FROM: HQ AFCESA/CEO
139 Barnes Drive, Suite 1
Tyndall AFB FL 32403-5319


1. Purpose. This ETL provides technical guidance for water distribution lines leak-detection programs on Air Force installations.

Note: The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this ETL does not imply endorsement by the Air Force.

2. Application. Requirements in this ETL are mandatory for all Air Force-owned, -operated and maintained water systems. This ETL does not apply to privatized utilities.

2.1. Authority:
• Air Force policy directive (AFPD) 32-10, Air Force Installations and Facilities
• Unified Facilities Criteria (UFC) 3-230-02, O&M: Water Supply Systems
• Air Force instruction (AFI) 32-1067, Water Systems

2.2. Effective Date: Immediately

2.3. Intended Users:
• Major command (MAJCOM) engineers and energy managers
• Base civil engineers (BCE)
• Base energy managers

2.4. Coordination:
• MAJCOM A7 (Installations & Mission Support) directorates

3. References.

3.1. Air Force:

3.2. Unified Facilities Criteria (UFC):
• UFC 3-230-19N, Water Supply Systems,  
  http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

3.3. Executive Order (EO):  
• EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management,  
• EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance,  

3.4. American Water Works Association (AWWA):  
• Manual M36, Water Audits and Loss Control Programs,  
• Free Water Audit Software,  
  http://www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=48511&navItemNumber=48158&showLogin=N

4. Acronyms and Abbreviations:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFI</td>
<td>Air Force instruction</td>
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<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
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<tr>
<td>BLCC</td>
<td>building life cycle costs</td>
</tr>
<tr>
<td>BCE</td>
<td>base civil engineer</td>
</tr>
<tr>
<td>CO</td>
<td>contracting officer</td>
</tr>
<tr>
<td>ECIP</td>
<td>Energy Conservation Investment Program</td>
</tr>
<tr>
<td>EO</td>
<td>Executive Order</td>
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<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>ETL</td>
<td>engineering technical letter</td>
</tr>
<tr>
<td>FY</td>
<td>fiscal year</td>
</tr>
<tr>
<td>GFM</td>
<td>government-furnished material</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>gpm</td>
<td>gallon per minute</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>HQ AFCESA/CEOA</td>
<td>Air Force Civil Engineer Support Agency, Operations and</td>
</tr>
<tr>
<td></td>
<td>Programs Support Division, Engineer Support Branch</td>
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<tr>
<td>Hz</td>
<td>hertz</td>
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<tr>
<td>MAJCOM</td>
<td>major command</td>
</tr>
<tr>
<td>NTP</td>
<td>Notice To Proceed</td>
</tr>
<tr>
<td>POC</td>
<td>point of contact</td>
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<tr>
<td>SOW</td>
<td>statement of work</td>
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<tr>
<td>UFC</td>
<td>Unified Facilities Criteria</td>
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5. Background. National studies indicate that, on average, 14 percent of the water treated by water systems is lost to leaks; 10 percent to 20 percent water loss is considered normal. Some water systems have reported water losses exceeding 60
percent. Leakage from water distribution systems costs the nation $1 billion to $2 billion annually from damage and increased water costs. These leaks are largely underground and unobserved. Only 1 percent of water loss is due to visible or obvious water main breaks, making leak detection vital to controlling water loss. Some of the key benefits from conducting a leak detection survey are listed below:

- Reduce water loss
- Lower the cost of treated water (reduces unnecessary pumping and treatment)
- Reduce operating cost
- Increase knowledge of system’s current condition
- Reduce liability to property and mission support capability due to leak damage
- Better use of resources to ensure a more reliable supply
- Improved compliance with mandated water conservation goals

5.1. Main Sources of Leaks.

5.1.1. Main Leaks. Leaks due to corrosion usually start small but can grow larger. Splits and joint leaks can occur due to excessive pressure, improper installation, settlement, and overloading. Joint leaks can also result from corrosion. Losses range from 1 gallon per minute (gpm) to over 1000 gpm.

5.1.2. Meter Box Leaks. Leaks may be caused by loose or broken/damaged meter parts. Losses range from 1 gpm to over 10 gpm.

5.1.3. Customer-side Leaks. Leaks can be caused by poorly installed or broken fixtures or valves. Losses range from 1 gpm to over 15 gpm.

5.1.4. Valve Leaks. Leaks start from loose or broken components in system controls such as pressure-reducing valves, pressure-sustaining valves, pressure-relief valves, altitude-control valves, blowoffs, and air-release valves. Losses range from 1 gpm to over 500 gpm.

