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PSEG Nuclear LLC

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QUARTERLY REMEDIAL ACTION PROGRESS REPORT, FIRST QUARTER 2011
PSEG NUCLEAR, LLC, SALEM GENERATING STATION

Dear Ms. Tuccillo:

PSEG Nuclear LLC (PSEG) has prepared this Quarterly Remedial Action Progress Report (RAPR) summarizing the groundwater remediation activities performed during the First Quarter 2011 at the PSEG Nuclear, LLC, Salem Generating Station (Station) as a component of the site-wide Tritium Management Program (TMP). The Site is located on Artificial Island in Hancock's Bridge, Salem County, New Jersey. Salem Unit 1 occupies the southernmost portion of this multi-reactor Site. Salem groundwater remediation activities are being conducted to address tritium detected in shallow groundwater adjacent to and south of the Salem Unit 1 Reactor Containment and Fuel Handling Building. The Station site plan is depicted on **Figure 1**. **Figure 2** presents a detailed view of the area undergoing active remediation.

The subject release of tritium contaminated water to the environment was remedied in February 2003 when the Salem Unit 1 telltale drains were cleared and the Spent Fuel Pool (SFP) water that had accumulated behind the liner was drained. Routine maintenance of the spent fuel pool (SFP) telltale drains has prevented a reoccurrence of the standing water condition responsible for the initial release and has precluded further flow restrictions in those drains. The installed seismic gap drains continue to provide a hydraulic gradient into the building and to the waste management systems, and away from the environment. The Groundwater Recovery System (GRS) continues to control the flow of shallow groundwater outside the cofferdam in the shallow unconsolidated zone maintaining the plume to the on-site area while removing the remaining tritiated groundwater.

The monitoring program provides data to support the adaptive management program and analyze the efficiency of the program. Plant related gamma-emitting radioisotopes have not been detected and tritium concentrations have generally continued to decline in groundwater samples, indicating that current activities meet the objectives of the program as provided in the Remedial Action Work Plan (RAWP).

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The present estimate of tritium left in the plume, where it exists above the NJDEP Ground Water Quality Criteria (NJGWQC), is less than 1 Curie of tritium (approximately 0.72 Ci). . The estimate is based upon the concentrations in wells (past and present) modified by estimates of: the amount of tritium drawn back through the seismic gap by gap draining activities, the actual degree of variability in the tritium concentrations of the groundwater, and the amount of mass held in dead end pore space. Further complicating the estimate is the fact that the existing monitoring network was designed to monitor a much more extensive plume; therefore the great reductions in plume mass achieved to date has resulted in the present situation where only a few wells indicate concentrations above the NJGWQC.

The following sections present the background of environmental investigation and remedial action at the site, the details and results of activities conducted since the recent submittal of the Fourth Quarter 2010 RAPR, and provide a discussion of upcoming activities projected for the next reporting period.

1 Project Background

The remedial program is based upon the 2004, Remedial Investigation Report (RIR) submitted to the New Jersey Department of Environmental Protection Bureau of Nuclear Engineering (NJDEP-BNE). This report presented results of the groundwater investigation performed in response to the discovery of tritium in groundwater adjacent to Salem Unit 1 resulting from a release from the Spent Fuel Pool.

The remedial action strategy was developed to hydraulically control and recover tritium remaining in groundwater adjacent to Salem Unit 1. Following the implementation of a successful pilot study a full scale system was activated in early 2005 following NJDEP-BNE approval of the RAWP in November 2004. As an additional protective measure, weekly draining of the Unit 1 seismic gap was initiated In April 2005, to ensure control of water present in the seismic gap. Continuous draining of both the Unit 1 and Unit 2 seismic gap drains was initiated in February 2007 and the program has been continued to date.

2 Continued Groundwater Monitoring

Groundwater monitoring has continued in accordance with the schedule provided to NJDEP-BNE. The sampling program was conceived to provide the best reasonable understanding of plume distribution and containment. The monitoring program has been supplemented with other wells outside the area of the plume to help provide an understanding of the presence of tritium in groundwater throughout the site. Analytical results for plume area monitoring well locations are depicted on **Figure 2**.

