C

From: "Croulet, Donald" <dcroule@entergy.com>
To: "'James Noggle'" <JDN@nrc.gov>, "Cox, Mark R" <mcox90@entergy.com>, "Bowman, Greg " <GBowm90@cc--exs03.prod.entergy.com>, "Conroy, Pat" <PConroy@entergy.com>, "Hinrichs, Gary" <ghinric@entergy.com>, "PRICE, ERNEST JR" <EPRICE2@entergy.com>, "Robert Oliveira (boliveira@amnucins.com)" <boliveira@amnucins.com>, "'Timothy Rice'" <tbrice@gw.dec.state.ny.us>
Date: 3/8/06 2:23PM
Subject: FW: IPEC Groundwater and Stormwater Dose.pdf

-----Original Message-----
From: Dennis Quinn [mailto:dquinn@daq-inc.com]
Sent: Wednesday, March 08, 2006 2:00 PM
To: Croulet, Donald; Jones, T. R.
Cc: Mayer, Don; Matt Barvenik; Axelson, William L; Lavera, Ron; Sandike, Steven; Wilson, Daniel; English, Christopher
Subject: IPEC Groundwater and Stormwater Dose.pdf

Don,
Attached is the revised dose calculation, with GZA's most recent map included as Figure 2. This was developed by GZA (Matt Barvenik) and Entergy (Steve Sandike), and I have reviewed the calculation. This should be sent to the NRC, as it has changed slightly since the Feb 28th draft version.

I spoke with Matt Barvenik, and we are in agreement that the Unit 1 related discharges through the North Curtain Drain (NCD)and Sphere Foundation Drain Sump (SFDS) are not included in this calculation. I believe this is appropriate because these Unit 1 releases are part of a monitored release path,and they have been included in the annual 1.21 Radioactive Effluents Report. The recent calculation (attached) was performed to estimate what amount of activity was potentially being released through the non-standard pathways. The calculation is conservative, because the amount of water assumed to be moving through the Unit 1 area (and hence being discharged to the river or to the discharge canal) was not decreased by the amount of water being collected by the NCD and SFDS systems, about 25 gallons per minute. That conservatism tends to overestimate the gallons and therefore the total Ci discharged. Please call with any questions or comments.

Dennis Quinn

Dennis Quinn, CHP
DAQ, Inc.
845-223-1960 office
845-223-1099 fax
845-519-7321 cell

C/4

Indian Point Energy Center

Water Mass Balance and Dose Calculation from Groundwater and Storm Water

An Assessment of 2005 Effluent Impact

GZA GeoEnvironmental, Inc
IPEC Chemistry and Rad Protection
DAQ, inc

March 3, 2006

IPEC Water Mass Balance and Dose Calculation from Groundwater and Storm Water

The basic methodology for this dose calculation is based on an overall mass balance driven by precipitation. The hydrology portion of this calculation was performed by IPEC's consultant, Matthew Barvenik, of GZA GeoEnvironmental, Inc. IPEC concurs with this methodology. This "watershed analysis" partitions the precipitation falling on the watershed catchment area (i.e., that portion of the Facility area where the surface topography is sloped towards the river) into water that infiltrates the ground to become groundwater (GW), water that flows off the surface as storm water (SW) and that water which directly moves back into the atmosphere via evapotranspiration and other processes. See Figure 1, "IPEC Groundwater and Storm Drain Conceptual Drawing". This method of analysis is based on well established hydrologic principles and the parameter selection we've employed is heavily biased towards larger flows and higher H^3 concentrations. As such, we believe that this analysis is significantly conservative, resulting in estimates of H^3 moving to the river (both directly and via the Discharge Canal) that will likely be proven to be substantially higher than actually exist with the acquisition of additional data.

Over the entire watershed catchment area of 3.2 million ft^2, the GW and SW has been segmented relative to the areas of the Facility through which it flows (primarily established based on H^3 concentrations in the various Facility areas. See Figure 2, "Indian Point Site Overview" depicting groundwater areas and storm water zones.

