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TECHNICAL SPECIFICATION		Rev. 0	04 Nov 96

## CHAD DEVELOPMENT PROJECT

## TECHNICAL SPECIFICATION

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## 1.0 SCOPE


- 1.1 This Specification covers the requirements for the design of the potable/ utility water and fire water supply from ground water wells.
- 1.2 A pound sign (#) indicates that ESSO review/approval is required before design and/or construction is finalized or equipment is purchased.

## 2.0 SUMMARY OF ADDITIONAL REQUIREMENTS

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

**TABLE 1**

SPECIFICATIONS	
<b>CCS</b>	
3-2-3	Fire Water Systems
3-7-1	Piping Flexibility and Supports
3-12-1	Valve Selection Criteria
11-10-2	Potable Water Treatment, Storage and Distribution
15-0-100	General Instrument Specification
16-7-1	Motor Application
16-9-1	AC Motors
17-6-1	Fire Protection Systems for Buildings
19-1-10	Painting Above-ground Facilities
19-5-1	Cathodic Protection
CODES AND STANDARDS	
<b>API</b>	
5L	Line Pipe
<b>AWWA</b>	
A100	Wells
A200	Steel Pipe (Over 150m)
C508	Check Valves
C654	Disinfection of Wells
E101	Vertical Turbine Pumps - Line Shaft and Submersible Types
<b>ASTM</b>	
A53	Standard Specifications for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
C33	Concrete Aggregates

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### 3.0 GROUND WATER SUPPLY AND WELLS


3.1 The water supply source is to be developed from an aquifer from which the quality and quantity desired can be produced

- # a. A hydrogeologist, approved by ESSO, shall be retained to advise on well location, spacing, design and construction. The wells shall comply with AWWA A100.
- b. Wells shall be located to avoid sources of surface or subsurface pollution and/or flooding. The elevation of the top of the wells should be at least 600 mm (2 ft.) above the highest expected flood level.
- c. Number of wells, size and depth of borings, gravel packs, screen sizes, well casings, sizes, number and capacity of multistage submersible pumps and electric motors, and size of discharge piping and other necessary components shall be designed to meet the required discharge pressures and flows as per CCS 3-2-3 and CCS 11-10-2.
- d. Spacing of wells shall be such that the drawdown curves do not overlap for adjacent wells (including hand-dug wells and other watering holes used by the local population).
- e. The well design shall ensure that the screen section is always fully submerged and that any fluctuations in the elevation of the top of the saturated zone have been taken into account.
- f. A water supply well shall not be located within 500 m (1640 ft.) radius of any landfill.

#### Test Hole & Alignment

3.2 Contractor shall drill a test hole to a depth required to reach and penetrate water bearing strata and continue for 3 meters (or 10 ft.) into impervious stratum immediately below the lowermost sand layer.

- a. Perform Eastman inclination single shot survey or other acceptable survey on each 20 meter (or 65 ft.) increment of drilling. Test hole shall be vertical within one degree from true vertical and vary not more than 75 mm (or 3 in.) in any 20 meters (or 65 ft.).


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- # b. Obtain samples of each water bearing sand stratum penetrated. Each sample shall be retained in a sack or container, plainly labeled, showing depth from which sample was obtained and location of test hole from known referenced point. The Contractor shall obtain a sieve analysis on each sample taken. In case of abandonment, seal well with gristles clay, starting from the bottom by pumping to within 6 meters (or 20 ft.) of ground surface. Fill remaining 6 meters (or 20 ft.) with Portland cement by the Haliburton process or an alternate method approved by ESSO.
- c. A complete drilling log shall be available for each test hole- The Contractor shall maintain an accurate log of location of top and bottom of each stratum penetrated.