5.2. Types of Leak Detection.
5.2.1. Audible Leak Detection: The use of electronic listening equipment to detect the sound of leaks. Pressurized water forced out through a leak loses energy to the pipe wall and the surrounding soil area. This energy creates sound waves that can be sensed and amplified by electronic or mechanical detection equipment. There are three types of sounds: Type one is 500 hertz (Hz) to 800 Hz (sound transmitted by the pipe’s vibration and through a sounding area some distance from the actual leak); type two is a drip-like sound that is 20 Hz to 250 Hz; and type three is a gushing sound that is also 20 Hz to 250 Hz. (Type two and type three leak sounds are in the immediate area of the leak.) Trained operators can discern the small differences between the three types. Using a correlator and audible detection on two known locations surrounding the leak, an operator can pinpoint the exact location of the leak. (A correlator is a microprocessor that accurately locates leaks by analyzing leak sounds traveling through a column of water and along the pipe.) This is the preferred method of leak detection for the Air Force.

5.2.2. Infrared/Thermal Detection: A multispectral and thermal aerial photograph obtained through aerial surveillance that shows ground temperatures. This method is best used on large distribution lines (16 inches or greater in pipe diameter) and in warm, dry climates and environments. High water tables and moist earth can hide leaks from this detection method. Due to this method’s limitations, it is not recommended.

5.2.3. Active/Automated Monitoring: Detection through actively monitoring flow rates, pressures, reservoir levels, and meters through a series of sensors. Leaks can be suspected when unusual readings are reported. Based on the type of hydraulic modeling software and the extent of the sensor system, the reported data can narrow down the location of the leak but audible detection is typically required to find the exact location.

5.3. Factors Affecting Detection. Audible leak detection is the most common method of detection. However, there are a number of sounds that may interfere with detection. Knowing the characteristics of the pipes and the surrounding area can help adjust the devices and identify the true leaks. Below is a summary of possible factors that can affect detection:

5.3.1. Mains with rubber gasket joints often do not transmit sound beyond the leaking section.

5.3.2. Pipe material can hamper sound. The following pipe materials are listed in the order of best sound transmittal to minimal sound transmittal: copper, steel, ductile cast iron, plastic, asbestos-cement, and concrete.
5.3.3. Increasing pipe diameter can diminish the sound of leaks.

5.3.4. Fittings such as tees and elbows can distort sound, creating difficulties in locating specific leak sites.

5.3.5. Surrounding soils also affect sound transmission. Dry, sandy soil is best, loamy soils are average, and clay is the most difficult for sound to travel through.

5.3.6. Gravel and lawns poorly transmit sound; paved surfaces are better.

5.3.7. Utilities buried/located nearby can produce sounds that interfere in pinpointing the location of the leak.


6.1. EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*. The goal is to reduce potable water consumption intensity by 2 percent a year from baseline fiscal year (FY) 2003 through FY 2015.

6.2. EO 13514, *Federal Leadership in Environmental, Energy and Economic Performance*. The goals include the following:

6.2.1. Reduce potable water consumption intensity by 2 percent a year from baseline FY 2007 through FY 2020.

6.2.2. Reduce industrial, landscaping, and agricultural water usage by 2 percent a year from baseline FY 2010 through FY 2020. (See ETL 09-13, *Irrigation of Installation Turfgrass and Landscaping*.)

7. Execution.

7.1. Conduct In-house Water Audit. Finding specific leaks is important but it is critical to capture the difference in total base need and total water supplied in order to determine if other leaks exist. Conducting an in-house audit can give a reference point to compare with the actual billed (amount treated) to determine if leaks exist and quantify the severity of any existing leaks. Example: A water audit uncovers that there is 150-gpm loss but only a 20-gpm loss is accounted for. This is an indication that additional leaks need to be found. This is also a good analysis point to determine if leak detection is warranted and cost effective. In-house water audits can utilize meter data or estimated usage methods. Meter data may present more accurate data and is preferred over calculated usage. UFC 3-230-02, *O&M: Water Supply Systems*, has a checklist for
repairing water main leaks and repairs. AWWA Manual M36, *Water Audits and Leak Detection*, also has useful information to support water audits; AWWA also offers free water audit software (see paragraph 3.4). AWWA standards are the industry standard for water systems.

7.2. Leak Detection. There are many aspects to leak detection but the key is preparation, training, and the resulting reports. Each of these steps leads and sets the foundation for future actions to reduce water loss for the life of the water system. Attachment 1 is an example statement of work (SOW) for leak detection.

7.2.1. Preparation. Preparing for the leak detection survey is vital to a cost-effective survey. To prepare for the survey, the following must be gathered:

- Maps and drawings of base utilities and collection and analysis of available metered and billing data
- Listing of historical breaks or recent repairs (completed or under construction) and known pipe sections/valves needing repair
- Knowledgeable base personnel who know the historical and current issues or concerns of the existing infrastructure (Depending on how base infrastructure is set up, multiple civil engineering shops may be involved. The leak can result from work on a non-water-related line.)
- Notification to local/base community and leadership (Depending on the events during the survey, there may be some interruptions to service, but only when necessary.)
- Historical monthly and annual usage for incoming supply as well as treated wastewater data
- Records from the fire department showing hydrant openings
- Existing data on any metered facilities
- Information on facility irrigation systems

7.2.2. Shop Training. Incorporate shop training into the survey. At the start of the leak detection survey there must be an initial survey. The initial survey will help the operator get a general idea where leaks may be located and also give the operators an idea of how sounds may differ from other sites; this is an ideal time to conduct shop training. This will help the shops gain or sharpen their capabilities and is also an opportunity to lay the foundation for survey quality assurance/quality control (QA/QC).