Groundwater samples are collected by Maplewood Testing Services personnel, submitted to Salem Chemistry for preliminary tritium analysis and gamma emitter screening then sent to an external lab for more refined evaluation yielding lower detection limits.

Historical and current analytical data indicate that plant related gamma-emitting radioisotopes have not been detected in groundwater from any monitoring well since monitoring was initiated in 2003.

Recent historical analytical tritium results for groundwater collected from the Station monitoring wells are presented on **Figure 2**. Included on **Figure 2** are: panel 1) the extent of tritium in groundwater at the completion of the remedial investigation (Baseline Plume); panel 2) the extent of tritium in groundwater one year prior to the reporting period, March 2010; and, panel 3) the extent of tritium in groundwater in March 2011. Based on a review of **Figure 2**, it is apparent that the mass of tritium in groundwater has been significantly reduced by the remedial efforts conducted to date. Details regarding these activities are discussed below.

The following sections present the groundwater analytical results based on the water-bearing zone from which they are collected. The three primary water-bearing units investigated beneath the Station are: 1) the Vincentown Formation; 2) the shallow water-bearing unit within the limits of the cofferdam surrounding Salem Unit 1; and, 3) the shallow, water-bearing unit outside the limits of the cofferdam.

2.1 Tritium Analytical Results for the Vincentown Formation

The following wells are screened in the Vincentown Formation: Well V, Well K, Well L, Well P, Well Q, and, Well CB. Groundwater quality for Well K, Well L, Well P, and Well Q is currently monitored on a semi-annual basis. Groundwater quality for Well V and Well CB is currently monitored on a quarterly and monthly basis, respectively.

Tritium has consistently not been detected above Station laboratory detection limits or detected at relatively low levels in groundwater at all monitoring wells screened within the Vincentown formation since the initiation of monitoring at these locations, with the recent exception of Well CB which has been discussed in previous reports. The groundwater monitoring results continue to indicate that the previous release of tritium impacted water from the SFP has not significantly migrated below the shallow water-bearing unit.

2.2 Tritium Analytical Results for Wells Installed Within the Limits of the Cofferdam

The following wells are screened in the shallow, water-bearing unit within the limits of the cofferdam: Well M, Well N, Well O, Well R, Well AC, Well AE, Well AI, Well AM, Well AN and Well AO. Groundwater quality for these wells is currently monitored on a monthly basis. Well AO is currently out of service.

Tritium concentrations in groundwater collected from Well AC and Well AM have declined significantly over the past year. Well M had exhibited a long term decline until the end of March 2011 when an uncharacteristic detection above 20,000 pCi/L occurred. PSEG will continue to monitor the developments at this well, however nearby Well AI has continued to exhibit a decreasing trend. Other wells exhibiting increasing trends include Wells O, AE AN, and R. Well R is still well below the 20,000 pCi/ limit, however Wells O and AE have continued to show concentrations above 20,000 pCi/L. Otherwise tritium concentrations in the cofferdam wells exhibit general decreasing trends since the initiation of remediation. **Figure 2** shows tritium concentrations in the plume area and **Figure 3** shows groundwater data for wells located outside the plume area.

2.3 Tritium Analytical Results for Wells Installed Outside the Limits of the Cofferdam

The wells installed in the shallow, water-bearing unit beyond the limits of the cofferdam are Well S, Well T, Well U, Well W, Well Y, Well Z, Well AA, Well AB, Well AD, Well AF, Well AG (Shallow and Deep), Well AH (Shallow and Deep), Well AJ, Well AL, Well AP, Well AQ, Well AR, Well AS, Well AT, and Well CA. These wells are screened either just above the clay confining unit that separates the shallow water-bearing unit from the Vincentown Formation, or in the interval indicating the highest tritium concentrations found in the shallow water-bearing unit at each boring location at the time of the Supplemental Investigation completed in August 2003. Additionally the (Radiological Groundwater Protection Program (RGPP) wells installed throughout the site generally fit into this classification however, all but five of these wells are managed under a separate reporting program. Data for these wells can be found in the 2010 Annual Radiological Environmental Operating Report.

