RESPONSE TO THE NRC REQUEST FOR ADDITIONAL INFORMATION ON APPLICABILITY OF THE METHODOLOGY USED TO ASSESS THE ACCIDENT χ/Qs AT THE CONTROL ROOM AIR INTAKES FOR NINE MILE POINT UNIT 2

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I. INTRODUCTION

On August 20, 1986, at a meeting of representatives from the Nuclear Regulatory Commission, Niagara Mohawk Power Corporation, Stone & Webster Engineering Corporation and Meteorological Evaluation Services, Inc., the NRC requested additional information justifying the methodology used to calculate χ/Qs at the control room air intakes, specifically due to accidental releases from the combined radwaste and reactor building vent at Nine Mile Point Unit 2. NRC accepted the methodology, but questioned its applicability to the specific release point-building configuration at Nine Mile Point Unit 2. The NRC suggested that comparisons and justification be based on previous field studies and/or fluid modeling analyses at other plant(s).

This report responds to the NRC request.

II. ASSESSMENT OF THE ANALYTICAL TECHNIQUE FOR PREDICTING ACCIDENT K_C ISOPLETHS AT NINE MILE POINT UNIT 2

Fluid dynamicists accept the fact that the concentration field created by a source located near a building in a wind stream will scale linearly with 1/(building height)^2,

1/(wind speed) and source strength if the building shape, wind and effluent velocity distributions, and source distribution remain similar over the scale ranges.

The concentration field measured in a well-conducted wind tunnel test can be extrapolated to full scale prototype conditions directly by application of the appropriate scaling factors. It can also be done indirectly by converting the model concentration field into a dimensionless concentration coefficient (K_C) field and then redimensionalizing to the full-scale concentration field. One uses direct extrapolation when the model is an exact replica of the prototype. The K_C technique applies when the model is a simple structure that resembles but does not exactly replicate the prototype. Hosker (1982) shows that the use of K_C as a basic nondimensional concentration parameter is fully supported.

Model K_C isopleths must be adjusted to reflect differences in building shape and source arrangement before use with the prototype. Such adjustments can be significant near the model surface where flow and dispersion patterns are sensitive to the building contours. However, at distances comparable to the end of the cavity and beyond, K_C isopleths form a common generalized pattern which is not sensitive to irregularities in building contours.

The accident χ/Q values for Nine Mile Point Unit 2, (Mangan, 1986) were calculated by the K_C technique by adapting wind tunnel-derived K_C isopleths downwind of a model of the EBR-II containment structure at Idaho National Engineering Laboratory (INEL), (Halitsky et al,

1963) Attachment 1. In a later publication, Halitsky (1977) Attachment 2, convincingly demonstrates the validity of the EBR-II K_C isopleths obtained by model testing in Figure 15, where model and full-scale test values of K_C agree in the overlapping distance range.

We have chosen the EBR-II isopleths as the basic pattern because they provide the most complete available data set for a building having a rounded surface and sources at several locations. The lower parts of both the EBR-II and Nine Mile Point Unit 2 containment structures are vertical cylinders. When the two structures are superposed with a common diameter, the Nine Mile Point Unit 2 cylinder is taller. The two roofs are different, being a hemispherical dome for EBR-II and flat for Nine Mile Point Unit 2. The release point is at a comparably high elevation in both, being at the top of the dome at EBR-II and above the cylinder wall at Nine Mile Point Unit 2. Both sources are small, have low momentum and zero buoyancy.

The above comparison indicates that the K_C isopleth pattern produced by the EBR-II containment structure with top release point should be quite similar, both in shape and magnitude, to that of Nine Mile Point Unit 2 near the end of, and beyond, the building cavity. The isopleths at the top of the cavity near the containment surface will be different due to the different roof contours, but the isopleths at the bottom of the cavity where the intakes are located should be similar since they are in the cavity reverse flow which originates at the end of the cavity. (The end of the cavity is about 400 feet, and the intakes are about 250 feet, from the containment center.)

Changes in flow and dispersion patterns caused by the presence of structures surrounding the containment building may be pronounced at short distances from the source if flow blockage by other structures diverts the still compact plume. However, blockage does not exist at Nine Mile Point Unit 2 since nearby structures are appreciably smaller than the containment structure. When blockage is absent the K_C technique has been demonstrated to provide good estimates.

As an example, Halitsky (1985) Attachment 3, provides a comparison of K_C values for the Grand Gulf Nuclear Plant, as predicted by the same techniques as used in the Nine Mile Point Unit 2 analysis and as observed in a wind tunnel test of the exact configuration. Where blockage was not a factor, the maximum predicted K_C values at the control room air intakes for a vent release were a pre-test estimate of 2.3 as compared with an observed wind tunnel value of 2.6. Due to the fact that blockage will be less of a factor at Nine Mile Point Unit 2 than was the case at Grand Gulf, the K_C technique can be applied with greater reliability at Nine Mile Point Unit 2.

At larger distances, the presence of additional buildings simply spreads the plume without significantly reducing concentrations except in a building wake where mixing will occur.

III. CONCLUSION

In summary, we believe that use of the K_C technique at Nine Mile Point Unit 2 provides sufficiently accurate estimates of K_C at the control room air intakes.

REFERENCES

Halitsky, J. 1963, J. Golden, P. Halpern and P. Wu: Wind Tunnel Tests of Gas Diffusion from a Leak in the Shell of a Nuclear Power Reactor and from a Nearby Stack. New York University Environmental Meteorology, College of Engineering Research Division, University Heights, New York, New York, Prepared for Environmental Meteorological Research Project, United States Weather Bureau, Washington, DC, Contract No. Cwb - 10321, April 1, 1963

Halitsky, J. 1977: Wake and Dispersion Models For The EBR-II Building Complex. Atmospheric Environment Vol. 11, pp. 577-596.

Halitsky, J. 1985: Concentration Coefficients in Atmospheric Dispersion Calculations. ASHRAE Transactions 1985, Vol. 91, Part 2.

Hosker, R. P. Jr., 1982: Methods for Estimating Wake Flow and Effluent Dispersion Near Simple Block-like Buildings. NUREG/CR-2521, ERL-ARL-108, National Oceanic and Atmospheric Administration Air Resources Atmospheric Turbulence and Diffusion Laboratory. Prepared for U.S. Nuclear Regulatory Commission.

Letter From C. V. Mangan, Niagara Mohawk Power Corporation To Ms. Elinor G. Adensam, Director, BWR Project Directorate No. 3, U.S. Nuclear Regulatory Commission, Washington, DC 20555, dated August 7, 1986.

ATTACHMENTS

1. Halitsky, J. 1963, J. Golden, P. Halpern and P. Wu: Wind Tunnel Tests of Gas Diffusion from a Leak in the Shell of a Nuclear Power Reactor and from a Nearby Stack. New York University Environmental Meteorology, College of Engineering Research Division, University Heights, New York, New York, Prepared for Environmental Meteorological Research Project, United States Weather Bureau, Washington, DC, Contract No. Cwb - 10321, April 1, 1963

2. Halitsky, J. 1977: Wake and Dispersion Models For The EBR-II Building Complex. Atmospheric Environment Vol. 11, pp. 577-596.

3. Halitsky, J. 1985: Concentration Coefficients in Atmospheric Dispersion Calculations. ASHRAE Transactions 1985, Vol. 91, Part 2.