7.2.3. Leak Detection Report/Prioritized Repair Plan. After the leak detection survey is completed, it is important to get the following information so that repair or follow-on work is clearly defined and contains the basic information needed to be submitted for various Air Force funding programs:

- Location of leak (grid coordinates, location/site description)
- Estimated gpm loss
- Estimated cost and scope of repair
- Prioritized repair list based on severity and criticality of the leak in supporting the base mission
7.3. Conducting Repair. Depending on the size and severity, the work can be accomplished in-house or as part of a construction/repair project. Leak detection and repair may not be accomplished under one contract due to contractual legal limitations. The survey and repair projects should be accomplished with little or no waiting period in between. The benefits of completing the survey and repair consecutively include preventing the leak from worsening over time (incurring more costs both in repairs and water loss) and all resources (completed report with solutions and equipment) are already available. In Attachment 2, an example SOW for a repair leak project has been provided.

7.4. Post-repair Documentation. The repair should be documented for future reference and, if possible, incorporated into the existing base Geographic Information System (GIS). Document the following information:

- Location of leak (Use Global Positioning System [GPS], if possible, or request a GPS locator from the GIS office or drafting shop. If GPS is not available, identify the street and the nearest building. Draft a sketch with measurements to two fixed features [e.g., corner of a building, manhole, flagpole]. Provide the location information to the GeoBase office.)
- Type of repair
- Cause of break (e.g., contractor-caused, frozen pipe, pipe shear, longitudinal split, joint failure, poor bedding materials)
- Type of pipe (e.g., cast iron, asbestos, ductile)
- Measured outside diameter
- Photo of leak
- Photo of repair

8. Point of Contact. Questions or comments about this ETL are encouraged and should be directed to the water and wastewater subject matter expert, HQ AFCESA/CEOA, DSN 523-6465, commercial 283-6465, AFCESAReachBackCenter@tyndall.af.mil.

KASS W. LARSON, Capt, USAF
Acting Chief, Operations & Programs Supt Div

2 Atchs
1. Statement of Work for Leak Detection Survey (Example)
2. Statement of Work for Repair Leak Project (Example)
STATEMENT OF WORK FOR LEAK DETECTION SURVEY (EXAMPLE)

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STATEMENT OF WORK

FOR

________________

PROVIDE LEAK DETECTION SURVEY & EQUIPMENT FOR BASE WATER DISTRIBUTION SYSTEM

________________ AIR FORCE BASE, ________________

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CONTRACT No: ________________

Firm: ________________

PROJECT No: ________________
1.0 PURPOSE

The purpose of this Statement of Work (SOW) is to provide leak detection equipment, provide leak detection survey of ___ miles of pipe, and identify and prioritize leak repairs at _____ Air Force Base. This survey will provide the necessary information (scope, estimate and energy economics) upon which to base a comprehensive leak repair project(s) that can be executed in the centrally funded AF Energy Programs. This project will contribute to keeping the utility systems operating in a safe manner and reduce overall water consumption and costs.

2.0 SCOPE

2.1 The scope of work under this contract is to provide survey equipment for leak detection at _______Air Force Base. Contractor will provide required training and support to ______ AFB. ______ AFB will retain ownership of the leak-detection equipment.

2.2 Contractor shall complete water leak detection survey of the proposed ____ miles at _______ AFB, using newly provided leak-detection equipment, and provide prioritized leak detection survey report with accompanying repair estimated costs and BLCC (building life cycle cost) ECIP (Energy Conservation Investment Program) report to _______ AFB.

2.3 The activities will be performed in a manner as to NOT negatively impact the operational capabilities of _______ AFB.

3.0 DESCRIPTION OF WORK

3.1 Contractor shall provide all necessary labor, personnel, facilities, equipment, transportation, scheduling, supervision, and materials to complete the tasks identified in the SOW. All work shall be performed in accordance with standards established by the American Water Works Association (AWWA).

3.2 Contractor shall provide training to BCE personnel on operation of the leak-detection system to allow Air Force personnel to continue using this equipment after the end of the contract. Contractor shall provide a minimum 8 hours’ classroom training for Base personnel.

3.3 Base utilities shop personnel shall escort the Contractor to all areas of the Base during execution of project.

3.4 Contractor shall perform leak detection survey using same leak detection equipment provided to ____ AFB and provide prioritized leak detection survey report to _____ AFB. Report shall include location of leak using GPS coordinates and estimated severity (gallons per minute [gpm]) of leak. Contractor shall coordinate with Base to determine which leaks are most critical, provide cost of estimated repair, and create prioritized list to be used for repair schedule. Contractor will conduct a water audit on
only the water distribution line to verify that all water lost is identified and accounted for. All background and analysis will be included in the final report.

