

**Preliminary Listing of Events Involving Tritium Leaks  
March 28, 2006**

The following presents a preliminary listing of events that have involved tritium leaks and spills at nuclear power reactor sites. This information is being compiled as part of several issues being addressed by the NRC's Liquid Radioactive Release Lessons-Learned Task Force. Specifically, the Task Force will conduct a review of inadvertent releases (from 1996 to present) of radioactive liquid to the environment, obtain additional information from each reactor site to complete its evaluation, and prepare recommendations focusing on specific improvements regarding operational practices and the NRC reactor inspection program. The information will be included in a report expected to be released in September 2006. Accordingly, the information presented at this time is preliminary and will be subject to revision as new or supplemental information is obtained by the Task Force.

To put all of these leaks into some perspective, all operating commercial nuclear power plants release tritiated water. That is part of their licensing basis. Typical releases are on the order of hundreds of curies per year, although they can be in thousands of curies per year and still meet strict regulatory requirements.

The EPA regulatory limit for tritium in drinking water is 20,000 picocuries (a millionth of a millionth of a curie) per liter. If a person drinks 2 liters per day of such water every day for a year, the person would receive about 4 mrem of radiation dose. That is about the same dose as would be received from eating a banana a day or flying from Washington to Los Angeles or spending 100 hours in the Capitol.

**1. NRC Region I Plants**

**Haddam Neck, CT**

In October 2005, the Haddam Neck plant identified soil contamination near an exterior spent fuel pool wall. The plant ceased operations about ten years ago and is being dismantled under an approved decommissioning and license termination plan. Trace indications on the wall indicated potential previous pool leakage. The soil may have been contaminated by a past spent fuel pool leak or leakage from radioactive water storage tanks which was previously identified and corrected by the licensee. As of June 2005, tritium levels have ranged from about 300 to 4,000 picocuries per liter as a result of ongoing remediation activities. Earlier results, have revealed concentrations on the order of 30,000 picocuries per liter onsite. The licensee is also evaluating ground water samples for the presence of other radionuclides, such as strontium 90. No offsite public dose impacts have been identified. The licensee is continuing to evaluate and characterize the extent of onsite contamination as part of demolition and remediation activities.

**Indian Point - 2, NY**

In September 2005, the utility discovered a small amount of water leaking from the spent fuel pool and the subsequent discovery of subsurface ground water contamination in a monitoring well located on site within the transformer yard. Tritium concentrations were noted to range from about 500,000 picocuries per liter of water in the immediate vicinity of the leak, to about

30,000 picocuries per liter near the discharge canal, and about 1,000 picocuries per liter near the outfall of the discharge canal. A bounding calculation estimated that the release of radioactivity from ground water into the nearby Hudson River would result in a dose of 0.0001 mrem per year to the maximally exposed individual based on a leak rate of less than 3.0 gallons per day out of the spent fuel pool. The resulting dose was found to well below the NRC-required dose limit of 3 mrem per year specified in NRC regulations and by plant technical specifications. NRC is pursuing independent sampling and analysis of well samples which have been sampled by the licensee. The NRC issued a report presenting the results of its inspections and findings on March 16, 2006.

### **Salem - 1, NJ**

In 2003, the licensee identified tritium adjacent to the Salem Unit 1 spent fuel pool within the restricted area. Specifically, water leaked from the Unit 1 spent fuel pool for an undetermined period of time through December 2002 and accumulated between the spent fuel pool liner and fuel building wall. The water subsequently leaked through the building walls presenting the potential for undetected releases of contaminated water. The highest level of tritium in ground water was estimated at about 3.5 million picocuries per liter at the test location. This event was the subject of an NRC special inspection conducted in August 2003. The State of New Jersey was notified under NRC regulations. To date, there is no evidence that tritium contaminated ground water has been released into the public domain beyond the site boundary. The licensee installed a number of monitoring wells and is pumping out contaminated ground water for processing as radioactive waste. The NRC is monitoring the licensee's activities. In addition, the State of New Jersey has been involved in sampling and monitoring of the site wells.

### **Seabrook, NH**

Seabrook has experienced some leakage out of the fuel transfer canal and fuel cask handling area since 1999. From 1999 to mid 2002, the leak rate ranged from 0.01 to 1 gallon per day. In mid 2002 to April 2004, the leak rate increased to approximately 30 to 40 gallons per day. During the period of April 16 to 19, 2004, in an effort to specifically determine the location of the leak, the leak rate increased to approximately 350 gallons per day. Following the discovery of this increase, the plant drained the fuel transfer canal, stopping the leakage. Subsequently, Seabrook conducted several inspections of the fuel transfer canal and cask handling areas and identified a crack, approximately 2 foot by 1/8 inch, in a weld between a support steel plate and canal liner. This was identified as the source of the leak. An NRC environmental inspection, conducted in December 2005, found the fuel transfer canal repairs were effective. The leak rate was found to have stabilized at approximately 0.02 gallon per day.

The licensee installed several ground water monitoring wells in June 2004 to determine tritium migration at the site. The licensee has since monitored the various onsite wells to evaluate the movement of tritium into the environment. Tritium levels measured outside of the buildings where leaks were noted were found to remain well within NRC regulatory limits and within the EPA drinking water limit of 20,000 picocuries per liter. Onsite monitoring wells showed tritium levels near non-detectable levels, indicating that tritium levels were associated with the old leakage. In addition, no tritium was detected in other environmental samples and no other

related radionuclides were detected in similar environmental samples. For 2004, the maximum dose to a hypothetical individual was estimated to be about 0.03 mrem from all exposure pathways. This dose is below the NRC As Low as is Reasonably Achievable (ALARA) objective of maintaining the dose below 3 mrem per year, specified in Appendix I to 10 CFR Part 50. This is also well below the NRC's 100 mrem per year radiation safety limit in 10 CFR Part 20.

