#6

Evaluation for Use of the Interim Remedial Action Pumping System At Braidwood Station

HH-1

EVALUATION OF THE INTERIM REMEDIAL ACTION PUMPING SYSTEM

Introduction

In 1998 and 2000, leaks from Vacuum Breakers #3 (0CW060) and #2 (0CW136), respectively, on the Lake Blowdown line (0CW09C48) going to the Kankakee River resulted in water contaminated with radioactive tritium being released into the surrounding area. Over time, the tritium entered the groundwater and due to the flow of the groundwater, the contamination has continued to spread. To remediate this problem, Exelon in conjunction with government agencies, has developed a plan to reduce the tritium concentration in the groundwater. The remediation plan involves lowering the level in a local pond (referred to as the Exelon Pond) in turn draw the surrounding groundwater into the pond. The pond water level will be lowered via a temporary pumping system that discharges into the Blowdown line where it will be diluted with lake water and discharged into the Kankakee River.

To accomplish this plan, the new pumping system must be installed, physical alterations must be performed on the Blowdown line and the operation of the plan must be procedurally controlled. All of these actions must be implemented while conforming to all Station design bases, licensing requirements, State permits and regulations and any new requirements imposed because of the spills and their remediation.

This EC (361017) evaluates the acceptability of discharging tritiated water from the Exelon pond, using the Interim Remedial Action Pumping System (IRAPS), pumping the tritiated water into the Circulating Water System Blowdown Line (CW BD) and discharging it to the Kankakee River. The EC provides a description of new and existing components, revisions to existing systems and components and their operation and control. Additionally, the EC provides the basis and the methods that will be employed to ensure the plan is acceptable with regards to licensing and regulatory requirements.

To accomplish this evaluation, numerous documents were reviewed and used as inputs for this EC and are referenced, as appropriate.

Open items requiring completion prior to the pumping of the pond are included in Reference 3.

EC 361017
Revision 000
EVALUATION OF THE INTERIM REMEDIAL ACTION PUMPING SYSTEM

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Executive Summary

EC 361017 has evaluated all areas of concern (as listed in the Table of Contents above) relative to implementation of the Interim Remedial Action Pumping System (IRAPS) for transferring water from the Exelon pond to the Kankakee River via the Circulating Water System Blowdown Line (CW BD).

EC 361017 finds all areas reviewed to be acceptable and transfer of water from the Exelon pond to the Kankakee River may commence upon completion of pre-operation actions included in Reference 3 and receipt of approval from the State of Illinois.

Effect on Groundwater

Geological discussion

From Reference 1:

A comprehensive groundwater investigation program was conducted by Conestoga-Rovers & Associates (CRA) at Braidwood Station in 2005 and early 2006.

As a result of that investigation, an area was identified where tritium has been detected above the 35 IAC 620 (Illinois Administrative Code) groundwater standard (20,000 picocuries per liter (pCi/L)). This area, approximately 4.5 acres in size, is located near Smiley Road, at the southeast corner of a pond owned by Exelon and just west of the Circulating Water Blowdown Line (CW BD).

Data indicate that tritium at concentrations above the lower detection capability (approximately 200 pCi/L) has migrated into the Exelon pond, north of Smiley Road and, to a limited extent, past the pond. Maps included in the attached Interim Remedial Action Plan (IRAP) illustrate the location of the tritium plume in the groundwater.

Remediation philosophy

From Reference 1:

The Interim Remediation Action Plan (IRAP) has been developed to retard the movement of the tritium plume in the groundwater and reduce the tritium that has migrated downgradient of the Exelon pond.

Per the evaluation performed in Reference 1, the removal of tritium in the groundwater will be achieved by pumping water from the Exelon pond to lower the level in the pond and create a 'cone-of-depression' in the water table. Lowering of the pond will reverse groundwater flow north of the Exelon pond and mitigate the concentrations of tritium over time. This will allow for the removal of tritium within the main plume area to prevent further tritium migration beyond the vicinity of the Exelon pond.

