50-344 P

PORTLAND GENERAL ELECTRIC COMPANY
121 S. W. SALMON STREET
PORTLAND, OREGON 97204

CHARLES GOODWIN, JR.
ASSISTANT VICE PRESIDENT

November 2, 1978

Trojan Nuclear Plant
Docket 50-344
License NPF-1

Director of Nuclear Reactor Regulation
ATTN: Mr. A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Sir:

By letter to NRC dated July 7, 1978, Portland General Electric Company provided additional information on the radiological consequences of a postulated fuel handling accident inside Containment at the Trojan Nuclear Plant. Subsequently, on October 13, 1978, Jack Donohew, who is the NRC staff reviewer on this subject, requested by telephone that additional justification be provided of the mixing model used by PGE.

Pursuant to Dr. Donohew's telephone request, measurements were made of thermal convection velocities above the Trojan Spent Fuel Pool. The results of these measurements, together with their application to the evaluation of a fuel handling accident inside Containment, are provided in the attachment to this letter. We believe that these measurements and additional analyses support our previous conclusion that the offsite doses from this postulated accident are well within the guidelines of 10 CFR 100.

We are forwarding three signed originals and 40 copies of this letter.

Sincerely,

C. Goodwin, Jr.

C. Goodwin, Jr.
Assistant Vice President
Thermal Plant Operation and
Maintenance

CG/JWL/4rflA16
Attachment

c: TNP:GEN ENGR:F-15.5

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ATTACHMENT

FUEL HANDLING ACCIDENT MIXING MODEL
TROJAN NUCLEAR PLANT

In PGE's analysis dated July 7, 1978 of a postulated fuel handling accident inside Containment, it was assumed that gaseous fission products evolve from the surface of the Refueling Cavity into a mixing volume of 500 ft^3 prior to being exhausted by an exhaust flow of 1250 cfm. This mixing model yields a dose reduction factor of 1.61 in comparison to the case where no mixing is assumed.

The choice of a mixing volume depends on the relative magnitudes of the upward velocity of air over the pool due to thermal convection and the horizontal velocity of air into the surface exhausters located around the pool.

Measurements of air circulation patterns above the fuel pool at the Susquehanna Steam Electric Station showed a dominant upward flow of air over the bulk of the pool, with the air recirculating downward alongside the pool prior to capture by the surface exhausters (see Figure 1 of the Susquehanna report provided in PGE's letter of July 7, 1978). The surface exhausters were found to capture air rising from the surface of the pool only within a distance of a few feet.

On October 24, 1978, measurements were made of the thermal convection velocities above the Trojan Spent Fuel Pool. All ventilation systems in the Fuel Building were shut down, and the water in the pool was allowed to heat up to 95°F. The ambient air temperature in the Fuel Building was 71.5°F DB/60°F WB. A hot-wire anemometer (Alnor Thermo Anemometer Type 8500M) was used to measure the air velocity over the pool. The air velocity was observed to be somewhat gusty and in a general upward direction. The velocity ranged up to 70 ft/min and averaged 43 ft/min over the pool.

Thermal convection velocity is a function of the wet-bulb temperature difference between the pool water and overlying air, and of the chimney effects of structures that confine air above the pool. For the Refueling Cavity located inside Containment, the minimum temperature of the pool water at 4 days after shutdown is about 80°F, and the maximum temperature of the overlying air is estimated to be about 58°F WB[(a)].

(a) During the 1978 Trojan refueling, the pool temperature was 80°F at 9.5 days after shutdown. The normal daily maximum outdoor air temperature is less than 68°F DB during the anticipated refueling months of March-May at Trojan (FSAR Table 2.3-3) and the relative humidity inside Containment is expected to be approximately 50 percent, giving a maximum air temperature of about 58°F WB.

For these temperatures and for a given air column height, the thermal convection velocity over the Refueling Cavity is approximately 0.79 times less than for the temperature conditions under which the convection velocities were measured for the Trojan Spent Fuel Pool[(b)]. The minimum convection velocity over the Refueling Cavity is, therefore, estimated to be about 34 ft/min.

The surface of Refueling Cavity is largely surrounded by the steam generator and pressurizer missile shield walls and the wall of the Containment, as shown in the attached figure. The minimum wall height is 13.5 ft. These walls will have a chimney-like effect, increasing the upward thermal convection velocity above the pool. For a 13.5-ft effective chimney height, a pool temperature of 80°F, and an air temperature of 58°F WB, the convection velocity is calculated to be 330 ft/min, which is about 10 times greater than the value of 34 ft/min, derived for velocities that were measured over the Trojan Spent Fuel Pool.

The surface exhausters located around the perimeter of the Refueling Cavity water surface have a face velocity of 1800 ft/min parallel to the pool surface. At a distance of 1.3 ft from the exhaust openings the velocity has decreased to 34 ft/min, and at 5 ft from the openings the velocity is only 2.5 ft/min[(c)]. Since the upward thermal convection velocity is in excess of 34 ft/min, the surface exhausters would only be expected to capture gases evolving from the surface of the pool within a distance of about 1.3 ft from their openings.