Tritium concentration trends for wells screened in the shallow, water-bearing unit are generally stable to decreasing and therefore indicate that the operation of the groundwater extraction system has achieved significant reductions in the concentrations of groundwater in the target zone. The distribution of tritium in groundwater in March 2011 is presented on **Figure 2**, along with the distribution of tritium prior to the initiation of the pilot study in March 2004, and in March 2010. As shown on **Figure 2**, the mass of tritium in groundwater has continued to decrease through the operation of the

groundwater extraction pilot study system and operation of the full-scale system, with minor fluctuations due to hydrogeologic conditions and pumping operations.

Figure 3 shows groundwater data for wells located outside the plume area.

3 Groundwater Extraction

Groundwater extraction was selected as the remedial strategy for the plume. As stated above, operation of the full scale system was initiated in 2005. The system is routinely inspected and serviced to ensure continued operation in support of the remedial action objectives.

3.1 Full-Scale System

The objectives of the full-scale GRS consist of:

- maintaining hydraulic containment of the tritium plume; and
- reducing tritium concentrations in groundwater

The present operation of the GRS consists of groundwater extraction from Wells S, AB, AD, AJ, AN, and AT. Pumping at Well AS was discontinued during the spring 2010 service event as a result of its low yield. A regular system service schedule was implemented beginning in the fourth quarter of 2009 to maximize system operation and efficiency. Groundwater extracted from the wells is processed in accordance with the Station's United States Nuclear Regulatory Commission (USNRC) license and plant procedures. Details of the extracted effluent are discussed below.

3.2 Mobile Groundwater Recovery Unit

The mobile groundwater recovery unit was designed and built to recover groundwater from specific areas of the plume as needs arise. The mobile unit is presently out of service due to a need for overhauling and maintenance. The activities are in process and will be performed to make the unit operable in the fourth quarter of 2011.

3.3 Total System Effluent Data and Evaluation

GRS operations were initiated on February 16, 2005. The GRS discharges continuously in accordance with the Station's USNRC license. As of December, 2010, the GRS has recovered nearly 26 million gallons of groundwater. The system recovered an estimated average of eleven gallons per minute throughout the quarter or greater than 15 times the recharge rate for the extraction area (calculated to be 0.7 gallons per minute, based upon an assumed percentage of annual precipitation).

3.4 Water-Level Data and Evaluation

Water level measurements from the extraction and select observation wells have been monitored to confirm hydraulic containment of the tritium groundwater plume. Water levels are periodically collected by MTS and ARCADIS personnel. The water levels are evaluated to provide insight into groundwater flow patterns at the facility.

3.5 Cumulative Curies Removed

The various groundwater recovery activities conducted to date have been successful in controlling the plume and recovering tritium from groundwater at and downgradient of the Salem Unit 1 seismic gap.

Figure 4 summarizes the results of groundwater remediation activities conducted using the well field including both the pilot study and the permanent system. As shown on **Figure 4,** approximately 3.3 curies of tritium have been recovered from the operation of the GRS through September, 2010. Approximately 1 curie (0.93 curies) of tritium was removed by the pilot system. Therefore a total of 4.3 curies of tritium have been recovered from the operation of the GRS through March 2011. As the mass remaining in the plume decreases so will the rate of tritium recovery by the GRS. The effectiveness of the GRS is emphasized by the decrease and stabilization of system effluent concentrations since the activation of the full scale system in February 2005. System effluent concentrations averaged 12,597 pCi/L during the first quarter 2011. This indicates that the GRS has been successful at decreasing tritium concentrations in groundwater as discharge concentrations are roughly 12% of the peak concentration (109,000 pCi/L) observed in March, 2005. This indicates that the GRS system is recovering a significant amount of clean water in addition to water with concentrations of tritium above the 20,000 pCi/L standard.