The IRAP involves the placement of a pump in the Exelon pond to transfer water from the pond into the Braidwood Station Blowdown Line. The pond water will be pumped via a forcemain (i.e., a discharge pipe to be installed from the pond to a connection point on the blowdown line).

During the start-up of the system, the tritium concentration in the pumped water will be closely monitored and correlated with the flow rate. This will be done to ensure the tritium entering the blowdown line will form a composite concentration in the blowdown line of less than 200 pCi/L.

Local temporary wells will also be closely monitored during the start-up phase to ensure that lowering of the pond will not overdraw nearby shallow private wells. The IRAP pumping system is a temporary installation. The expected duration of the operation is approximately two years. Pumping may not be continuous, once a steady state pond level is achieved (i.e. pond level is controlled within a specified range).

The duration of the proposed interim remediation operation will be based on a review of the operating conditions at the impacted area and the effectiveness of the remedial action over time. This review will consider how the proposed pond pumping system could be modified to shorten the cleanup time and to increase tritium recovery. (Reference 3, #1)

Effects on neighboring residents

The influence on private wells of neighboring residents has been predicted by CRA and is documented in Reference 15 and 16.

The predicted drawdown, or drop in the level of the water table, at locations where private wells exist and are being used is shown on CRA drawing Reference 16. These drawdown values are based upon preliminary modeling performed to assist in the design of the pumping system. The estimated drawdown ranges are from 5.5 feet near the pond to 3.2 feet at locations farther north of the pond. This drawdown amount is valid only for the shallow sand aquifer and would not be experienced in the deeper bedrock private wells, which are installed at depths of 60 ft to over 600 ft, and are in different geological formations.

The predicted drawdown for the pond (7 ft) and the predicted drawdown in areas of the shallow private wells (3 to 5 ft) are based upon conservative modeling assumptions and simplified input parameters. As such, the drawdown required in the pond (and therefore the drawdown measured in the capture zone in the groundwater) will likely be less than predicted.

Planned monitoring of pond and groundwater levels at the start up of pumping will better establish the actual degree of drawdown or drop in the water table aquifer (Reference 3, #2). Areas located out of the predicted capture zone, or approximately 1200 feet from the pond, would not be affected by the pumping according to the preliminary modeling evaluations.

It is not possible to predict, at this time, the specific affects on the shallow private wells because of unknown conditions such as:

- pumping level in the private wells
- average yield of the private wells
- average pumping rate of the private wells
- history of seasonal water table fluctuations around the pond.

Consequently, it is possible that the performance of some of the private wells may be affected by pond pumping. During the pumping operations, Exelon and CRA will monitor water levels in groundwater sampling wells and private wells and take actions to adjust pumping rates and/or provide water for any residential wells that may be affected. (Reference 3, #2)

Audible noise impact to neighbors from the pumping site was considered and determined to be negligible, since the IRAPS pump/motor is submersible and will be below the surface of the pond, reducing noise from the pump/motor.

Communications with neighboring residents

The communications plan for the interim remediation project consists of direct communication with the most affected stakeholders, outreach to local and county officials, media outreach and an information night to inform the general public.

Door-to-door communications were made with the most affected stakeholders on March 29, 2006. This included residents whose groundwater is affected along with those who live in the vicinity of the plume or within 1000 feet of the blowdown line. These residents received an information packet that included a letter from the Braidwood Station Site Vice President and a copy of the news release that explained the interim remediation plan. They also received an invitation to the April 6, 2006 information night, and a page with frequently asked questions.

Also on March 29, 2006, a news release was issued to inform the general public. Additionally, local and county officials were contacted by telephone and faxed pertinent information.

The news release and frequently asked questions documents were loaded onto the Braidwood Station tritium communications website (www.braidwoodtritium.info) and the information was included in a previously established hardcopy repository of tritium project documents at the Fossil Ridge Library in Braidwood, IL.

