleaning
SP 10	Surface Preparation Specification No. 10 Near-White Blast Cleaning
AISC	
M016	Manual of Steel Construction Allowable Stress Design
AWS	
D1.1	Structural Welding Code Steel
ASCE	
7	Minimum Design Loads for Buildings and Other Structures
ASME	
Section VIII, Div. 1	Boiler and Pressure Vessel Code
B 16.5	Pipe Flanges and Flanged Fittings
B 1.20.1	Pipe Threads, General Purpose
OSHA	
29 CFR Part 1926	
AGMA	
390.03	Gear Classification

3.0 STRUCTURAL

Design of non-pressure parts shall be based on the guidelines from the AISC Steel Construction Manual, and CCS 4-1-2. The treatment Plant shall be built of 6 mm (1/4 in.) minimum thickness structural grade A36 steel plate and shall be designed to withstand normal hydrostatic pressures. All welded structural members shall be in accordance with AWS D1.1, structural welding code using E-70XX electrodes. Welds shall be continuous inside and out where required for structural strength or water

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tightness. Attachment welds shall be of the same specification, grade and heat treatment condition as the plate material used to fabricate the major components. The structural components shall be joined by welding as described above and shall meet AISC and AWS welded joint requirements.

The treatment plant shall be hydrostatically tested per governing code. The hydrostatic test shall be performed prior to external coating, with chlorine controlled water (50 ppm max.) where stainless steel is in contact with the testing medium.

4.0 CORROSION PROTECTION

Surfaces immersed in water shall be prepared in accordance with SSPC SP-10 and other surfaces shall be per SSPC SP-6. Prepared surfaces shall be primed with a 75 μm (3 mil) coat of Carbozinc 11 primer and a 75 μm (3 mil) coat of Carboline finish coat. Painting shall be in accordance with CCS 19-1-10.

5.0 ELECTRICAL SYSTEM

The treatment plant shall be completely prewired at the supplier's factory and shall be in accordance with IEC Standards and meet the requirements of specification CCS 16-101-1 (Electrical Requirements for Packaged Mechanical Equipment). Electrical enclosures shall be IP66. Motors shall be provided with 1.15 service factor, shall be TEFC, and shall be in accordance with CCS16-9-1.

6.0 MECHANICAL

Pumps shall be suitable for use in sewage application. Selection of the pump shall be based on its intended service (recessed impeller, diaphragm, metering, etc.)


Motor drivers shall be suitable for the area classification. The motors shall be designed per IEC standards. Motors shall be standard sizes and readily available.

Vessels shall be sized for the volume or holding time required for the proper operation of the system. Materials shall be compatible with sanitary sewage. Construction shall be industry standard.

Supplier's standard materials are acceptable; as long as Supplier shall furnish material equal to or better than the material specified herein.

Mechanical drives shall be gear reduction type with gears that conform to AGMA gear classification for continuous duty.

Drives shall be enclosed in suitable housings with seals between the rotating and fixed components to prevent oil leakage.

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Torque ratings for the drive shall be based on standard design criteria accepted and used in the gear industry and shall be limited by the strength or surface durability, whichever is least.

Machinery shall operate under all conditions without excessive vibration.

All grease fittings, oil fill, and drain points shall be extended for easy access and service form walkway or operating platform without raising floor plates.

7.0 PIPING

Piping shall be arranged so that no liquid pockets or vapor traps are installed. Block valves shall be provided to isolate principal skid termination points for inspection and maintenance. Flanged connections shall be provided for the skid battery limit. Butterfly valves shall not be used where positive shut-off is required. Piping and fittings shall be located in the confines of the skid and supported in such a way as to avoid unacceptable vibration, stresses or loads on equipment. Sufficient 19 mm (3/4 inch) vents and drains with corrosion resistant plugs shall be provided for hydrostatic testing and purging prior to start-up. Sufficient 19 mm (3/4 inch) or larger valved vents and drains shall be provided to permit ease of start-up and shutdown. Sampling ports between processes and at the effluent discharge shall be provided.

Piping shall be per supplier's standard practice and this specification.