3.5 In the report, Contractor shall prepare detailed description of work to be performed in each recommended repair project(s) execution plan based on discussions and coordination with Base CE personnel. For the resultant project(s), the Contractor will run the most current Department of Energy (DOE) BLCC ECIP report. For any project to be accepted into the centrally funded Air Force Energy Program, the project must retain a savings to investment ratio (SIR) greater than 1. The report will have an executive summary highlighting the estimated cost of repairs, SIR, potential amount of water savings, and a short summary of the project(s) executing plan.

3.6 Contractor shall supply formal weekly progress reports to BCE and Base point of contact (POC) in the format specified by the ____ AFB Contracting Officer Representative (COR). These progress reports will include written and verbal communications and document to whom and when the communications were supplied. The Progress Review meetings are defined in Table 1 and will occur monthly. The Contractor shall provide an electronic copy of all progress reports to the Contracting Officer, COR/CORA (Contracting Officer Representative/Contracting Officer Representative Advisor) and Base Project Manager (PM). All meeting minutes will be taken by the Contractor and distributed to Base POCs and Contracting Officer no later than 2 calendar days following meeting dates.

3.7 Contractor shall conduct a kick-off meeting no later than 5 days from the Notice To Proceed (NTP). This meeting will include a complete overview of the project and implications and be presented to the relevant Base staff and POCs.

3.8 Contractor shall notify all POCs immediately of any and all issues which may result in a delay of the project and/or impact quality of the work.

3.9 If any leaks or damage are found and require immediate repairs the Contractor shall contact the BCE customer service desk and report the urgent condition during duty hours; if discovered during off-duty hours, contact the 24-hour fire department dispatcher.

4.0 GENERAL REQUIREMENTS

4.1 Contractor shall conduct all Progress Review meetings and shall provide an agenda and topics for consideration. Contractor shall be responsible for meeting minutes and distribution of documents to all POCs.

4.2 Contractor shall perform field reconnaissance, surveys, site investigations, and work required to obtain engineering information, existing utilities and easements, and design data for the accomplishment of the contract documents of the project in accordance with requirements of this SOW. Contractor shall conduct field investigations to verify dimensions for each pipe size and operations and other information shown on existing
record drawings. Contractor shall document all discrepancies found compared to Base utility drawings and identify previously undocumented taps to the distribution system. Excavation is not necessarily required, but, if required, Contractor must obtain appropriate digging permits prior to commencing excavation.

4.3 Applicable Standards:

4.3.1 American Water Works Association (AWWA) standards

4.3.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) mechanical systems standards

4.3.3 National Electrical Code, National Fire Protection Association (NFPA) No. 70

4.3.4 Institute of Electrical and Electronics Engineers (IEEE) National Electrical Safety Code

4.3.5 National Fire Protection Association (NFPA 101) Life Safety Code

4.3.6 Uniform Building Code (UBC)

4.3.7 Uniform Federal Accessibility Standard (UFAS)

4.3.8 Uniform Mechanical Code (UMC)

4.3.9 Uniform Plumbing Code (UPC)

4.3.10 Applicable state, city and county codes and regulations

4.3.11 Air Force Engineering Technical Letter (ETL) 00-1, EPA Guideline Items in Construction and other Civil Engineering Specifications

4.3.12 Air Force Instruction (AFI) 32-1067, Water Systems

4.3.13 Unified Facilities Criteria (UFC) 3-230-02, O&M: Water Supply Systems

4.3.14 UFC 3-230-03A, Water Supply

4.3.15 UFC 3-230-04A, Water Distribution

4.3.16 UFC 3-230-10A, Water Supply: Water Distribution

4.3.17 UFC 3-230-19N, Water Supply Systems

4.3.18 UFC 3-420-01, Plumbing Systems
4.4 All submittals shall be well-prepared, complete, and accomplished in accordance with the best professional practice to show clearly and concisely the type and extent of work to be performed.

4.4.1 Submittal package shall be on 8 1/2" x 11" paper, arranged by equipment to be installed, and support all design decisions made throughout the project. The package shall include calculations, material cut sheets, and explanations of any options considered. In general, Contractor should indicate the make, model number, etc., of all equipment to be purchased and installed. All materials, components, and equipment shall be specified for approval by the Government Contracting Officer.

5.0 GOVERNMENT FURNISHED MATERIAL (GFM)

5.1 Site plans will be provided for the parts of the Base water distribution system that will be surveyed.

5.2 ALL GFM utilized during any part of the performance of this project MUST be returned to the Base POC upon completion of this contract.