### Well Materials

3.3 The water well components shall be made from the following materials:

- a. The main casing material shall consist of steel, API 5L Grade B or ASTM A53 Grade B, seamless, with standard couplings.
- b. Screen shall be Type 304 stainless steel, continuous slot, wire-wound design to provide maximum inlet area consistent with strength requirements. Exact screen gauge openings shall be determined after sieve analysis, if applicable, has been conducted on sand samples obtained from test hole.
- c. Blank pipe shall be installed between sand formations and 3 meters (or 10 ft.) below the bottom screen section. Blank pipe shall also extend above the bottom of main casing. Blank pipe shall be the same type and weight as screen pipe.
- d. Gravel shall be clean, well-rounded and graded, smooth and uniform having a specific gravity of 2.5 or greater. The grading shall meet the requirements of the screen manufacturer. The gravel shall be thoroughly disinfected with a 50mg/l chlorine solution as it is added to the well cavity. The gravel size shall be recommended by the Contractor after the results of the sieve analysis are obtained.
- # e. All other materials used such as drilling fluid and cement grout shall require ESSO's approval.

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## Well Construction

3.4 Each water well shall be constructed to meet the following guidelines:

- a. For the entire depth of the main casing, ream well hole to a minimum 100 mm (4 inches) greater than the outer diameter of main casing. The main casing shall extend from 500 mm (1 ft. -8 in.) above the finished grade to the depth of the shallowest water bearing formation to be developed. The space between the casing and drill hole shall be completely sealed by using cementitious grout under pressure. Allow sufficient time for cement to properly set before cement plug is drilled.
- # b. After cement has set, underream with positive hydraulically operating expanding underreamer in continuous operation of water bearing formations which are to be used in completed well. Size of underreams shall be recommended by the Contractor and requires ESSO's approval. Hole which extends into impervious stratum underlying lower water bearing sand shall be 100 mm (4 inches) larger than outside diameter of screen and blank pipe. Set screen to coincide with and conform in length to the thickness of water bearing formations as determined by electric log. The well design shall ensure that the screen section is always fully submerged and that fluctuations in the elevation of the water level in the saturated zone have been taken into account.
- c. For water bearing sand formations a gravel wall filter is required. After screen and blank pipe are set in hole, fill annular space around outside of screen and blank pipe and inside of underreamed hole with well graded gravel. Convey gravel from hydraulic graveling machine to the point of deposit at the bottom of the well through graveling tube. As annular space on outside of screen and blank pipe are filled, gradually raise graveling tube to maintain bottom of graveling tube near point of deposit at all times. Deposit gravel to within 3 meters (or 10 ft.) from top of blank pipe.

## Well Development

3.5 Following installation of the well, Contractor shall set test pump and conduct a continuous pumping test for a period of not less than 36 hours to establish well capacity, draw down, and recovery level for pump installation.

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- a. All equipment and power for testing shall be furnished by the Contractor. Equipment shall include a test pump with a capacity of 1.5 times the guaranteed yield, orifice meter for measuring quantity of water, air line and certified gauges calibrated in meters of water. ESSO shall be a advised of all testing.
- b. Should the test of the well indicate that the yield is below the minimum gallons per minute required, Contractor shall immediately take such steps that may be necessary to reconstruct or recondition the well to attain the required capacity yield.

### Well Cleaning

- 3.6 After well development, contractor shall clean each well. To clean up the wells, tubing is run past the bottom of the screens and compressed air is pumped down the tubing. As the air returns up the annulus, it lifts the water and any small debris that may be inside the casing. If the well does not produce satisfactorily, the casing/tubing annulus can be blocked off and the compressed air forced through the screens and up through the gravel pack to back flush same. Water can also be pumped up through the gravel to flush same. Water can also be pumped through the gravel to flush out debris.
- 3.7 Wells should be cleaned by jetting with air for several days before running the submersible pump. Jetting removes any fine sand that may get through the screens.