Pipe connections 50 mm (2 in.) and larger shall be flanged. Flanges shall be in accordance with ASME B 16.5. Flange bolt holes shall straddle natural centerline. Two bolt pipe flanges shall not be used.

Cast iron piping materials shall not be used.

Unless otherwise specified, minimum wall thickness shall be Schedule 80 for 50 mm (2 in.) nominal and smaller, Schedule 40 for 3 inches and larger. Nominal pipe sizes of 30 mm (1 1/4 in.), 60 mm (2 1/2 in.), 90 mm (3 1/2 in.), and 125 mm (5 in.) shall not be used.

8.0 INSTRUMENTATION

The treatment plant control system and instrumentation shall be designed so that the plant is capable of unattended operation, except for maintenance and periodic oversight. Supplier shall provide all necessary instrumentation for operation and testing of the system. All instrumentation shall be in accordance with CCS 15-1-5 and CCS 15-0-100. All instrumentation and associated junction boxes shall be rated for IP66.

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9.0 UNIT PROCESSES

The unit processes shall consist of, but not be limited to:

- A coarse screen
- A comminutor/grinder.
- Biological activated sludge, suspended growth, complete mix unit process with contact stabilization or extended aeration
- Settling basin
- Sludge wasting system
- Chlorine contactor

10.0 UNIT PROCESS SPECIFICATIONS

10.1 Coarse Screen

The coarse screen shall have a screen opening of 19 mm (3/4 inch). A manual or automatic means for removing solids and cleaning the screen shall be provided.


10.2 Comminutor/Grinder

The comminutor/grinder shall be designed to prevent solids larger than 6 mm (1/4 inch) from passing.

10.3 Biological Treatment Unit

The biological treatment unit shall be the activated sludge, suspended growth process with the following design basis:

- The sewage consists of liquid sanitary waste originating from the kitchen sinks, lavatories, showers, urinals and toilets.
- Water Temperature is expected to vary from 10° C to 32° C
- Flow shall be based on 360 liters (95 gallons) of wastewater generated per person assigned to the camp or facility, per day.
- The design shall be based on a mean cell residence time of not less than 5 days.
- Mixed liquor volatile suspended solids (MLVSS) are 1500 mg/L and mixed liquor suspended solids (MLSS) are 1600 mg/L.

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- Influent BOD₅ shall be 250 mg/l (30 day avg.).
- Cell yield coefficient Y (MLVSS/BOD₅) equals 0.71 and the endogenous decay coefficient b (1/t) equals 0.064 days⁻¹.
- Minimum air requirements are 1.1 Kg air/Kg BOD₅ removed. Average dissolved oxygen (DO) concentration of 2.0 mg/L shall be maintained.

Air requirements may be provided by blower/diffuser system, mixer, induced air, or combination thereof. The air distribution system shall be designed to evenly distribute air over the entire length of the aeration tank. Air diffusers, if part of the system, shall be the fine bubble (for shallow tank), non-clog type, operational between 122 and 490 SCM/d (3 and 12 scfm) per diffuser. Each assembly shall be designed and installed such that non "in-situ" replacement will not impact unit operations.

10.4 Secondary Clarification


The secondary clarifier shall be based on the following design criteria:

- Overflow rate shall not exceed 24 m³/m²-d
- Minimum tank depth shall be 3 m.
- Sludge Volume Index equals 150
- Solids loading rate shall not exceed 6 Kg/m²- hr

The data noted above constitutes Clarifier Data Sheet information.

The clarifier shall include, but not be limited to, the following:

- Tank
- Feedwell
- Bottom Rake Assembly and Lifting Devices
- Skimmer and Scum Trough
- Drive Mechanisms and Speed Reducer Effluent Weir
- Walkways and Ladders or Stairways.
- Overload Alarm and Control System
- Piping and Valving

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The Clarifier/Thickener shall be Supplier's standard design, modified as required to comply with this specification. Major equipment shall be of proven design with a minimum of 2 years of successful operation in equal to or more severe than design operating conditions.

All gears and bearings shall run in an oil bath.

Drive units shall be furnished with overload protecting device(s) that shall visually indicate relative load by suitable means. When overloaded, an alarm shall be activated and the motor shall be de-energized. The loads where the alarm and motor cut-off occur shall be independently adjustable.