6.0 DELIVERABLES

6.1 Period of Performance. Contractor shall begin work as described in the scope of work within 5 days of NTP. All meetings and progress report are due in a timely fashion and will begin no later than 30 days of NTP. The entire project shall be completed within **120 calendar days (estimate 1.5 miles per day for survey and 2 months for report development)** from NTP.

6.2

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Frequency</th>
<th>Media</th>
<th>POC</th>
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<tbody>
<tr>
<td>Leak Detection Survey</td>
<td>1 time only</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
</tr>
<tr>
<td>Weekly Reports</td>
<td>Weekly</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
</tr>
<tr>
<td>Monthly Progress Review Reports</td>
<td>Monthly, 15th of each month</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
</tr>
<tr>
<td>Meeting Minutes</td>
<td>As required</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
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### TABLE 1: PROGRESS REVIEW MEETINGS

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<thead>
<tr>
<th>Meeting Title</th>
<th>Performance Threshold</th>
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<tbody>
<tr>
<td>1 Progress Review 1</td>
<td>Within 30 days of NTP</td>
</tr>
<tr>
<td>2 Progress Review 2</td>
<td>Within 30 days of Progress Review 1</td>
</tr>
<tr>
<td>3 Progress Review 3</td>
<td>Within 30 days of Progress Review 2</td>
</tr>
<tr>
<td>Close Out</td>
<td>Within 30 days of final scope of work item completion</td>
</tr>
</tbody>
</table>

**NOTE:** ________ POCs should receive the meeting minutes and transmittal cover letter only for all other deliverables. Monthly status reports shall be submitted electronically to the three government POCs listed below.

### 7.0 GOVERNMENT POINTS OF CONTACT (POC)

7.1 **Contracting Officer (CO):**

- Name:
- Title:
- Address:
- Comm:
- DSN:
- Fax:
- E-mail:

7.2 **Contracting Officer’s Representative (COR):**

- Name:
- Title:
- Address:
- Comm:
- DSN:
- Fax:
- E-mail:

7.3 **Project Manager (PM)/Contracting Officer’s Representative Advisor (CORA):**

- Name:
- Title:
- Address:
- Comm:
- DSN:
- Fax:
- E-mail:
STATEMENT OF WORK FOR REPAIR LEAK PROJECT (EXAMPLE)

_______________________

STATEMENT OF WORK

FOR

_______________________

PROVIDE LEAK DETECTION SURVEY, EQUIPMENT, & REPAIR FOR BASE WATER DISTRIBUTION SYSTEM

__________________ AIR FORCE BASE, ________________

_______________________

_______________________

CONTRACT No: ________________

Firm: ________________

PROJECT No: ________________
1.0 PURPOSE

The purpose of this Statement of Work (SOW) is to accomplish leak repairs of ____ miles of pipe with identified and prioritized leaks from ______ leak detection survey (See Appendix 1) at ____ Air Force Base. This survey will provide the necessary scope and priority for execution. This work is required to keep the utility systems operating in a safe manner and reduce overall water consumption and costs.

2.0 SCOPE

2.1 The scope of work under this contract is to accomplish leak repair at ______ Air Force Base.

2.2 Contractor shall repair identified and prioritized leaks as noted in the ______ leak detection survey at ______ AFB in prioritized order.

2.3 The activities will be performed in a manner as to NOT negatively impact the operational capabilities of ______ AFB.

3.0 DESCRIPTION OF WORK

3.1 Contractor shall provide all necessary labor, personnel, facilities, equipment, transportation, scheduling, supervision, and materials to complete the tasks identified in the SOW. All work shall be performed in accordance with standards established by the American Water Works Association (AWWA).

3.2 Base utilities shop personnel shall escort Contractor to all areas of the Base during execution of project.

3.3 Contractor shall locate, excavate, repair, and backfill leaks on the agreed-upon list of leaks resulting from the _____ leak detection survey. Repaired leaks will NOT be backfilled until INSPECTION and ACCEPTANCE is made by the Base Utilities Department. Contractor shall provide locating support during excavation periods to ensure leaks are exposed in a timely fashion. Excavation requires Contractor to obtain appropriate digging permits prior to any excavation.

3.3.1 Detailed listing of leak repairs are found in the table below. The leak survey report is located at Appendix 1 and maps are located at Appendix 2. More detailed maps will be provided by Base POC as required.
Water Leak Repair/ Feature for Replacement | Sheet Identification | Waterline Diameter | Material | Quantity To Be Installed (ft) | Valves | Notes
---|---|---|---|---|---|---
1 | A-1 | 4-Inch | Class 250 D.I.P. or PVC C-900 DR-18 PC 235 pipe | 6,000 | 10 | All lines shown in Zone.
2 | A-2 | 6-Inch | Class 250 D.I.P. or PVC C-900 DR-18 PC 235 pipe | 6,000 | 7 | All lines shown in Zone.
3 | C | 8-Inch | Class 250 D.I.P. or PVC C-900 DR-18 PC 235 pipe | 8,000 | 7 | Between Hatchee Rd and Fire Station#3

3.3.1.1 Contractor shall include a per-unit cost for each size piping indicated in the above table. The unit costs shall include the furnishing of all necessary piping materials, excavation/trenching, piping installation, site restoration (grassing/sodding), testing, and other requirements as indicated in section 3.4 of this SOW. The limits and locations of the installation of the piping shall be as approved by the Contracting Officer Representative (COR) and Contracting Officer (CO) prior to mobilization to the field for execution. The information shall be recorded by Contractor on a systematic plan that shall be provided to the CO as part of their monthly reporting requirements.

