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WCAP - 13757

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EXISTS AS WCAP-13756

WIND TUNNEL PHASE 4A TEST PLAN, INVESTIGATION OF THE HIGH REYNOLDS NUMBER BEHAVIOR OF THE WESTINGHOUSE AP600 SYSTEM

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WIND TUNNEL PHASE 4A TEST PLAN
INVESTIGATION OF THE HIGH REYNOLDS NUMBER BEHAVIOR
OF THE WESTINGHOUSE AP600 SYSTEM

OBJECTIVES

The primary objectives of the test proposed to be carried out at the National Research Council of Canada's 30' x 30' wind tunnel are:

1) To confirm that the detailed Phase 2 results carried out at UWO are conservatively representative of those expected at full scale Reynolds numbers; and

2) To obtain better estimates of baffle loads in the presence of a cooling tower (revised sketch attached), which represented a blockage in the UWO wind tunnel that is normally unacceptable (although it should have introduced conservative errors).

Basic Approach:

Due to the high costs of operating the 30' x 30' wind tunnel, and in the interests of maintaining comparative data that are as well-matched as possible, it is proposed that the current 1:96.67 model and the complete instrumentation system to be used in the 30' x 30' tunnel be pretested in the UWO simulation. More specifically, both scale models would be instrumented with circumferential rings of pressure taps at the following locations:

1) on the exterior at 2/3 [illegible]et height.

2) on the exterior at the inlets.

3) just inside the inlet manifold.

4) on the exterior at 1/2 chimney height.

5) within the chimney.

For the 1:96.67 model, (1), (2), and (4) correspond to new instrumentation. (1) and (3) are particularly useful for the overall comparison of Reynolds Number effects. The 1:25 model will not have complete internal passages; however, the chimney will be open inside to its base, and it will have a simple inlet manifold extending just below the inlets themselves. This will be connected with an additional internal volume designed to compensate for the frequency response of the volume of the blocked passages in the 1:96.67 model.

For comparative purposes, the 1:96.67 model will be equipped with a sealing plate at the interior base of the chimney to prevent flow through the interior passages when desired. The presence of the blocked containment and shield building annuli are not expected to materially affect the flow in and out of the inlets through the intake manifold and secondary effects will be modelled by the aforementioned additional volume in the 1:25 model. Thus, the 1:25 model and the 1:96.67 sealed model should be aerodynamically similar.

The UWO Pre-Test Program

The pretest program at UWO with the updated 1:96.67 model is then proposed to be as follows:

[ ] a,c

[ ]a,c

All tests would use the pressure scanning system, cables, and data acquisition system in identical form to that intended to be used in the 30' x 30' tests. Software would be developed to provide immediate displays of mean and peak pressure coefficient distributions for the five rings mentioned above and for the instantaneous inlet-chimney pressure difference.

The results of the UWO tests would provide:

a) True instantaneous baffle loads for the prime case (4 above with passages open). These were not previously measured.

b) True instantaneous baffle loads for the tornado case (5 above).

c) A definitive comparison of the inlet-chimney pressure differences for the matched cases where the only difference is that there is flow through the building. Agreement between these results, or the degree of disagreement is important in assessing the 1:25 model's result which will not have internal flows. If a significant difference is observed (although it is not expected) correction factors can be developed.

d) Pressure distributions measured away from the inlets and chimney outlets (i.e. at the rings (1) and (4) above) which can provide confirming Reynolds number comparisons, in the case that flow through the model has a significant effect or the prime (inlet-chimney) pressure difference comparisons. On the basis of the Phase 1 and 2 results, this is not expected, but these alternative exterior pressure distributions will provide a useful backup.

e) Verification that the instrumentation and model system is all working with the long cables required by the 30' x 30' tests, and that the software to rapidly compare results is also completely debugged.

The 30' x 30' Test Program

The 30' x 30' Test Program is detailed in the attached table. As soon as results are available for the 1:25 shield building model with no surroundings, comparisons would be made with the UWO data, and a "DECISION" would be made as to whether to continue with the three wind angle tests including the surroundings. During the decision process, it is likely that the first wind angle would be set up and tested anyway; however, the final two at least might be avoided. If the initial comparison with no surroundings shows significant differences, then the comparisons would continue through the cases with the surrounding buildings, since these are likely to reduce Reynolds number sensitivity.