The Clarifier/Thickener shall be fabricated, assembled, and tested at the supplier's factory to the maximum extent feasible to minimize field installation and startup time. The system shall be complete with all structural supports, controls, instrumentation, piping, wiring, and components mounted.

Equipment and piping shall be arranged so that when installed, all external and internal components requiring manipulation, observation, and maintenance shall be readily accessible and safe to operating and maintenance personnel.

Supplier shall provide any special tools required for maintenance and servicing of the equipment. The tools shall be new and not used for construction.

Provisions shall be made for the removal of bottom sludge during maintenance periods by scouring.

10.5 Sludge Wasting System


Supplier shall provide a method for wasting and dewatering excess sludge from the clarifier underflow. Water from the dewatering process shall be returned to the biological treatment unit. Dewatered sludge will be landfilled or landspread into suitable soil.

10.6 Return Activated Sludge (RAS)

Supplier shall provide a system for returning activated sludge from the clarifier underflow to the biological treatment unit. The system shall be capable of returning RAS at a rate equal to 100% of the treatment unit flow rate and shall be capable of operating when turned down to 20% of the treatment unit flow rate.

10.7 Chlorination

Supplier shall provide a disinfection tank with baffles to prevent short circuiting. The chlorine tank shall have sufficient capacity for 30 minutes retention time at the average hourly design flow. The chlorinator shall consist of a compact

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chlorinator box which dispenses a predetermined, stable quantity of chlorine from a tablet form. The chlorinator shall be manufactured of high density cross-linked polyethylene or stainless steel for durability and corrosion resistance. The chlorinator shall be designed to assure good contact between the water and disinfectant tablets, and to permit the free flow of water through the unit. Chlorine shall be injected at a rate of 2-5 mg/L at a point which will provide a minimum contact time of 30 minutes prior to discharge.

10.8 Walkways

The treatment plant shall be equipped with walkways, steps, ladders and handrails meeting OSHA standards and CCS 4-2-1. The walkways, steps, ladders and handrails shall be of galvanized steel, aluminum or fiberglass construction.

10.9 Effluent Criteria

Effluent shall meet World Bank effluent guidelines for onshore oil and gas development. Table 2 highlights key World Bank effluent criteria. The system shall include provisions for ensuring that effluent criteria are met during periods of system start-up and upsets.


TABLE 2

World Bank Liquid Effluent Criteria¹

Parameter	Maximum Levels
pH	6-9
BOD ₅	50 mg/L
Oil and Grease	20 mg/L
Heavy Metals (except Barium)	10 mg/L
Phenolic Compounds	100 mg/L
Total Suspended Solids	50 mg/L
Coliform Bacteria	400 MPN/100 mL ² (MPN - Most Probable Number)
Temperature - at the edge of the mixing zone	Max. 5° C above ambient temperature of receiving waters - Max. 3° C if receiving waters >28°C.

Source: The World Bank Environment, Health and Safety, Guidelines, Onshore Oil and Gas Development (World Bank, 1995)

1. Maximum daily discharge limits
2. Average monthly concentration (i.e., 30 consecutive days of sampling)

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10.10 Discharge

Discharge of treated fluids will be to perennial surface waters or to absorption/evaporation system. Discharge will be performed in a manner that avoids erosion.

11.0 NOISE

The system noise shall not exceed 85 dBA and must be in accordance with CCS 2-1-1.

12.0 START-UP AND OPERATING INSTRUCTIONS

The manufacturer shall provide detailed operating and installation instructions. A trained representative shall also be provided to perform initial plant start-up and to assist the Contractor and/or ESSO in the operation and maintenance of the plant.

13.0 IDENTIFICATION AND TAGGING

Identification and Tagging shall conform to CCS 10-19-1.

14.0 INSPECTION AND TESTING

Inspection and testing shall conform to CCS 20-1-1.

15.0 PERFORMANCE GUARANTEE

Contractor shall guarantee that the system provided meets the requirements of the World Bank for effluent quality and functional performance of this specification. The Contractor shall immediately correct any deficiencies in the equipment or its performance.