4.0 Operation of the Seismic Gap Drain

As stated above the seismic gap drains in Salem Unit 1 and Unit 2 are being used to continuously drain the water from the gaps to provide control over water present within

the gaps. This permits recovery of additional tritium concentrations over that which is recovered by the GRS system.

Water samples from the seismic gap drains are periodically collected for tritium analysis. **Figure 5** summarizes the results of periodic tritium analysis from the Unit 1 seismic gap. A comparison of **Figure 2** and **Figure 5** indicates that concentrations of tritium in water recovered in the Unit 1 seismic gap have been consistently higher than those detected in groundwater samples collected from Well AC and Well AM located to the southeast and southwest of the seismic gap, respectively. Thus, continuous operation of the Unit 1 seismic gap drain is effectively removing SFP water in the seismic gap. Tritium concentrations in water presently being removed from the gap are close to the concentrations present in the pool, indicating that the continuous draining program has been successful.

Continuous or nearly continuous draining (resulting in a hydraulic head less than that which is present in the geologic materials present outside the seismic gap) provides a positive assurance that the engineering control established by the seismic gap drain is effective at capturing any SFP water that enters the gap. The gap drain creates an inward gradient such that groundwater flows into the seismic gap limiting the potential for a discharge to the environment from the gap.

Monitoring of water drained from the Unit 2 seismic gap acts as a screen for a potential release from the Unit 2 SFP. Water collected in the Unit 2 seismic gap drain indicate tritium levels several orders of magnitude below the Unit 1 seismic gap drain concentration, and consistent with the trends in the Unit 1 seismic gap drain.

Water samples will continue to be obtained on a weekly basis from the Unit 1 and Unit 2 seismic gap drain to evaluate the potential for the release of radioisotopes to the environment.

5.0 Upcoming Activities

Activities projected for the 2nd Quarter 2011 include the following:

- Continue to monitor continuous draining of seismic gap drains;
- Evaluate GRS operation to determine if well operation can be reduced.
- Continue to measure groundwater levels and evaluate flow and plume containment;
- Continued groundwater sampling and analysis; and,
- Continued operation and evaluation of the GRS performance;

If you have any questions or comments regarding the contents of this report, please do not hesitate to contact me at (856) 339-7900.

Sincerely,

Jeffrey Pantazes
Manager – Nuclear Environmental Affairs

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"WELL LOCATIONS", Figure 1

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"GROUNDWATER TRITIUM RESULTS",
Figure 2

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"WELLS BEYOND THE PLUME AREA", Figure 3