Pressure measurements around the throat of the cooling tower have been added to assist smaller scale modelling for the later topography tests (phase 4B) These data will allow the determination of the appropriate drag to use.

SUMMARY OF PROPOSED TESTS (not necessarily performed in listed order)

We deal with permutations of the following possibilities:

[ ]a,c

[ ] a,c

UWO Tests (All 1:96.67 scale)

[ ] a,c

30' x 30' Tests (see attached detailed test scope)

[ ] a,c

30' x 30' Test Scope

Wind Tunnel Occupancy Cost @ $2100 Cdn/hr (7 hrs/day); Personnel O.T Cost = $75/hr
WT hrs + (man hours)

[ ] a,c

Notes:

1) 1:100 model refers to existing 1:96.67 model already in existence. It will be updated at UWO to include:
   a) exterior taps immediately adjacent to the inlets.
   b) a circumferential ring of exterior taps at roughly 2/3 of the height of the inlets.
   c) a circumferential ring of exterior taps at roughly 1/2 of the chimney height.
   d) a sealing plate that can be added at the bottom of the chimney well.

2) 1:100 cooling tower model is to be rebuilt by UWO, and will include throat pressure instrumentation.

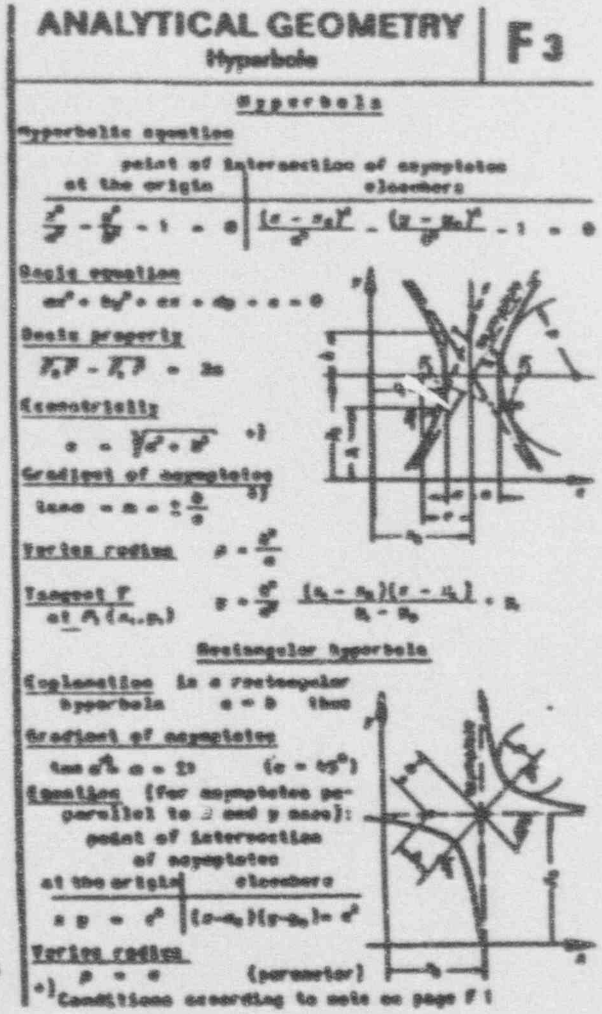
3) The nominally 1:25 model will be built at UWO with the final scale based on initial pilot tunnel test results.