The information night event held on April 6, 2006 was intended to educate the public on the planned remediation efforts and to allow those interested to engage in one-on-one conversations with Exelon, State and NRC representatives. Prior to beginning the pumping, the remediation team will communicate with neighbors whose wells may potentially be affected to describe the monitoring process and contingency plans for any effect on private well performance. (Reference 3, #3)

Exelon Pond

General description

The Exelon owned pond at issue, is located north and east of the Smiley Road and Center Street intersection. This pond is generally square in shape, with the approximate dimensions of 1100 feet by 1150 feet and an average depth of 16 feet. Pond level is measured using a manual level reading gauge in the southeast corner of the pond. (Reference 2)

Tritium Concentration

Tritium concentration in the pond is currently 2425 pCi/L based upon the average of sampling performed during the 2006 (Reference 29). However, the concentration level will be assumed to be 3577 pCi/L (Reference 14). This value was chosen for use in the procedural flow rate calculation, with the expectation that the concentration in the pond would remain below this value. Weekly chemistry sampling will verify that this number is not challenged (Reference 3, #11). See 'Tritium Concentration in Blowdown Line' below for further details.

Effect on pond fish

Tritium transport occurs rapidly through water and is distributed in biological tissue as tritiated water in aquatic vegetation, fish and other animals.

The pond contains several varieties of fish including large mouth bass, crappie, blue gill, catfish and grass carp (white amur). Estimated sizes for the bass are in the 6 to 10 pound range and the grass carp could weigh as much as 40 pounds.

The Illinois Department of Natural Resources (IDNR) and Exelon's Environmental Department have determined the following:

1. While the pond is expected to be pumped down an estimated 7 feet, leaving an approximate pond depth of 9 feet, moving the fish is expected to be more harmful than leaving them in the pond,
2. With IRAPS in operation, the pond will be monitored twice per week by conducting shoreline walk-downs to look for signs of stressed fish. A log of the shoreline inspections will be maintained including the person who conducted the inspection, time of day and general observations. The twice per week inspections will be conducted by Joe Tidmore, Site Environmental Analyst (or designee). John Petro, Cantera Environmental will provide periodic inspections to support site staff. (Reference 3, #15)

3. A contingency plan to move the fish from the pond will be established. A fish sampling effort is planned to collect representative species of fish. Collected fish will follow standard IDNR and/or IDPH contaminant sampling protocol and will be sent to a lab for tritium analysis. Completion of any such sampling, or the results, is not required prior to pumping of the pond. (Reference 3, #4)

The Exelon environmental department has reviewed reportability requirements in the unlikely event of a fish die off in the Exelon pond. The review determined such an event would not be reportable because the pond is not covered by any NPDES Permit nor is it impacted by power plant operations governed by the NPDES Permit.

Pond level limits

The pump will be operated at a sufficient flow rate to drop the pond level by approximately 7 feet. The actual level that will be maintained by the pump will be dependent upon the groundwater level responses in monitoring wells surrounding the pond to ensure that private shallow wells in the area are not lowered to a level that may limit water intake.
(Reference 1 and 20)

Although preliminary modeling was performed to develop the initial design criteria, the system will be closely monitored and modified during the start-up phase. That is, the steady state pond level and the pump flow rate can and will be varied depending on groundwater response, if design conditions change. (Reference 1)

CRA will provide the aforementioned monitoring and advise Exelon of any recommended changes to monitoring or pumping operation.
(Reference 3, # 2)

Additionally, Exelon will review this EC evaluation in approximately two years to determine if any additional testing or re-testing is required to ensure the continued validity of this evaluation. (Reference 3, #16)

Interim Remedial Action Pumping System

Flow path

The IRAPS is designed to transfer water from the Exelon Pond into the Circulating Water System Blowdown Line (CW BD) through a connection in the Vacuum Breaker #2 (0CW136) vault. Once injected into the Blowdown Line (0CW09C48), the pond water will be diluted with the blowdown water from the Braidwood Cooling Lake and ultimately discharged to the Kankakee River.

Basic description of the IRAPS

The IRAPS pump is attached to an 8-inch flexible hose that flanges under the water level to an 8-inch carbon steel line resting on the sloped walls of the pond.