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G:\ENV\CAD\Newtown\ACTIVITP\000571\0010\000009\Q1_2011\FIG-4 HISTORIC TRITIUM RECOVERED THROUGH WELL FIELD OPERATION_Final.dwg LAYOUT: 4 SAVED: 6/15/2011 4:41 PM ACADVER: 17.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: ARCADIS(SIZE A-B).CTB PLOTTED: 6/15/2011 4:42 PM BY: WASILEWSKI, MATT
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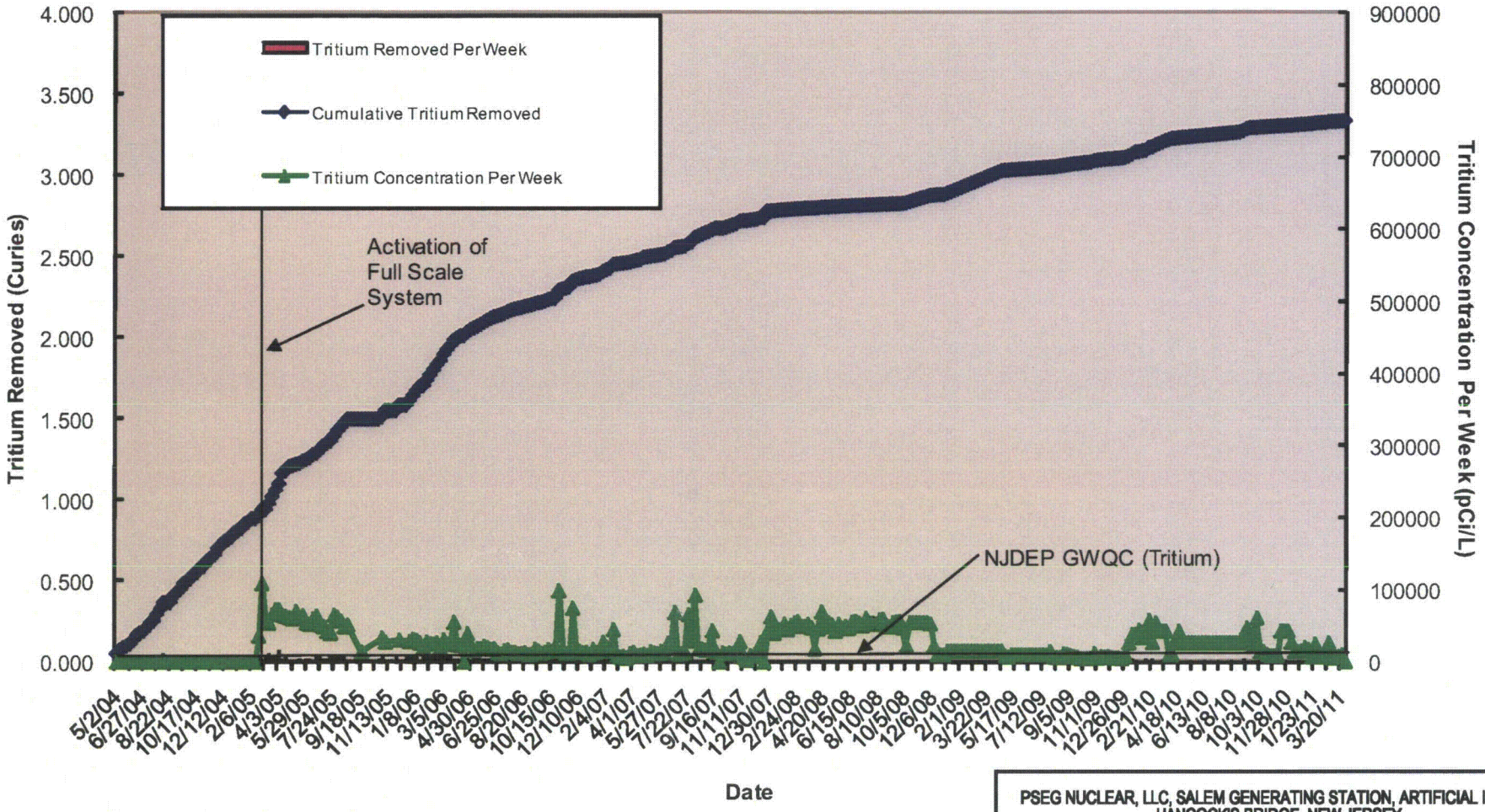
PSEG Nuclear, LLC Salem Generating Station - Unit 1
Tritium Recovered Through Well Field Operation



