



HUGHES ASSOCIATES, INC.
FIRE SCIENCE & ENGINEERING

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**REVIEW OF SELECTED FIRE PROTECTION SYSTEMS
AT
THE US EMBASSY IN IRAQ
(DRAFT)

FIRE WATER SUPPLY SYSTEM**

Prepared For:

First Kuwaiti Trading & Contracting Co.

Prepared By:

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HAI-HOC 000289

1.0 INTRODUCTION

The new US Embassy Compound in Baghdad, Iraq contains twenty six buildings including seven residential buildings (~680 units), five office buildings, two warehouses, a gym, a pool, a commissary, a power generation building, a water-treatment plant, VIP residences, and security buildings.

Hughes Associates, Inc. (HAI) was requested by First Kuwaiti Trading and Contracting Co. (FKTC) to provide 3rd party acceptance evaluation of selected fire alarm and suppression systems within the US Embassy compound in Iraq for compliance with applicable project specifications and codes. The reviews were limited to the following buildings:

Chief Mission Residence*	Recreation Facilities*
New Office Annex*	Water Treatment Plant
Deputy Chief Mission Residence*	New Office Building
Utility Building	Apartment A1 (SDA1)
GSO Annex	Apartment A2 (SDA2)
MSGQ*	Apartment A3 (SDA3)
Interim Office Building	Apartment A4 (SDA4)
Warehouse	Apartment A5 (SDA5)
Motor Pool (GMP)	Apartment A6 (SDA6)

* Contain kitchens

2.0 APPLICABLE CODES, STANDARDS, & SPECS

The following codes and standards are applicable to the project as defined by HAI's scope of work.

2.1 Applicable Project Specifications (13 May, 2005):

- SECTION 13921 - FIRE PUMP ASSEMBLIES
- SECTION 02510 - WATER DISTRIBUTION
- SECTION 13851 – FIRE ALARM SYSTEMS
- SECTION 13916 – FIRE SPRINKLER SYSTEMS

2.2 NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances (2002 ed.)

2.3 NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection (2003 ed.)

2.4 NFPA 13, Standard for the Installation of Sprinkler Systems (2002 ed.)

2.5 NFPA 72, National Fire Alarm Code (2002 ed.)

2.6 NFPA 17A, Standard for Wet Chemical Extinguishing Systems (2002 ed.)

- 2.7 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations (2004 ed.)

3.0 SCOPE OF SERVICES

The fire alarm and suppression system review is intended to determine if the system documentation and installation complies with the mandated codes/standards and contract specifications. The review is also intended to determine if the systems are ready for final turnover to the State Department.

HAI's review was strictly limited to the following systems:

- Underground Fire Water Supply System
- Sprinkler Systems.
- Notifier Fire Alarm Systems.
- Kitchen Suppression systems (Equipment, Hoods, Ducts, & Ansul Chemical Extinguishment).

HAI's review did not examine other life safety or fire protection related systems including:

- Egress components as described in chapter 7 of the Life Safety Code, NFPA 101.
- Stairwell pressurization.
- Atrium Smoke Control.
- Fire Barriers installation evaluation.
- Emergency Preparedness/Response.

HAI performed onsite evaluation of the fire protection systems during the period of 11/17 through 12/17/2007. Full access to all documentation, personnel, and facility locations (with the exception of secured portions of NOB building) was provided to HAI personnel during the conduct of this evaluation. At the time of the surveys, the systems installation had been mostly completed. In most cases, ceilings had been already installed and visual access to system components was conducted using ladders and removing portions of the ceiling panels. HAI's review was not intended to serve as a quality-assurance or quality-control (QA/QC) review, which is typically required during the system installation.

This report only addresses the underground fire water supply system. Reports for other systems are provided separately.

4.0 UNDERGROUND FIRE WATER SUPPLY SYSTEM

4.1 System Description

A dedicated underground fire water supply system is provided within the embassy compound to supply fire hydrants and sprinkler systems. Piping consists of eight inch diameter ductile iron piping manufactured by Saudi Arabian Ductile Iron Pipe Co. Ltd (SADIP). Pipe joints are push-on types with thrust blocks utilized for joint restraints. The system is gridded, with many sectional valves located within concrete man-holes. In all, 14 hydrants are provided within the compound.