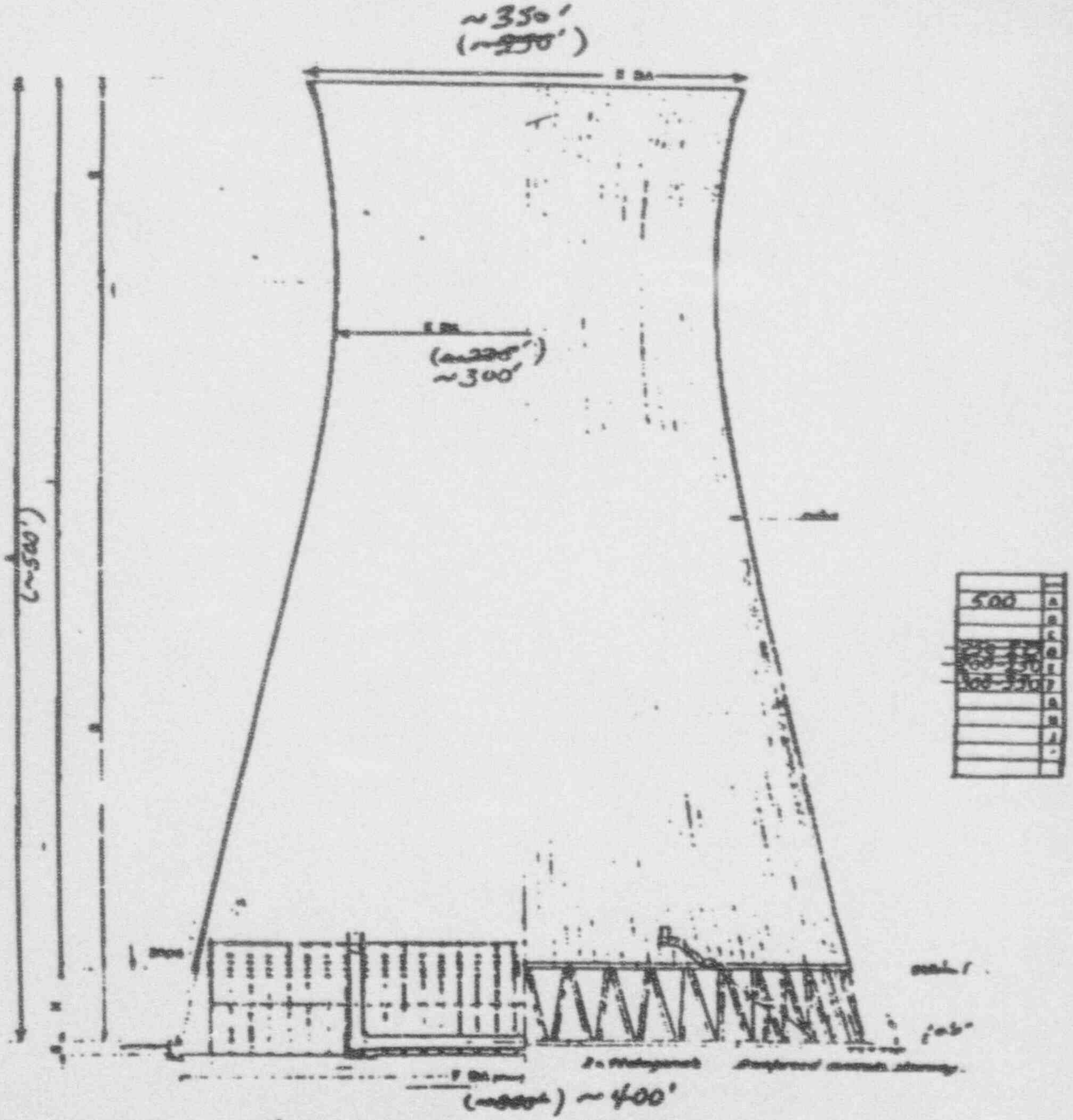
4) Test instrumentation would allow simultaneous pressure time histories to be captured in each case; the number of taps is still to be decided.

5) The new 1:25 model would have top rings corresponding to (a), (b), and (c) above. It would have a chimney hollowed out, corresponding to the sealed geometry of (d) above. The inlets would include the representation of the immediate inlet manifold to a depth sufficient to reasonably represent the inlet manifold of the 1:100 model, and would be fitted with similar internal pressure taps.

6) The sealed 1:100 model would still have passages open from the inlet to the sealing plate of 5(d); however, the internal passages would not be expected to significantly contribute to the inlet-driven internal manifold flows, so that the 1:25 simplified internal geometry would be expected to be representative of the 1:100 sealed case.

"DECISION" - based on comparisons between pre-measured UWO circumferential pressure distributions and the 1:25 results of (4), a decision will be made to abort or continue with the remaining 1:25 tests.


ANALYTICAL GEOMETRY
Hyperbola
F 3
Hyperbola
Rectangular hyperbola
Conditions according to note on page F 1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