



HUGHES ASSOCIATES, INC.
FIRE SCIENCE & ENGINEERING

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

SPRINKLER SYSTEM**

Prepared For:

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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 selective 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 sprinkler systems. Building specific punch list items are provided as an Annex to the report; reflecting status as of HAI's departure from the site. Reports for other systems are provided separately.

4.0 SPRINKLER SYSTEMS

4.1 System Description

All reviewed buildings were fully protected with wet pipe sprinkler systems supplied by four or six inch diameter risers. All systems were supplied by the site underground fire water supply loop. Typically installed components are Minimax OS&Y gate valves for the main risers, and Victaulic butterfly valves for sectional floor/area subdivision. Figure 1 shows a typical riser installation.

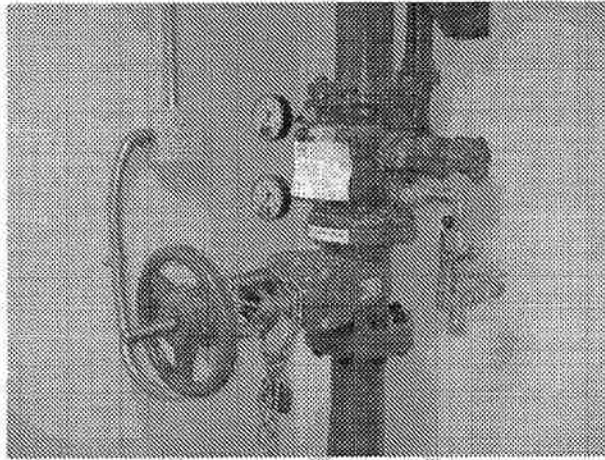


Figure 1 — Typical arrangement of sprinkler riser.

4.2 Scope of Review

HAI's site review/evaluation was conducted from 11/18–12/15/2007 and encompassed the following:

- Witness flow testing of sprinkler systems (including main drain and inspectors test).
- Review of hydrostatic testing documentation.
- Review/evaluation of prior acknowledged issues and completed punch-list items.
- Site walk-down of sprinkler installation.
- Shop drawing review conducted by home based HAI personnel (to be completed upon receipt of updated design documentation).

4.3 System Evaluation

4.3.1 *Material* – Many of the sprinkler system components were not manufactured in the US. Specification 13916 §1.6.A mandates utilization of US manufacturers "...except by written approval from OBO." HAI assumes that approved submittal by OBO will serve that purpose. With the exception of the SIAM fittings, reviewed documentation (approved submittals) indicate

that installed sprinkler system components are listed for use in sprinkler systems, and had been reviewed/approved through the appropriate project review channels. HAI visited the project warehouse to ensure that non-listed components were not being stored for potential use. Installed listed components include:

- Crane Fittings & Valves.
- SIAM Fittings.
- Victaulic Fittings & Valves.
- RASCO Sprinklers.
- Minimax Valves.
- Schedule 40 and Schedule 10 steel pipe.

HAI noted the use of SIAM fittings that were rejected during the transmittal process. In discussion with FKTC and OBO project management, HAI was verbally informed that these fittings had been subsequently approved – though no approval documentation was presented. In reviewing the manufacturer's website/documentation, it is noted that these fittings meet applicable ANSI/ASME criteria for the use per Project Specification §2.2.A.2 (ANSI B16.3 for dimension and ANSI/ASME B1.20.1 for threading). Approval of their use on the project must be obtained from the AHJ.

Follow-up Item # 1: FKTC to document approval for the installed SIAM fittings from the AHJ representative.

4.3.2 Pipe Threading – HAI noted excessive use of Teflon tape on threaded pipes. The systems have been hydrostatically tested (see section 4.4), and no active leaks were observed during HAI's site inspection. FKTC agreed to submit representative samples of installed threaded pipes with their associated fittings to an independent lab for measurement and confirmation that installed threads/fittings meet ASME B1.20.1 (Pipe Threads - General Purpose, 2001). FKTC will evaluate and address the results of these tests. Further evaluation of this observation is currently outside of HAI's scope.

Follow-up Item # 2: FKTC to submit representative samples of installed threaded pipes with their associated fittings to an independent lab for measurement and confirmation that installed threads/fittings meet ASME B1.20.1 (Pipe Threads - General Purpose, 2001), and evaluate/address the results of these tests.