The fire water is supplied by a 1500 gpm @150 psi Patterson diesel fire pump taking suction from a 400,000 gallon water storage tank. The tank and pump are located within the Water Treatment Plant Building.

4.2 Scope of Review

HAI's review/evaluation was conducted from 11/18 through 12/7/2007, during which only the installation of the hydrants was observed. All other portions of the system had already been installed and tested in witness of Overseas Buildings Operations (OBO) project representatives (see 11/07 hydrostatic testing and flushing documentation). HAI's review/evaluation encompassed the following:

- Site walk-down of fire pump and associated piping.
- Review/evaluation of existing commissioning documentation and prior issues.
- Site walk-down of underground piping (in open trenches) and field inspection of installed thrust block installations prior to back filling.
- Witness of hydrostatic test following hydrants installation, and subsequent system flushing.
- Review of system shop drawings conducted by home based HAI personnel.

4.3 System Evaluation

4.3.1 *Material* – As per manufacturer specifications (p.9 of catalogue & correspondence), the installed piping meets ANSI/AWWA C151/A21.51, and thereby NFPA 24, Table 10.1.1.

Project Specification 02510 §2.2.B.3 only references “PVC, Schedule 80 Pipe: ASTM D 1785” and “PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket and spigot end.” Ductile Iron is not specified within this section. The section also only refers to utilizing “Mechanical-joint, Ductile-Iron fittings” on PVC (as opposed to the currently installed push-on type. The installation of ductile iron pipe with restrained push-on fittings meets applicable NFPA 24 requirements; however, OBO approval for this specification deviation is required.

Follow-up Item # 1: FKTC to document OBO concurrence of ductile iron pipe and push-on type joints as currently installed.

4.3.2 Hydrant Location – Neither NFPA 24 or the project specifications define the required hydrant spacing/location. International Fire Code (IFC) §208 and §508.5 require that hydrant coverage be within 600-ft of all perimeter building points for sprinklered buildings. Hydrants are currently located within a 300-ft radius of the perimeter of all buildings, and are no closer than 40-ft from the buildings in accordance with NFPA 24 §7.2.3. Hydrant spacing complies with the requirement of the IFC and NFPA 24. Concurrence by OBO for the utilization of the IFC §208 & §508.5 as a basis for hydrant spacing was documented on attached memo dated November 20, 2007 from OBO-PM to FKTC-PM.

4.3.3 Joint Restraints – NFPA 24 section 10.8.2.3 states that: “wherever possible, thrust blocks shall be placed so that the joints are accessible for repair.” Although joints for the newly installed hydrants were made accessible for repair, 63 existing joints were completely encased in concrete thrust-blocks (per OBO memo). HAI was not at the field during construction/installation. Acceptance of the installation by OBO was documented on attached memos dated November 20th & 29th, 2007 from OBO-PM to FKTC-PM (see attachments 1 & 2).

4.3.4 Design Review – Design review was not completed due to incomplete design documentation. HAI also raised a concern about the potential settlement of the concrete blocks causing eventual pipe failure, and requested documented calculations to justify the installation of the thrust-blocks. FKTC provided structural calculations, which HAI reviewed, and recommended their incorporation into the final as-built drawings.

FKTC is currently working to finalize as-built drawings for the underground fire water system and associated hydraulic calculations, which were not available at the time of this writing. The drawings should also show thrust block installation/calculations.

Follow-up Item # 2: FKTC to provide shop drawings and hydraulic calculations for the underground fire water supply system. Drawings must also incorporate structural details & calculations of the thrust block installations.

4.3.5 Fire Pump – The fire water is supplied by a 1500 gpm @150 psi Patterson diesel fire pump taking suction from a 400,000 gallon water tank. Both are located within the Water Treatment Plant Building. The fire pump was accepted in the presence of OBO, FKTC, and Manufacturer representatives on 5/23/07 (refer to Pump Acceptance Test Data report).