Overall, the partitioning was established as follows for infiltration areas contributing to GW flow (does not include paved or building areas):

GROUNDWATER AREAS:

- **AREA 1.** The northwestern most area where GW appears to move directly to the river, but passes to the north of the Unit 2 Turbine Building Road (area of 0.25 million ft^2). This GW is unlikely to contain appreciable H^3 concentrations based on the data available to date and the lack of likely H^3 sources;
- **AREA 2.** The area where the GW appears to move through Unit 2 facilities (area of 0.57 million ft^2);
- **AREA 3.** The area where the GW appears to move through Unit 1/3 facilities (area of 1.7 million ft^2);
- **AREA 4.** The southwestern most area where GW appears to move directly to the river, but passes to the south of the Unit 3 Turbine Building Road (area of 0.67 million ft^2). This GW is unlikely to contain appreciable H^3 concentrations based on the data available to date and the lack of likely H^3 sources.

SW flow from paved areas and building roof areas has also been partitioned into various zones within the above Facility GW areas as follows:

STORM WATER AREAS:

- **ZONE A.** The eastern most parking lots which likely drain along flow paths where the SW is unlikely to contain H^3, and storm drain exfiltration into the GW flow zone is also unlikely to pick up H^3 (area of 0.35 million ft^2);
- **ZONE B.** Within the Unit 2 Facility, the eastern and western zones where SW appears to discharge to the river, but does not pass through the Unit 2 Transformer Yard (area of 0.21 million ft^2);
- **ZONE C.** Within the Unit 2 Facility, the middle zone where SW flows to the Discharge Canal, and does pass through the Unit 2 Transformer Yard (area of 0.15 million ft^2);
- **ZONE D.** Within the Unit 1 Facility where SW flows to the Discharge Canal (area of 0.13 million ft^2); and
- **ZONE E.** Within the Unit 3 Facility where SW flows to the Discharge Canal (area of 0.75 million ft^2).

A portion of the SW has been assumed to leak out of storm drains and thus increases the GW flow to the river as follows:

- **ZONE A.** Storm drain exfiltration =0% - set to 0% because exfiltration from pipes in this zone are unlikely to contribute flow to GW which contains H^3 and the SW itself is unlikely to contain H^3;
- **ZONE B.** Storm drain exfiltration =0% - set to 0% because exfiltration from pipes in this zone are unlikely to contribute flow to GW which contains H^3 and the SW itself is unlikely to contain H^3;
- **ZONE C.** Storm drain exfiltration =25% - set to a relatively high value to result in higher than anticipated GW flow through the Unit 2 Transformer Yard which contains the highest H^3 GW values, so as to be conservative;
- **ZONE D.** Storm drain exfiltration =50%; set very high given current knowledge of these drains; and
- **ZONE E.** Storm drain exfiltration =10%; set to a nominal value given current lack of specific data and limited impact on overall H^3 flux due to low H^3 concentrations.

H^3 concentrations have been established using 2005 data, and Strontium-90 has been included for groundwater flow Area 2.

- **GW flow AREA 1.** $[H^3]$ = 0 pCi/L given lack of likely H^3 source areas and flow path which appears not to flow through areas exhibiting H^3 concentrations in the GW ;
- **GW flow AREA 2.** $[H^3]$ = 200,000 pCi/L which represents an upper bound average of the concentrations found in the Unit 2 Transformer Yard (it is expected that the pending Phase I and II data will prove this assumed value for H^3 in the GW moving to the river through the Unit 2 area to be substantially higher than actually exists);
- **GW flow AREA 3.** $[H^3]$ = 620 pCi/L which represents an upper average of the concentrations found in the Unit 1 and 3 Facility areas;
- **GW flow AREA 4.** $[H^3]$ = 0 pCi/L given lack of likely H^3 source areas and flow path which appears not to flow through areas exhibiting H^3 concentrations in the GW;

