2.1.15 Due to the addition of Hafnium control rods at Unit 3, an offsite dose may need to be calculated for Hafnium isotopes in waste pathways. In the absence of site-specific bioaccumulation and dose factors for Hafnium, factors for Zirconium are used, as suggested in ICRP 30. Should these calculations become necessary, they will be performed per the following sections, and manually added to other totals.

2.1.16 Investigations from the Ground Water Monitoring Program (GWMP) may result in a determination of liquid effluent. A quantification and dose assessment of radioactive groundwater or storm water leaving the site shall be performed at least annually.

This quantification shall include, as a minimum, the source term from samples obtained near the effluent points of each applicable pathway (eg, ground water wells nearest the site boundary), and a determination of release rate and dilution flow.

Release rates to the river from both the bedrock pathways and collective storm drain pathways are provided from modeling by hydrologists. A precipitation mass balance was initially applied (Reference 32), and later verified by an application of the Darcy's Law model. Future determinations will continue to use a combination of these models at various depths, over effected zones, as discussed in Attachment J, Hydrological Verification of Grounwater Flow Rates.

Dilution flow is directly measured in the Discharge Canal for the Storm Drain component. For groundwater reaching the Hudson via a direct path under the canal, a dilution factor equivalent to a 6-hour half-tidal surge in the effected area of the Hudson applies, as discussed in Reference 33.

Dose calculations are otherwise then completed per the following sections.

2.2 Liquid Effluent Concentrations

2.2.1 This section provides a description of the means that will be used to demonstrate compliance with the RECS D3.1.1.

2.2.2 Compliance with the instantaneous limits of 10CFR20 is achieved by allocating dilution flow on a per unit basis, as described in Section 2.1.6. Compliance with 10CFR50 (quarterly and annual limitations) is assured by completing a monthly report which summarizes the time-average releases from the site.

2.2.3 Each isolated liquid waste tank must be recirculated for at least two tank volumes prior to sampling in order to ensure a representative sample is obtained. At Unit 2, this duration is determined from station procedures with every batch release. At Unit 3, a default minimum recirculation time of 4 hours may be used for 31 and 32 monitor tanks in lieu of the actual calculation:

$$\frac{11750\ gals * 2\ Tank\ Volumes}{100\ gal/\min} = 3.9\ Hours \approx 4\ Hours$$

Note: Nominal monitor tank pump flow rate is approximately 135 gpm. For conservativism however, 100 gpm is used for the recirculation flow rate, while 150 gpm is used for the discharge flow rate in all release calculations.

APPENDIX J

HYDROLOGICAL VERIFICATION OF GROUNDWATER FLOW RATES

Site hydrologists have verified the overall direction of groundwater flow at IPEC to be ultimately into the Hudson River. From this established understanding, two independent models are applied to determine groundwater flowrates from the site into the river, the precipitation mass balance and the Darcy's Law models. Either of these methods involves identification of specific zones over which the method is applied:

Zone 1	Area north of Unit 2, determined to have no impact on site effluents
Zone 2	Area along the Unit 2 riverfront
Zone 3	Area facing the river in front of Units 1 and 3, later split into Areas 3A (Unit 1) and 3B (Unit 3), to represent the groundwater flow from each unit.
Zone 4	Area south of Unit 3, determined to have no impact on site effluents.

Precipitation Mass Balance Method:

Measurements of the effected area, annual average rainfall, and infiltration rates (determined from USGS data) are used to compute a total mass to the river for each zone. This value is then adjusted for any known removal mechanism, such as evaporation, transpiration, runoff into storm drains (and any exfiltration back into groundwater), or footing drains. The resulting flow rates are then applied to the source term at the river front for each zone.

Source terms for this method are combined from all levels, and a 3^{rd} quartile conservative assessment is generally assumed, where there is sufficient data to evaluate this statistical interpretation. Otherwise, a simple conservative average is used, or on rare occasions, a single positive value if all other values are negative. Doses are then calculated normally, in accordance with the ODCM and Reference 44.

Darcy's Law Method:

In this model, groundwater elevation contours and measurements of hydraulic conductivity are developed from the wells on site, recognizing that flow is perpendicular to the contours. This effort also provides knowledge of facility-specific flow paths. Darcy's Law is then applied to determine flow rate: $Q = k * i * A$ where Q, the ground water flow rate is a function of;

- k — the ease of which flow can be forced through the subsurface media, otherwise known as hydraulic conductivity;
- i — the pressure driving the flow, or the gradient (groundwater elevation change divided by the distance over which the change occurs);
- A — the cross-sectional area through which the flow occurs (length of groundwater or river interface times depth to bottom of contaminated groundwater flow).

Source terms for this method are more integrated than the mass balance method, and split into higher and lower elevations. At IPEC, this method is applied to verify the mass balance determinations, particularly to further integrate the area of the plume(s) in Areas 2 and 3A. In these key areas, dose calculations are integrated separately, as defined by individual well data, with source term quantification split into high and low doses. As in the model above, doses are again calculated and summed in accordance with the ODCM and Reference 44.