“Machinery spaces and gas turbines – Engineering solutions for real world designs”

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The Subject.

To discuss the challenges & obstacles when engineering a HPWM systems for Gas Turbines and Machinery spaces.

• Looking at the pragmatic approach to achieve the desired solutions.

• Looking at the relationships with authorities, test laboratories and clients.

• To give greater confidence in water mist as a reliable solution for “unique and problematic” applications.
Contents.

BACKGROUND - Compare the Fire Test Enclosure and the clients product.

WORKFLOW – How can we solve the problem.

TESTING – Look at tests, results and findings.

SUMMARY – Findings and conclusions.
FM5560 APPENDIX D: Fire Tests for Water Mist systems for the Protection of Combustion Turbines in Enclosures with Volumes not Exceeding 9175 ft³ (260m³).
Translates to...

7.3m 7.3m 4.9m
In turn, translates to...
The clients product.
The clients product.
The clients product.
The clients product.
Challenges for this project.

- Perforated Plenum wall.
- GT Exhaust Plenum Obstruction.
- Ceiling opening above LC.
- Internals and maintenance access.
The chosen approach.

**Phase 1**

**PROJECT SPECIFIC FIRE TESTS.**

**Phase 2**

**WITNESSED FIRE TESTS - to give greater longer term flexibility.**
PHASE 1.

“....tests were to be developed, to reflect configuration of the Gas Turbine as close as possible within the time/cost resources and physical limitations of the test enclosure.” – UF & client.

- Enclosure modified to “reflect” product.
  - Perforated wall (to replicate the Perforated plenum wall)
  - Obstruction (to replicate the GT exhaust plenum)
  - Ceiling opening (to replicate the opening above the LC)

- Fire Tests “based” on FM5560 APPENDIX D.
  - Fire tests were based on D4.3 and D4.4
<table>
<thead>
<tr>
<th></th>
<th>GT Compartment Fire</th>
<th>LC compartment Pool Fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shielded</td>
<td>Shielded 2 MW Diesel Spray Fire,</td>
<td>Shielded (1 m²) Diesel Pool Fire</td>
</tr>
<tr>
<td>fuel</td>
<td>Diesel</td>
<td>Diesel</td>
</tr>
<tr>
<td>Type</td>
<td>Horizontal spray</td>
<td>10.8 ft² (1.0 m²) pool fire</td>
</tr>
<tr>
<td>Spray Nozzle</td>
<td>2 MW spray nozzle</td>
<td>N/A</td>
</tr>
<tr>
<td>Fire Location</td>
<td>The test fire shall be located below the table at a position. The test fire shall be located 20 in. (50 cm) above the floor, centred between the baffles underneath the test table, with the fuel spray nozzle aimed horizontally.</td>
<td>The pool test fire shall be centred below the steel plate and located in the outlet plenum</td>
</tr>
</tbody>
</table>

*Fire tests were based on D4.3 and D4.4 in FM5560 Appendix D.*
TEST ENCLOSURE PARAMETERS

Fire Test Enclosure  7.4m L x 3.7m W x 5.0m H
(Actual GT Enclosure  6.6m L x 3.2m W x 3.4m H)
TEST ENCLOSURE FEATURES

- Perforated wall
- Obstructions
- Opening
FIRE TESTING OBJECTIVES

“....Preliminary tests were conducted for Ultrafog to evaluate the effects of the opening in the ceiling - [the major concern]. Whilst some tests were not passed this was an important exercise in arriving at the final solution.” – UF.

• Fires to be fully extinguished.
  • To align with previous witnessed tests.

• To conduct as many fire tests as possible within test program.
  • Worst case scenarios.

• Nozzle configurations.
  • To optimize for efficiency, thus resulting in smaller system/footprint.
~20 seconds.

~40 seconds.
CONCLUSION

“... testing proved, the opening in the ceiling represented the biggest challenge, however, it was overcome.” – UF/client.

• Configuration
  • Four nozzles (2 in the GT area) and 2 in the LC area.

• Based on these results and considering installation & maintenance requirements it was agreed that the following was acceptable for the LC area:
  • Nozzle for of GT = Centreline of GT (+/- 250mm)
  • Nozzle for possible floor pool locations = 250 to 500mm from the floor.
PHASE 2.

“.... project specific testing is not always feasible or cost effective, therefore flexibility was required for nozzle placement,..” – UF & client.

- **New witnessed Fire Tests to give greater flexibility.**
  - Fire tests to allow for nozzles to be positioned in alternative positions, allowing for more flexible configurations.

- **Fire Tests conforming to FM5560 APPENDIX D.**
  - FM witnessed Fire tests.
FIRE TEST

• Enclosure “in accordance with” FM5560 APPENDIX D.

• Witnessed Fire Tests “in accordance with” FM5560 APPENDIX D.
  • 25 Fire Tests Performed.

Fire tests witnessed by FM Approvals.
The Conventional Configuration.
The flexible Configurations.
CONCLUSION

• Based on these results
  
  • Flexible configuration allows the client more options for nozzle placement.
  
  • Reduction in the quantity of nozzles, leads to a smaller footprint for the water delivery unit.
  
  • Both contribute to reduce installation maintenance costs.
IN SUMMARY

• Working with Test Laboratories.
  • The ability to quickly and efficiently set up testing configurations.

• Working with authorities (FM).
  • Witness testing for an approved system, that when installed in accordance with the recommendations described in FM Global Data Sheets will provide a ‘Highly Protected Risk’.

• Working with clients.
  • Demonstrating the “fire” – understanding the influences.
  • Giving confidence by testing.

“....the way forward for all parties is collaboration” – UF.
Thank you for your attention.