SPECIFICATION SHEET
**PACKAGE SEWAGE TREATMENT
 SYSTEM**

TAG NO. _____
 SHEET _____ OF _____
 BY PROCESS _____
 MECH. _____
 REV. _____ DATE _____

CLIENT _____ SPEC. NO. _____ CONTRACT _____

1 NO. OF UNITS _____ MFR. MODEL NO. _____

2 SERVICE _____ MANUFACTURER _____

3 _____ PROCESS DATA

4 PLANT CAPACITY: NORMAL _____ GPD MAX. _____ GPD

5 PLANT INFLUENT: BOD₅ _____ mg/L SUSPENDED SOLIDS _____ mg/L

6 OTHER _____

7 PLANT EFFLUENT: BOD₅ _____ mg/L SUSPENDED SOLIDS _____ mg/L

8 OTHER _____

9 TYPE OF PLANT: ACTIVATED SLUDGE _____ CONTACT STABILIZATION _____

10 EXTENDED AERATION _____ PHYSICAL-CHEMICAL _____

11 OTHER _____

12 _____ MECHANICAL DESIGN

13 PLANT SIZE: LENGTH _____ WIDTH _____

14 HEIGHT _____ DIAMETER _____

15 PLANT TO INCLUDE THE FOLLOWING ITEMS. (NOTE SIZE OR VOLUME)

16 EQUALIZATION TANK: _____ CHLORINE CONTACT CHAMBER: _____

17 FLOCCULATION & COAGULATION: _____ AERATION TANK: _____

18 CLARIFIER: _____ SLUDGE HOLDING TANK: _____

19 TUBE SETTLERS: _____ SLUDGE THICKENING: FROM _____ % TO _____ % SOLIDS

20 FILTERS: GRAVITY _____ BY: CENTRIFUGE _____ FLOTATION _____

21 PRESSURE _____ GRAVITY _____ CONT. BELT FILTER _____

22 MATERIALS OF CONSTRUCTION _____

23 _____

24 _____

25 BLOWER(S): NO. _____ CFM _____

26 POSITIVE DISPL. _____ CENTRIFUGAL _____

27 ITEMS TO BE INCLUDED BY MANUFACTURER

28 CONTROL PANEL _____ ACTIVATED CARBON _____ SKID MOUNT _____

29 FLOW TOTALIZER _____ SLUDGE RECIRCULATION _____ SCUM BAFFLE _____

30 COMMINUTOR _____ AUTO.SLUDGE B.O. _____ ADJ. WEIR _____

31 BAR SCREEN _____ CHEM. FEED TANKS _____

32 FROTH SPRAY _____ CHEM. FEED PUMP & DR _____

33 OTHER _____

34 _____

35 INSTRUMENTATION: _____

36 _____

37 MOTORS:

38 POWER AVAILABLE: VOLTS _____ PHASE _____ Hz _____

39 BLOWER(S) HP _____ / _____ VOLTS CONTROL PANEL: VOLTS _____

40 COMMINUTOR: HP _____ / _____ VOLTS OTHER _____

41 SLUDGE RECIR: HP _____ / _____ VOLTS

42 NOZZLES: INLET: SIZE _____ RATING _____

43 OUTLET: SIZE _____ RATING _____

44 SLUDGE REMOVAL: SIZE _____ RATING _____

45 OTHERS: _____


46 OPERATING WEIGHT _____ SHIPPING WT. _____ CUBAGE _____ CU.FT.

47 MATERIALS OF CONSTRUCTION: _____

48 _____

49 _____


50 _____

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SPECIFICATION SHEET
**PACKAGE SEWAGE TREATMENT
 SYSTEM (Continued)**

- 61 PAINTING: INTERNAL PRIME _____, FINISH _____, OTHER _____
- 52 EXTERNAL PRIME _____, FINISH _____, OTHER _____
- 53 REFERENCE OTHER EQUIPMENT SPECIFICATION SHEETS _____
- 54 _____
- 55 _____
- 56 REMARKS: _____
- 57 _____
- 58 _____
- 59 _____
- 60 SKETCH: _____

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