4.3.3 Sprinkler & Hanger spacing/locations – HAI performed visual inspection of all sprinklers within the compound. Additionally, hanger spacing/installation was also reviewed, although inspection was constrained due to access restrictions caused by the installed ceilings, ducts, and other installed obstructions. HAI gained visual access to above the ceiling areas using ladders and flashlights.

With few exceptions in each building, sprinklers installations are noted to be adequate to meet NFPA 13 spacing requirements for Ordinary Hazard occupancies. There are, however, a few locations where sprinklers are missing and or exceed the maximum allowable 7.5 ft spacing from walls Specification 13916 section 1.4.D.2 & 1.5.C.1. Hanger spacing also are noted to be in compliance with NFPA 13 requirements, with some exceptions as noted in the attached punch-list.

Attached is a punch-list of items discovered during HAI's field review. About two thirds of these items were addressed during the course of the site evaluation. FKTC was working on resolving the remaining items requiring resolution in preparation for re-inspection.

Follow-up Item # 3: FKTC to correct remaining sprinkler Punch-list items for all buildings.

4.3.4 Warehouse System - The sprinkler system within the Warehouse provides protection for the installed storage racks which are 18 feet high. Information regarding the final arrangement of racks and the commodities to be stored is required in order to assess the adequacy of the sprinkler system for protecting the rack storage.

Follow-up Item # 4: FKTC to provide appropriate design documentation for the sprinkler protection of the rack storage within the warehouse – based on the height, rack dimensions, and potential storage hazards per NFPA 13, Chapter 12.

4.3.5 Specification Compliance – HAI noted several required items per Project Specification 13916 which have not been provided. In discussion with FKTC and OBO project management, it is noted that exclusion of some items from the installation has been mutually agreed-upon, although formal documentation to that effect was not provided for all. These items include:

- Standpipe/Hose stations not installed per Specification 13916 section 1.4.C & 3.13 (email correspondence also referred to these as Landing Valves). Memo from OBO/OM/FIR/FPS dated 11/28/06 states that “if all buildings are provided with sprinklers coverage/protection, hose valves Are Not Needed” (see Attachment 1).
- Lack of seismic bracing per Specification 13916 section 1.4.E. Per email dated 1/17/07 from OBO-PM to FKTC PM, this requirement was deleted (see Attachment 2).
- Lack of Fire Department Connection per NFPA 13, and Spec. 13916 §3.9.K.
- Empty spares sprinkler cabinets in noncompliance with NFPA 13 § 6.2.9 & Spec. 13916 §1.8.A (which FKTC intends to provide).

Follow-up Item # 5: FKTC to provide all buildings with a Fire Department Connection per NFPA 13 and Spec.13916 §3.9.K; or obtain approval for the exclusion of such installation.

Follow-up Item # 6: FKTC to ensure that all buildings are provided with spare sprinkler cabinets per NFPA 13 § 6.2.9, (Spec.13916 §1.8.A).

4.3.6 Design Review – The design review was not complete due to inadequate documentation. The shop drawings provided are inaccurate, and do not contain the required information per NFPA 13. Adequacy of pipe sizing could not be validated without drawings that reflect the associated hydraulic nodes. Also related is an OBO letter dated 4/12/07 (reply to Submittal #FK-208) stating that all buildings except NOB are installed under pipe schedule method. In accordance with NFPA 13 (2002) section 11.2.2.3”...pipe schedule method shall be permitted only for new installations of 5000 ft² (465 m²) or less” FKTC has agreed to update the as-built drawings and finalize the hydraulic calculations Per NFPA 13, section 14.1, to include the following applicable information:

- Name of owner and occupant

- Location, including street address
- Point of compass
- Full height cross section, or schematic diagram, including structural member information if required for clarity and including ceiling construction and method of protection for nonmetallic piping
- Location of partitions
- Location of fire walls
- Occupancy class of each area or room
- Location and size of concealed spaces, closets, attics, and bathrooms
- Any small enclosures in which no sprinklers are to be installed
- Make, type, model, and nominal K-factor of sprinklers including sprinkler identification number
- Temperature rating and location of high-temperature sprinklers Total area protected by each system on each floor
- Number of sprinklers on each riser per floor
- Pipe type and schedule of wall thickness
- Nominal pipe size and cutting lengths of pipe (or center-to-center dimensions). Where typical branch lines prevail, it shall be necessary to size only one typical line
- Location and size of riser nipples
- Type of fittings and joints and location of all welds and bends. The contractor shall specify on drawing any sections to be shop welded and the type of fittings or formations to be used
- Type and locations of hangers, sleeves, braces, and methods of securing sprinklers when applicable
- All control valves, check valves, drain pipes, and test connections (Partially shown, but not to shop drawing detail)
- Kind and location of alarm bells
- Size and location of standpipe risers, hose outlets, hand hose, monitor nozzles, and related equipment
- Private fire service main sizes, lengths, locations, weights, materials, point of connection to city main; the sizes, types and locations of valves, valve indicators, regulators, meters, and valve pits; and the depth that the top of the pipe is laid below grade
- Piping provisions for flushing
- For hydraulically designed systems, the information on the hydraulic data nameplate
- A graphic representation of the scale used on all plans
- Name and address of contractor
- Hydraulic reference points shown on the plan that correspond with comparable reference points on the hydraulic calculation sheets
- The minimum rate of water application (density), the design area of water application, in-rack sprinkler demand, and the water required for hose streams both inside and outside
- The total quantity of water and the pressure required noted at a common reference point for each system
- Relative elevations of sprinklers, junction points, and supply or reference points

- Calculation of loads for sizing and details of sway bracing
- Size, location, and piping arrangement of fire department connections

Follow-up Item # 7: FKTC to update as-builts per NFPA 13, section 14.1, and finalize hydraulic calculations that validate the installed pipe sizes.

Follow-up Item # 8: FKTC to install Hydraulic Design Information Signs per NFPA 13 §10-5 within all buildings.

4.4 Acceptance Testing of Sprinkler Systems

With the exception of the NOB & Warehouse (which FKTC intends to retest in case documentation is not available), hydrostatic testing documentation was provided for all buildings. Review of this documentation shows that sprinkler systems were hydrostatically pressurized to 210 psi for 2-hrs (as per NFPA 13, section 24.2.1). These successful hydrostatic tests were witnessed/signed by OBO project representatives in addition to FKTC representatives.

During the initial days of inspection, HAI witnessed waterflow testing of the flow switches for several buildings as part of the fire alarm testing. Subsequently, fire water was turned off due to hydrant installation, and then due to relocation/addition of sprinklers within the buildings. To that end, water flow testing was not witnessed by HAI in the following buildings: GNP, MSGQ, RECs, SDA1-6, WTP, & Utility.

Follow-up Item # 9: FKTC to provide documentation of hydrostatic testing of sprinkler systems for NOB & Warehouse.

Follow-up Item # 10: Flow testing of the sprinkler systems remains to be conducted within the following buildings: GNP, MSGQ, RECs, SDA1-6, WTP, & Utility.

4.5 Conclusion

The as-built shop drawings provided for the sprinkler systems are inaccurate, and do not contain the required information as per NFPA 13, section 14.1 - Working Plans. Adequacy of pipe sizing cannot be validated without drawings that reflect the associated hydraulic nodes. The installed pipe sizing remains to be validated.

Review of sprinkler systems reveal that in general installed materials/components are acceptable (SIAM fittings approval remains an issue). With few remaining exceptions within each building, sprinkler coverage and hanger locations comply with NFPA 13. The following issues remain to be addressed:

- FKTC to document approval for the installed SIAM fittings from the AHJ representative.
- FKTC to submit representative samples of installed threaded pipes with their associated fittings to an independent lab for measurement and confirmation that installed threads/fittings meet ASME B1.20.1 (Pipe Threads - General Purpose, 2001), and evaluate/address the results of these tests.
- FKTC to correct remaining sprinkler Punch-list items for all buildings.

- FKTC to provide appropriate design documentation for the sprinkler protection of the rack storage within the warehouse – based on the height, rack dimensions, and potential storage hazards per NFPA 13, Chapter 12.
- FKTC to provide all buildings with a Fire Department Connection per NFPA 13 and Spec.13916 §3.9.K; or obtain approval for the exclusion of such installation.
- FKTC to ensure that all buildings are provided with spare sprinkler cabinets per NFPA 13 § 6.2.9, (Spec.13916 §1.8.A).
- FKTC to update as-builts per NFPA 13, section 14.1, and finalize hydraulic calculations that validate the installed pipe sizes.
- FKTC to install Hydraulic Design Information Signs per NFPA 13 §10-5 within all buildings.
- Flow testing of the sprinkler systems remains to be conducted within the following buildings: GNP, MSGQ, RECs, SDA1-6, WTP, & Utility.

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