3.4 Water Line System Requirements *(Check if specifications are applicable for your area)*

3.4.1 Contractor shall account for all site and surface restoration (e.g., sidewalks, pavement, grassing) in areas impacted by Contractor’s efforts.


3.4.3 Additionally, prior to sections being brought online, Contractor shall conduct the necessary pressure testing and other efforts as necessary to ensure the integrity of the newly installed water lines.

3.4.4 Contractor shall be responsible for collection and testing of newly installed water lines in accordance with the regulations of the State of ______’s Department of Environmental Protection (DEP), and coordinate such actions with the Base Bio-Environmental Flight.

3.4.5 Contractor shall be responsible for re-establishing all service connections to facilities supplied by the water line being replaced. On the maps provided in Appendix 2, a service line may not be shown from the water transmission line to an adjacent facility; however, Contractor shall account for reconnection of water service to each facility indicated on the drawings whether a service line is indicated or not. Contractor is not responsible for replacement of the individual service lines unless damaged due to their actions.
3.4.6 Contractor shall attempt to minimize interruption of potable water service to the various facilities. Contractor shall coordinate for interruption of water service only during non-standard business hours (e.g., before 0700 or after 1700) or on weekends. All other actions not involving interruption of potable water service can be conducted during regular working hours.

3.4.7 At locations where the new waterline ties into a secondary distribution line that is not being replaced, Contractor shall account for replacement of a minimum of 40 feet of the secondary line, along with an isolation valve at that location.

3.4.8 All new piping shall be minimum Class 250 Ductile Iron Pipe (D.I.P.) or PVC C-900 DR-18 PC 235 pipe. D.I.P. shall be used for all water mains larger than 12 inches in diameter. Piping shall conform to the requirements in Sections 3.15 and 3.16.

3.4.9 Water lines shall have a minimum cover of 3 feet to the top of pipe.

3.4.10 Fire hydrants shall be replacement in kind for what is shown on the maps provided in Appendix 2. Fire hydrants shall have a maximum spacing distance of 500 feet apart or as required by UFC 3-600-01, whichever is less. Fire hydrants shall be required at the end of all dead-end lines.

3.4.11 All water valves 12 inches and smaller shall be resilient-seated gate valves.

3.4.12 Air release valves shall be provided in accordance with sound engineering practice at high points in water mains as required.

3.4.13 All connections to existing water mains shall be made with tapping sleeves and tapping valves and shall be properly restrained.

3.4.14 All back-taps shall be shown on the plans and labeled as such. Back taps shall not be installed by Contractor unless specifically shown on the water line drawings approved for construction.

3.4.15 All stub-out valves and dead-end valves shall be shown to have a restrained joint cap on the plans. These devices shall be properly restrained to allow for future connections.

3.4.16 Detection wire shall be installed along the length of PVC pipe (not required if D.I.P. is used). Detection wire shall be THHN 12 gauge (minimum) solid copper wire and shall form a single electrical conductor along the length of the pipe. Each splice shall be made with copper split bolt wire connectors and completely wrapped in electrical tape. Wire shall be wrapped around each hydrant barrel and main line valve box, accessible for direct connection of locating equipment to the wire. If the connections or wire is broken during installation of the pipe, Contractor will be required to excavate and make the repairs. Metallic detection tape shall not be acceptable.
3.4.17 Polyvinyl Chloride (PVC) Pipe
Polyvinyl chloride (PVC) plastic pipe supplied for water main installations shall meet the requirements of AWWA C900 Standards for potable water transmission mains. Pipe shall be in accordance with the applicable ASTM and/or ANSI/AWWA Specifications, as amended to date, and the following requirements:

3.4.17.1 Pipe shall be supplied in 20-foot nominal laying lengths.

3.4.17.2 The pipe shall include an integral bell with factory-installed gaskets meeting the requirements of ASTM F-477 and the gasketed joints shall meet the requirements of ASTM D-3139.

3.4.17.3 Must bear the National Sanitation Foundation (NSF) seal of approval for potable water use. All service lines must bear the NSF seal for potable water use.

3.4.17.4 Meet the approval of AWWA, meet the minimum standards of AWWA C900 DR-18 PC 235 PVC pipe.

3.4.17.5 Be marked at intervals of not more than five feet with the above-mentioned ratings.

3.4.17.6 Fittings for PVC pipe shall be mechanical joint ductile iron fittings conforming to ANSI/AWWA A21.53/C-153 or ANSI/AWWA A21.10/C-110, with the joint meeting the requirements of ANSI/AWWA A21.11/C-111. Ductile iron fittings shall have a working pressure of 350 psi.