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HISTORIC TRITIUM RECOVERED THROUGH WELL FIELD OPERATION

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FIGURE
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G:\ENVCAD\Newtown\ACT\NP000571\0010\00006\Q1_2011\FIG-5 TRITIUM CONCENTRATIONS OBSERVED DURING SEISMIC GAP DRAIN OPERATION.dwg LAYOUT: 5 SAVED: 6/15/2011 4:46 PM ACADVER: 17.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS(SIZE A-B).CTB PLOTTED: 6/16/2011 2:53 PM BY: SHARPE, CHRISTOPHER
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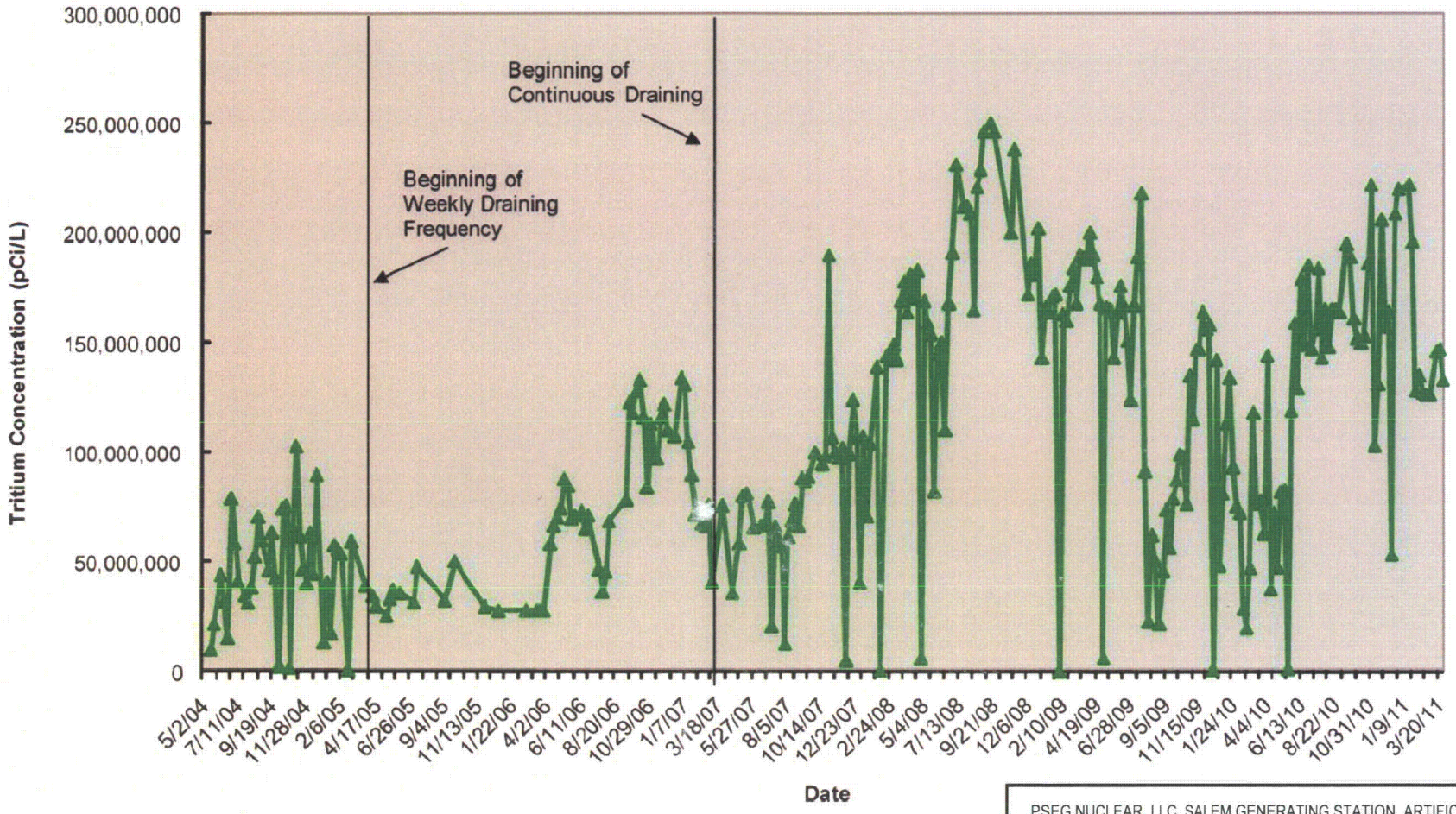
PSEG Nuclear, LLC Salem Generating Station - Unit 1
Concentrations of Tritium in Water Recovered Through Seismic Gap Drain Operation



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HISTORIC TRITIUMCONCENTRATIONS OBSERVED DURING SEISMIC GAP DRAIN OPERATION

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FIGURE
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