It is extremely unlikely that 100 percent of the fission gases in a damaged fuel assembly would evolve from the pool surface within a distance of 1.3 ft from one of the exhausters. For the case where a uniformly damaged fuel assembly is assumed to fall on the Refueling Cavity floor immediately below the surface exhausters, with its long axis (12.6 ft) parallel to the Refueling Cavity wall, only about 40 percent of the gases evolving from the pool would be immediately captured by the exhausters within a radius of 1.3 ft (minimum exhauster spacing is 6 ft). This results in a dose reduction factor of about 2.4.

Beyond a distance of about 1.3 ft from the surface exhausters, evolving fission gases would be carried upward to a minimum height of about 13.5 ft prior to recirculating downward into the surface exhausters, yielding a mixing volume of about 1700 ft^3[(d)]. A smaller, more conservative, mixing volume of 500 ft^3 was used in PGE's analysis of July 7, 1978.

(b) The convection velocity is proportional to the square root of the difference in densities of the ambient air and saturated air at the pool temperature.

(c) See equation for velocity versus distance from round exhaust hoods given on Page 4-3 of Industrial Ventilation, A Manual of Recommended Practice, American Conference of Govermental Industrial Hygienists, 10th Ed, 1968.

(d) Length of fuel assembly (12.6 ft) x mixing height (13.5 ft) x one half of pool width (10 ft).

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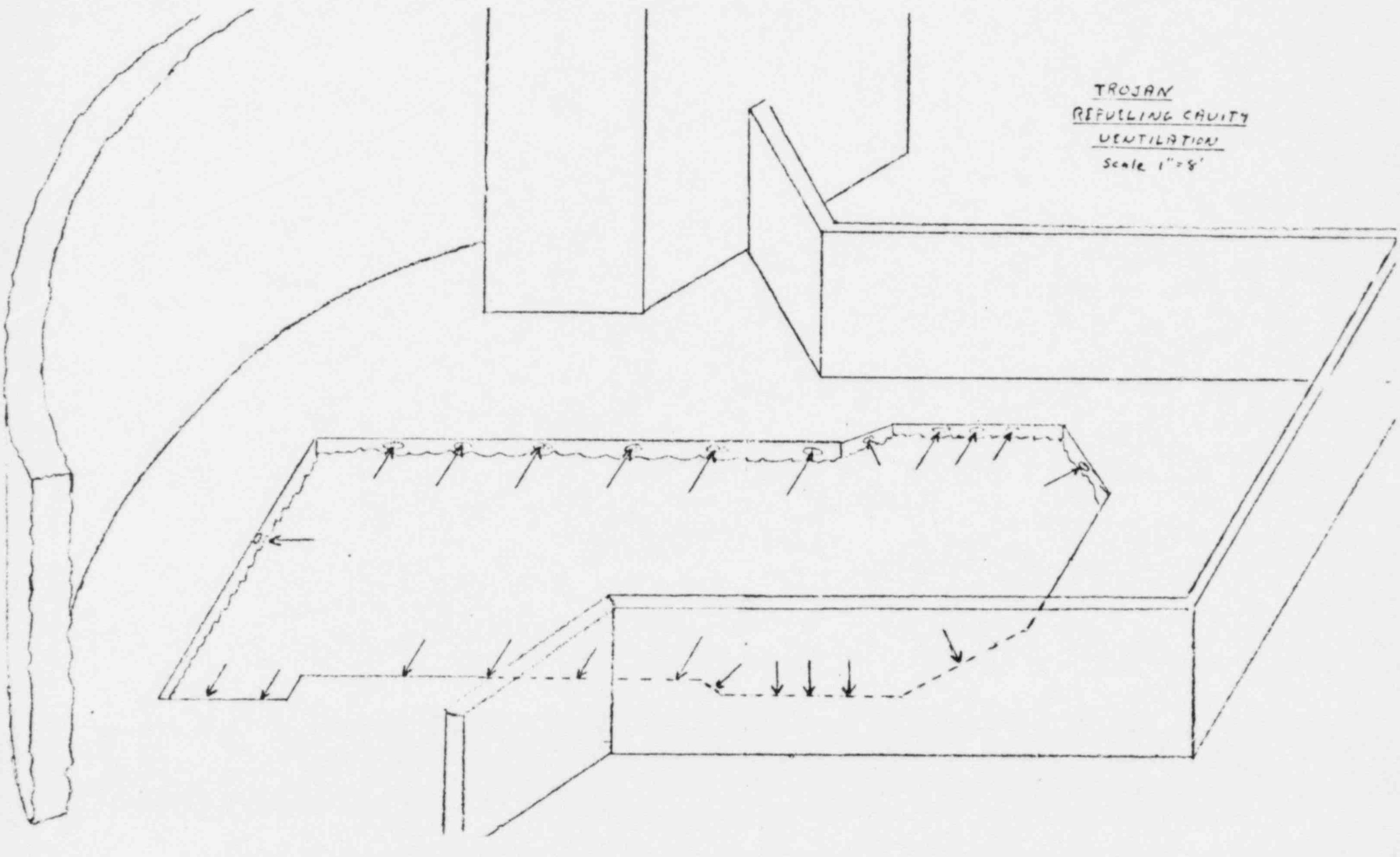
TROJAN
REFUELING CAVITY
VENTILATION
Scale 1"=8'