3.4.17.7 PVC pipe shall be installed in accordance with AWWA C605 and manufacturer’s written instructions.

3.4.18 Ductile Iron Pipe and Fittings

3.4.18.1 Ductile iron pipe, where called for on the drawings, shall:

3.4.18.2 Conform to ANSI/AWWA C151/A21.51

3.4.18.3 Be Pressure Class 250 D.I.P., minimum.

3.4.18.4 Be cement lined in accordance with ANSI/AWWA C 104/A21.4

3.4.18.5 Have rubber gasket joints conforming to ANSI/AWWA C111/A21.11

3.4.18.6 Fittings shall be cast from ductile iron and shall conform to ANSI Specifications A21.53 (AWWA C-153) or ANSI/AWWA A21.10/C-110 as amended to date. All fittings shall have standard mechanical joints. Fittings for pipe sizes through 24-inch shall be Pressure Class 350 and for fittings above 24-inch through 48-inch shall be Pressure Class 250.
3.4.19 Gate Valves
Any valve which is installed on pipe having a depth of cover of more than 5 feet shall be provided with a permanently installed valve stem extension and guide. Gate valves shall:

3.4.19.1 Conform to the latest revision of AWWA-C509

3.4.19.2 Be resilient seated valves

3.4.19.3 Have non-rising stem with “O”-ring seals

3.4.19.4 Have cast iron, bronze mounted bodies

3.4.19.5 Have rubber-covered gates

3.4.19.6 Open to the left

3.4.19.7 Have mechanical-joint type connections

3.4.19.8 Contractor shall locate each valve by measurements to two prominent terrain features or structures (e.g., center of road, fire hydrant, power pole). Each measurement should be taken as perpendicular to the other as possible and a record of these location distances shall be submitted to the Owner on the as-built drawings at the conclusion of the work. A sketch of each valve location with the points of reference shown shall also be neatly drawn on a separate 5” x 7” card and provided to the Owner along with the as-built drawings. Location cards shall be plastic-coated and wire-bound for usage by field crews.

3.4.19.9 Valve boxes shall be of close-grained gray cast iron. The valve boxes shall be the two-piece screw type and the cover or cap shall have cast on the upper surface in raised letters the word “WATER”. Valve boxes shall be made with an integral base which measures 8 ¾ inches in diameter by 9 inches high. The base will cover only the stuffing box for valves 10 inches and smaller. Valves shall be painted with a coat of protective bituminous paint before being shipped from the factory.

3.5 Contractor shall supply formal weekly progress reports to BCE and Base POC in the format specified by the ____ AFB COR. These progress reports will include written and verbal communications and document to whom and when supplied. The reporting intervals are defined in Table 1. Contractor shall provide an electronic copy of all progress reports to the Contracting Officer, COR/CORA (Contracting Officer Representative/Contracting Officer Representative Advisor) and Base Project Manager (PM). All meeting minutes will be taken by Contractor and distributed to Base POCs and Contracting Officer no later than two calendar days following meeting dates.
3.6 Contractor shall provide complete as-built drawings (electronic and hardcopy) of all repairs performed within 30 days of project completion. These drawings will become the property of _____ AFB. Drawings shall be prepared on AutoCAD® or other compatible format.

3.7 Contractor shall perform a kick-off meeting to take place no later than five days from the Notice To Proceed (NTP). This meeting will include a complete overview of the project and implications and be presented to the relevant Base staff and POCs.

3.8 Contractor shall notify all POCs immediately of any and all issues which may result in a delay of the project and/or impact quality of the work.

**4.0 GENERAL REQUIREMENTS**

4.1 Contractor shall conduct all Progress Review meetings and provide an agenda and topics for consideration. Contractor shall be responsible for meeting minutes and distribution of documents to all POCs.

4.2 Contractor shall perform field reconnaissance, surveys, site investigations, and work required to obtain engineering information, existing utilities and easements, and design data for the accomplishment of the contract documents of the project in accordance with requirements of this SOW. Contractor shall conduct field investigations to verify dimensions for each pipe size and operations and other information shown on existing record drawings. Contractor shall document all discrepancies found compared to Base utility drawings and identify previously undocumented taps to the distribution system. Excavation is not necessarily required, but, if required, Contractor must obtain appropriate digging permits prior to commencing excavation.