The 8-inch carbon steel line rises above the surface of the pond to a 20-foot horizontal run of above ground piping. This 20-foot section of piping includes the locally mounted instrumentation and valves required to operate the system.

Instrumentation and valves include a 1-inch vent line, pressure indicator, flow meter, including flow totalizer, 2-inch line for sample compositor feed, an 8-inch wafer check valve, and an 8-inch globe valve. All instrumentation and controls will physically be located near the point where the IRAPS pump discharge exits the pond surface. The above ground piping and instruments are heat traced to prevent freezing. (Reference 2)

The 8-inch carbon steel line then is flanged to a 10 inch High Density Polyethylene (HDPE) line. This HDPE line, SDR 11 rated for 160 psig, is routed underground, approximately 4 feet below the surface for freeze protection, and enters the Vacuum Breaker # 2 vault through a penetration in the side of the vault. (Reference 2)

Within the vault, the 10-inch HDPE is connected, via an 8-inch reducing flange, to the 8-inch piping/valve segment that replaces Vacuum Breaker # 2 per EC 360234 (Reference 9).

HDPE pipe sections are 'heat fusion welded' together. When fusion pressure is applied at the designated temperature and prescribed force, with special fusion welding equipment, the molecules from each pipe surface end mix. As the joint cools, the molecules return to their crystalline form, the original interfaces have been removed, and the two pipes have become one continuous length. The result is a fusion joint that is as strong, or stronger, than the pipe itself, creating a leak-free joint.

There are no underground mechanical connections within the HDPE piping.

The IRAPS pump, Gorman-Rupp S Series, Model S8A, has a shut off head of 75 psig (Reference 2, EF-01) which is below the design pressures of the HDPE and the CW BD of 160 psig and 110 psig, respectively. This pump is capable of 1000 gpm, however, flow will be throttled (minimum flow greater than 400 gpm), based upon the dilution calculation that will be included in the new Operating Procedure BwOP CW-28, Rev 0, 'Operation of the Exelon Pond Pump' (Reference 5) described further in this document.

Startup Testing

Upon completion of IRAPS piping construction, before connecting to the IRAPS pump and CW BD and prior to any pumping operation, hydrostatic testing of the new piping will verify its integrity at a pressure of 150 psig, twice the shut-off head pressure of the pump.

In addition to hydrostatic pressure testing, standard construction testing, electrical 'dead circuit' testing and instrument calibrations will also be performed.

Exelon will direct testing conducted by the piping contractor. Exelon engineers will conduct an integrated control and interlock test to verify that the controls, interlocks, and alarms function as designed. The test will be documented in Work Order 00907166. (Reference 3, #5)

Procedural control of the IRAPS

Initial startup operation of the IRAPS will be performed by Braidwood Station Operating Procedure, BwOP CW-28.

BwOP CW-28 will incorporate the following topics:

1. Verification of the valve lineup.
2. Calculation of IRAPS pump flow rate, based upon current tritium sample results (Reference 10).
3. Starting of the IRAPS pump and throttling flow to the calculated dilution flow rate.
4. Direction to shutdown IRAPS pump <u>immediately</u>, after being notified of leak detection in <u>any</u> of the CW Blowdown Line vacuum breaker vaults by means of the remote monitoring system. See Section 'Remote Monitoring of Vacuum Breaker Integrity' below for further detail.