## **Oyster Creek, NJ**

The radioactive condensate liquid system, cross-connected to a cooling water system, resulted in the discharge of about 130,000 gallons of radioactive liquid to the discharge canal and then to Barnegat Bay in September 1996. The total radioactivity release was estimated to be about 7.5 curies and consisted mostly of tritium.

## **2. NRC Region II Plants**

### **Watts Bar, TN**

In August 2002, low levels of tritium (less than 1,000 picocuries per liter) were detected in one onsite well. The well is sampled as part of the routine radiological environmental monitoring program. Additional sampling conducted in 2003, revealed the presence of tritium in three other wells, at levels up to 20,000 picocuries per liter. Historically, concentrations of tritium have been about 5,000 picocuries per liter, but in January 2005, there was a sudden increase to about 500,000 picocuries per liter. Several potential sources of leakage were identified, including liquid effluent lines, fuel transfer canal and tube, refueling water storage tank, spent fuel pool, and the spent fuel cask loading pit. In addition, numerous liquid process system tanks were inspected for evidence of leakage. The licensee has taken actions to reduce or eliminate the identified sources of leakage into ground water. In addition, the licensee is continuing to monitor levels of tritium in ground water to assess the movement and extent of ground water contamination. The NRC has scheduled an inspection during which these issues will be reviewed and evaluated.

## **3. NRC Region III Plants**

### **Braidwood, IL**

On November 30, 2005, the licensee informed the NRC Resident Inspectors of higher than expected tritium levels (about 60,000 picocuries per liter) measured in onsite monitoring wells at the northern edge of the owner controlled area. More recent sampling and analysis revealed tritium levels on the order of several hundred thousands of picocuries per liter in ground water and, recently, similar levels in water spilled in an area where contaminated water is being stored in tanks. The licensee attributed the higher levels of tritium to historical vacuum breaker valve leakage in the circulating water blowdown line to the Kankakee River that occurred in 1998 and 2000. The licensee uses the blowdown line to conduct liquid effluent releases to the river.

Recently, the licensee has detected measurable levels of tritium in offsite ground water. Elevated levels were detected in one offsite monitoring well in a vacant development (on the

order of 30,000 picocuries per liter). One nearby residential well was found to have detectable tritium (about 1,500 picocuries per liter). The licensee is continuing to sample and to develop plans for remediation. The licensee has issued a report identifying the cause of the spills and is working with the NRC on expanding its surface and ground water sampling and analysis program. NRC is also pursuing independent sampling and analysis of well. The NRC is expected to issue a report outlining the results of its inspections and findings in the near future.

### **Byron, IL**

As a result of the issue identified at Braidwood and subsequent NRC inspections, at Byron the licensee initiated a sampling and analysis program along its discharge line to the Rock River. All valve pits have been inspected, and 5 of the 6 pits were identified to have some standing water and levels of tritium. The levels ranged from just above detectable to about 80,000 picocuries per liter. The licensee suspended all radioactive liquid effluent releases. Additional well installations were planned in February 2006. Two residential wells have been sampled, both have shown negative results. The licensee is pursuing sampling and analysis of an additional nine residential wells. The NRC plans to accompany the licensee during their residential sampling and offer independent NRC sampling and analysis. NRC will also pursue independent sampling and analysis of the two wells which have been sampled by the licensee.

### **Callaway, MO**

A January 2005 pipe break, due to onsite construction activities, resulted in the contamination of soil and ground water. All effluent discharges were suspended until the pipe was fixed, soil and water samples were taken and evaluations were made. The pipe break was located beyond where the radiation monitor is situated on the discharge pipe. As a result, the release was monitored at all times during the discharge and, consequently, the radioactive material and associated dose were accounted for in the permit allowing the release. The licensee has included the location around the pipe break for follow up sampling and analysis as part of its radiological environmental monitoring program.

### **Dresden, IL**

In August of 2004, the licensee identified an underground leak of its condensate storage tank (CST) piping. The licensee detected levels of tritium in onsite ground water monitoring wells as high as 1,700,000 picocuries per liter, with current levels about 600,000 picocuries per liter. Onsite tritium levels in the two closest wells have stabilized at about 20,000 to 50,000 picocuries per liter. The licensee isolated the leakage and replaced the faulty section of piping in November 2004. Onsite monitoring well data confirm that the flow of groundwater is generally away from residential areas and towards the river. In 2004 and 2005, the licensee sampled the private wells of nearby residents. One of the residents' wells had measurable levels of tritium above background (approximately 1,000 picocuries per liter) and has shown positive results for tritium for a number of years. However, the licensee's other monitoring results and an independent hydrology study do not appear to support that the elevated levels of tritium in that well were from the 2004 CST pipe leakage. The licensee continues to evaluate the tritium in that well, which is a normal sample point for its radiological environmental monitoring program. The NRC is following up on the licensee's actions.

#### **4. NRC Region IV Plants**

##### **Palo Verde, AZ**

The licensee has reported that tritium has been detected at the Palo Verde site. The licensee dug a hole about 13 feet deep near the Unit 3 tunnel where the spray pond piping penetrates the vault, in response to water found inside the pipe tunnel. The licensee took three samples of water and tested them for tritium. The licensee's testing found tritium in all three samples; at 75,000, 30,000, and 70,000 picocuries per liter. At this time, the licensee has identified three potential sources for the tritium, including a holdup tank, nearby system piping, and from plant stack discharges that were washed into the ground during rainfall. NRC's Region IV inspectors are evaluating the licensee's effort in tracing the origin of the leak and in quantifying the amounts of tritium and its movement in ground water.