4.3 Applicable Standards:

4.3.1 American Water Works Association (AWWA) standards

4.3.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA) mechanical systems standards

4.3.3 National Electrical Code, National Fire Protection Association (NFPA) No. 70

4.3.4 Institute of Electrical and Electronics Engineers (IEEE) National Electrical Safety Code

4.3.5 National Fire Protection Association (NFPA 101) Life Safety Code

4.3.6 Uniform Building Code (UBC)

4.3.7 Uniform Federal Accessibility Standard (UFAS)
4.3.8 Uniform Mechanical Code (UMC)

4.3.9 Uniform Plumbing Code (UPC)

4.3.10 Applicable state, city and county codes and regulations

4.3.11 Air Force Engineering Technical Letter (ETL) 00-1, *EPA Guideline Items in Construction and other Civil Engineering Specifications*

4.3.12 Air Force Instruction (AFI) 32-1067, *Water Systems*

4.3.13 Unified Facilities Criteria (UFC) 3-230-02, *O&M: Water Supply Systems*

4.3.14 UFC 3-230-03A, *Water Supply*

4.3.15 UFC 3-230-04A, *Water Distribution*

4.3.16 UFC 3-230-10A, *Water Supply: Water Distribution*

4.3.17 UFC 3-230-19N, *Water Supply Systems*

4.3.18 UFC 3-420-01, *Plumbing Systems*

4.4 All submittals shall be well-prepared, complete, and accomplished in accordance with the best professional practice to show clearly and concisely the type and extent of work to be performed.

4.4.1 Submittal package shall be on 8 1/2" x 11" paper, arranged by equipment to be installed and support all design decisions made throughout the project. The package shall include calculations, material cut sheets and explanations of any options considered. In general, Contractor should indicate the make, model number, etc. of all the equipment to be purchased and installed. All materials, components, and equipment shall be specified for approval by the Government Contracting Officer.

5.0 GOVERNMENT FURNISHED MATERIAL (GFM)

5.1 Site plans, maps, GIS data and previous leak detection surveys will be provided for the parts of the Base water distribution system that will be repaired.

5.2 ALL GFM utilized during any part of the performance of this project MUST be returned to the Base POC upon completion of this contract.

6.0 DELIVERABLES
6.1 Period of Performance. Contractor shall begin work as described in the scope of work within 5 days of NTP. All meetings and progress report are due in a timely fashion and will begin no later than 30 days of NTP. The entire project shall be completed within **365 calendar days** from NTP.

6.2

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Frequency</th>
<th>Media</th>
<th>POC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Detection Survey</td>
<td>1 time only</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
</tr>
<tr>
<td>Weekly Reports</td>
<td>Weekly</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
</tr>
<tr>
<td>Monthly Progress Review Reports</td>
<td>Monthly, 15th of each month</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
</tr>
<tr>
<td>Meeting Minutes</td>
<td>As required</td>
<td>Electronic</td>
<td>CO, COR/A, Base POCs</td>
</tr>
</tbody>
</table>

6.3

**TABLE 1: PROGRESS REVIEW MEETINGS**

<table>
<thead>
<tr>
<th>Meeting Title</th>
<th>Performance Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Progress Review 1</td>
<td>Within 30 days of NTP</td>
</tr>
<tr>
<td>2 Progress Review 2</td>
<td>Within 30 days of Progress Review 1</td>
</tr>
<tr>
<td>3 Progress Review 3</td>
<td>Within 30 days of Progress Review 2</td>
</tr>
<tr>
<td>4 Progress Review 4</td>
<td>Within 30 days of Progress Review 3</td>
</tr>
<tr>
<td>5 Progress Review 5</td>
<td>Within 30 days of Progress Review 4</td>
</tr>
<tr>
<td>6 Progress Review 6</td>
<td>Within 30 days of Progress Review 5</td>
</tr>
<tr>
<td>7 Progress Review 7</td>
<td>Within 30 days of Progress Review 6</td>
</tr>
<tr>
<td>8 Additional Progress Reviews</td>
<td>Performed within 30-day intervals as required for project duration.</td>
</tr>
<tr>
<td>Close-out</td>
<td>Within 30 days of final scope of work item completion</td>
</tr>
</tbody>
</table>

**NOTE:** _______ POCs should receive the meeting minutes and transmittal cover letter only for all other deliverables. Monthly status reports shall be submitted electronically to the three government POCs listed below.
7.0 GOVERNMENT POINTS OF CONTACT (POC)

7.1 Contracting Officer (CO):
Name:
Title:
Address:
Comm:
DSN:
Fax:
E-mail:

7.2 Contracting Officer’s Representative (COR):
Name:
Title:
Address:
Comm:
DSN:
Fax:
E-mail:

7.3 Project Manager/Contracting Officer’s Representative Advisor (CORA):
Name:
Title:
Address:
Comm:
DSN:
Fax:
E-mail:
APPENDIX 1 – LEAK DETECTION SURVEY

[Insert leak detection survey report here]
APPENDIX 2 – MAPS

(Insert leak location maps here)
DISTRIBUTION LIST

SPECIAL INTEREST ORGANIZATIONS

Information Handling Services (1) Construction Criteria Base (1)
15 Inverness Way East National Institute of Bldg Sciences
Englewood, CO 80150 Washington, DC 20005