- **SW flow ZONE A.** $[H^3]$ = 0 pCi/L given that exfiltration from pipes in this zone are unlikely to contribute flow to GW which contains H^3 and the SW itself is unlikely to contain H^3;
- **SW flow ZONE B.** $[H^3]$ = 651 pCi/L given measured storm drain concentrations;
- **SW flow ZONE C.** $[H^3]$ = 2,900 pCi/L given measured storm drain concentrations;
- **SW flow ZONE D.** $[H^3]$ = 1,560 pCi/L given measured storm drain concentrations; and
- **SW flow ZONE E.** $[H^3]$ = 1,560 pCi/L given measured storm drain concentrations.

The infiltration rate in non-paved/building areas was established at 0.46 feet/year based on the USGS report: Water Use, Groundwater Recharge and Availability, and Quality in the Greenwich Area, Fairfield County, CT and Westchester County, NY, 2000 - 2002. The precipitation rate for the area was set at 3.74 feet/year based on onsite meteorological data.

Based on the above analysis, it is estimated that approximately 1.36 Ci/year of H^3 migrates directly to the river via the GW flow path. It is also estimated that less than 0.02 Ci/year flows directly to the river via SW. It is further estimated that approximately 0.16 Ci/year flows to the river with SW via the Discharge Canal.

It is noted that the H^3 concentrations adopted herein are expected to represent values which are significantly greater than those which actually exist given the conservatism exercised during parameter selection. An example of the conservatism employed in these calculations includes:

- H^3 concentrations selected for the various GW and SW flows are likely to be higher values than actually exist. It is believed that these values will be proven to be significantly too high with the acquisition of additional Phase I and II data. This is particularly true for the 200,000 pCi/L adopted for the Unit 2 Transformer Area;
- The areas contributing GW flow through various IPEC Facilities was biased toward placing more flow through the Unit 2 Transformer Yard where the highest H^3 concentrations were used;
- All GW flow has been assumed to discharge directly to the river. Some of this GW flow must infiltrate the Discharge Canal thus reducing the apportionment to the river;
- All storm drain pipe leakage has been assumed to be exfiltration which will increase GW flow values. However, current data in the Unit 2 Transformer Yard indicates that significant GW infiltrates the storm drain during rainfall events, thus flowing to the Discharge Canal via SW rather than directly to the river as GW. In addition, it is noted that SW H^3 concentrations were typically obtained during non-storm events and thus represent the high end of H^3 values associated with low flow conditions. However, these high H^3 concentrations, were then applied to the much higher storm flows where much lower H^3 values should exist;
- All precipitation falling on paved/building areas was assumed to result in SW flow. Some of this water actually evaporates directly to atmosphere from pavement and buildings; and
- The very large value of GW flow extracted from the GW system via the Unit 1 curtain and footing drains has not been subtracted from the GW flows adopted in the analysis.

Results:

The results of the calculations are shown in Table 1, and they show that the annual dose from the groundwater and storm water pathways due to tritium is 0.0000154 millirem per year to the whole body (less than 0.1 percent of the 3 millirem per year liquid pathway limit). If Sr-90 is included in the calculation, the dose to the critical organ (bone) is 0.000840 millirem per year, which is less than 0.1 percent of the 10 millirem per year critical organ limit. The total tritium activity calculated to be released via this pathway is 1.53 Curies, which is less than 0.1 percent of the liquid tritium releases via other pathways.

There are six tables attached:

- A summary table of curies and dose,
- Three tables of curies and doses from storm water pathways, and
- Two tables of curies and doses from groundwater pathways

Figure 1 shows a representation of the conceptual water balance.
Figure 2 shows a map of the IPEC site, broken down into Areas and Zones referenced in the calculation.
Figure 3 shows precipitation data for the Indian Point site.