HAI performed a field verification of design drawings and noted missing supports on the north side of the pump. These supports are shown on the drawings, but were not installed in the field. FKTC intends to install these supports.

Follow-up Item # 3: FKTC to install piping support on the north side of the pump as shown on the drawing.

4.4 Acceptance Testing of Underground Fire Water Piping

HAI witnessed the hydrostatic testing of the underground piping which was conducted during a period of three days. During that time, sectional portions of the system were incrementally pressurized by 50 psi for 1-2 hours until reaching 210 psi. Several leaks were observed around

flange connections of a couple of hydrants, which were repaired and the sections were retested. On 12/7/2007, the complete piping system (mains and hydrants) was pressurized to 210 psi for 2 hours with no drop in gauge pressure (50 psi above operating pressure per NFPA 24 §10.10.2.2). Although NFPA 24 §10.10.2.2.4 allows limited leakage, no leakage was accounted for during the entire two hour hydrostatic test.

Following the hydrostatic test, each leg of the loop was flushed at the most remote hydrant at over 1600 gpm for 8-10 minutes until the water was clear (NFPA 24, §Table 10.10.2.1.3 requires a minimum flushing flow of 1,560 GPM for an 8 inch diameter pipe). Afterwards, each hydrant was fully opened and closed under system water pressure (per NFPA 24, §14.1.1). Sectional valves were also operated during the testing activities.

A copy of the Contractor Material and Test Certificate was signed by FKTC and the Owner representative. HAI also signed as witness to the testing activities.

4.5 Conclusion

Review of the underground water supply pipe as-built drawings for the US Embassy in Iraq was not completed since final drawings and associated hydraulic calculations have not been provided. Drawings must incorporate structural details & calculations of the thrust block installation.

Review of the field installation of the underground water supply system for compliance with NFPA 24 and Project Specification 2510 revealed the following issues; some of which require FKTC to obtain specific concurrence/acceptance by the AHJ representative:

- FKTC to document OBO concurrence of ductile iron pipe and push-on type joints as currently installed.
- FKTC to provide shop drawings and hydraulic calculations for the underground fire water supply system. Drawings must also incorporate structural details & calculations of the thrust block installations.
- FKTC to install piping support on the north side of the pump as shown on the drawing.

5.0 ATTACHMENTS

Attachment 1



**Overseas Buildings Operations
Iraq Projects Coordination Office**



Memorandum

DATE: 20 November 2007

TO: Mr. Murad Abbas
FKTC Project Manager

FROM: Mary M French
OBO Project Director

RE: Installation of NEC Ductile Iron Fire Main

A review of the current installation of the ductile iron fire main has been performed with the following comments/approvals:

1. The ductile iron piping and fittings as installed are approved.
2. The line has been installed as per the approved layout. The locations of the hydrants are approved with the following comments:
 - a. The hydrant at the CMR needs to be relocated to the service areas of the residence
 - b. A hydrant needs to be added to cover the SE CAC.
3. The pipe bedding and installation of the plastic sleeves has been reviewed and approved.
4. The installation is approved to proceed with partial backfilling of the trenches. Once this has been done, a valve and 4-inch outlet needs to be installed at the west end of the line and a flow test administered to ensure pressure can be maintained. Please advise the OBO office when the test can be performed so that personnel are available to monitor.

Please advise if additional information and/or clarification is required.

cc: Mr. James Golden
Mr. Greg Hudson
Project File

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HUGHES ASSOCIATES, INC.

HAI-HOC 000295

Attachment 2



**Overseas Buildings Operations
Iraq Projects Coordination Office**



Memorandum

DATE: 29 November 2007

TO: Mr. Murad Abbas
FKTC Project Manager

FROM: Mary M French
OBO Project Director

RE: Installation of NEC Ductile Iron Fire Main

A review of the current installation of the ductile iron fire main has been performed with the following comments/approvals:

1. The installation is approved to proceed with backfilling of the trenches. It is recommended that the trenches at the newly installed hydrants is not backfilled until the successful completion of the flow test.

Please advise if additional information and/or clarification is required.

cc: Mr. James Golden
Mr. Greg Hudson
Project File

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HAI-HOC 000296