### Well Disinfection

- 3.8 After well has been developed and cleaned of sand and debris, Contractor shall thoroughly clean casing pipe by swabbing using alkalis, if necessary, to remove oil, grease, and lubricants. Contractor shall disinfect the well prior to use for potable water production by introduction of 50mg/liter chlorine solution into the well. The disinfectant shall be allowed to stand for 2 hours. Flushing water shall then be introduced at the bottom of the well forcing the chlorine solution out of the casing. After flushing, the well shall be pumped until there is no chlorine odor in the water. Disinfectant procedures shall comply with AWWA 654 and meet the World Health Organization Standards as per CCS 11-10-2.

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### Well Testing

- # 3.9 Before final acceptance of the well, water tests shall be performed by an ESSO approved laboratory to ensure water is free of any unacceptable concentrations of harmful chemicals or microbiological contaminants including bacteria, viruses, protozoa and parasites.
- # a. Contractor shall take one sample on five successive days after well has been chlorinated and permanent pumping equipment installed and tested, and submit it to an ESSO approved laboratory for testing. Contractor shall re-disinfect water well until bacteria free samples are obtained.
  - # b. Contractor shall collect sufficient samples of water for chemical analysis after the well is free of chlorine residual, determine pH and free carbon dioxide at time of sample collection at the well site and make other determinations in a laboratory. The Contractor shall submit a procedure to ESSO for approval for the treatment of any unacceptable concentrations of chemicals in the well water as per CCS 11-10-2.

### Well Completion

- 3.10 To complete the well installation, the Contractor shall provide and install the following:
- a. To prevent ground water contamination, at least two well seals shall be installed within the annulus:
    - (1.) One just above the screen, and
    - (2.) the other at the ground surface.


Sealing material shall be suitable for the intended purpose and examples may be neat cement grout, dry bentonite, bentonite slurry or a mixture of a small amount of bentonite with neat cement.
  - b. Install well pump as indicated on the drawings and in accordance with the manufacturer's instructions. If the permanent well pump cannot be installed within three days, a cap shall be welded temporarily to the top of the casing to protect the well from damage or contamination. The cap shall be removed when a permanent pump is installed.

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- c. Concrete sealing block shall be installed extending 1 meter (3 ft.) in all directions from the main casing. The block shall be a minimum of 150 mm (6 in.) thick and shall slope away from the wellhead at 20 mm per meter (1/4 in. per ft.).
- d. A well casing vent shall be provided with the opening screened with 16-mesh or finer stainless steel screen. The vent shall be turned downward and elevated above the pump base so as to minimize the drawing of contaminants into the well.
- e. Either an electric resistance tape or a water level measuring air line shall be installed and calibrated to permit monitoring of ground water levels.
- f. A sampling point shall be provided at a suitable location for taking samples for water quality monitoring.
- g. On completion of the work on water wells and prior to design of water treatment, the following shall be reported:
  - 1) Log of well drilling
  - 2) As-built drawings of wells, well pumps and other details.
  - 3) Final pump test results to verify capacity requirements have been met
  - 4) Results of chemical and bacteriological tests on water samples
  - 5) Verification of water treatment requirements originally planned

#### 4.0 PUMP CONTROL

- 4.1 The system design shall incorporate the automatic operation of up to two well pumps. Each well pump shall start or stop as controlled by the storage water levels in fire water tank or potable/utility water reservoir reaching pre-determined elevation set points or by the hydropneumatic tank pressure reaching pre-determined set points.
- 4.2 The local pump panel (if required) shall be an IP66 enclosure.
- 4.3 Any additional well pumps shall be manually controlled remotely from the control room.

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## 5.0 WELL PUMPS AND MOTORS

- 5.1 Multi-stage submersible well pumps shall comply with AWWA E101.
- 5.2 Check valves shall be installed in pump discharge pipes.
- 5.3 Well pump motors shall comply with IEC in accordance with CCS 16-7-1 and CCS 16-9-1 and shall be stainless steel.
- 5.4 The power available will be 400 Volts, 3-phase, 50 Hz with the controls located in the station power house motor control center.
- 5.5 When running the submersible pump, care shall be taken to firmly secure the electric cable to the tubing. Very little slack shall be maintained when pulling the pump to be certain that the cable is coming up with the tubing.