Figure 1

IPEC Ground Water and Storm Drain Conceptual Drawing

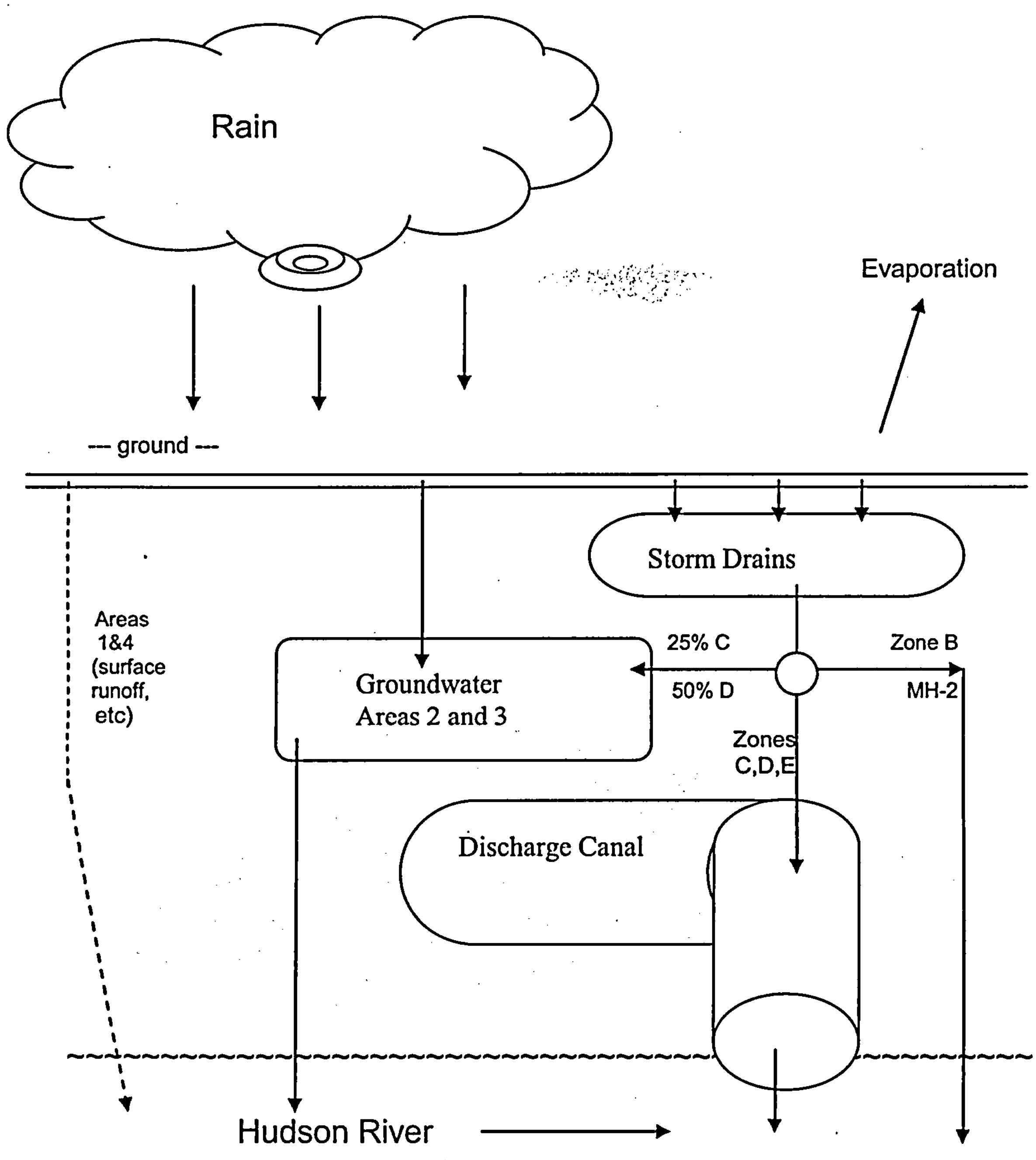

Figure 2.. Indian Point Site Overview