BwOP CW-28 will provide direction for continued operation of the IRAPS, including limitations of pump flow, based upon evaluations of tritium concentrations in the pond. The procedure contains a table (see Attachment A of this EC) that will be used to determine maximum IRAP pump flow to keep tritium concentration in the Blowdown line below 200 pCi/L. (Reference 3, #6)

IRAPS Interface with other Procedures

SPP 06-003, 'CW BD Flow Throttled at Discharge Structure Test' (Reference 4) determined the amount of throttling required at 0CW150 (Reference 13, EC 360114) and the achievable CW BD flow at which all installed CW BD

Vacuum Breakers are fully seated. Completion of this test is tracked by Reference 3, #23. The CW BD flow at this pressure will be incorporated into a procedure revision to BwOP CW-12, 'Circulating Water Blowdown System Fill, Startup, Operation and Shutdown'. (Reference 6)

Furthermore, BwOP CW-12, 'Circulating Water Blowdown System Fill, Startup, Operation and Shutdown' will contain a cross reference to BwOP CW-28 and will require shutdown of the IRAP pump prior to any planned CW BD flow changes or after any transient that causes changes in CW BD flow. (Reference 3, #7)

Operator Rounds will be revised to include daily checks of the IRAP pumping system. (Reference 3, #8)

Basic description of IRAPS controls

From Reference 2 (CRA Drawing E-02):

IRAPS has a Hand/Off/Auto switch mounted in the panel board, which is the main control of the pump. When in the Hand mode, the pump will remain in operation until it is placed in the Off mode or it is turned off by the internet-based remote shutoff.

When the position switch is in the Off mode, the pump cannot be turned on remotely.

A level sensor, mounted in the pond, is functional when the switch is placed in the Auto mode. This level sensor sends a signal to the pump controller, turning the pump on or off based upon the 4 to 20ma control signal.

The pump controls also send high and low level alarm signals to the remote monitoring device. That allows an operator to determine whether the pond is within the expected level at any time. The pond level alarms are monitored by a website providing notification to the operators, through a telephone call, if the pond level is high or low.

If the pump is in any mode other than Off, the remote monitoring device has the ability to Trip and Restart the pump, at any time.

The main operating panel is equipped with a main disconnect switch and transformer disconnect. The transformer powers the breaker panel that powers the internal outlets, the pump controller and the remote monitoring device.

Power for the IRAPS is supplied from the Commonwealth Edison off-site power, not an on-site Braidwood Station power supply.

Maintenance of IRAPS

Maintenance of the IRAPS will be performed by Exelon maintenance personnel. Preventive maintenance tasks as appropriate will be developed and scheduled. This action will be completed following startup of the system. (Reference 3, #14)

Operator Training for IRAPS

All Operations crews are required to attend classroom training on operation of the IRAPS.

Crews that currently have scheduled training after the IRAPS is to be operational are required to read and sign the required reading package prior to their operation of the system.

This reading package covers the purpose of the IRAPS, how to control it and proper response if an alarm is received from the system.

All Operations crews are currently scheduled to have classroom training on the IRAPS by the end of Operation training cycle 06-3 (Cycle ends 6/23/06).

There will be no additional training with regards to the leak detection system (remote monitoring of vacuum breaker integrity) since the required training package describes adequately the tasks associated with responding to an alarm.

Connection to Circulating Water System Blowdown Line

Existing vacuum breaker configuration

CW Blowdown Line, 0CW09C48, has eleven air/vacuum valves strategically placed along the length of the Blowdown line. (References 19 and 22).

These valves, referred to as vacuum breakers in this discussion, act to introduce air into the line under conditions where a section, or sections, of the pipe are no longer water solid, thus helping prevent a vacuum condition, or to release air from the line when filling the system or during operation.

Referred to as a 'vacuum breaker', the device is actually a combination of an air/vacuum valve and an air release valve, both mounted on top of a surge check valve.

As described in APCO Valve and Primer Corporation information, the vacuum breaker vendor, the air/vacuum valve operates to allow air to escape freely at any velocity (maximum discharge velocity is approximately 300 feet per second at 6.7 PSI)

The surge check valve operates on the interphase between the kinetic energy in the relative velocity flows of air and water. This surge check is a normally open valve, spring loaded, so that air passes through unrestricted. When water rushes into the surge check unit, the disc begins to close against the spring tension and reduces the rate of water flow into the air valve by means of throttling holes in the disc.

This action ensures normal gentle closing of the Air/Vacuum Valve regardless of the initial velocity flows involved and minimizes pressure surges when the valve closes.

As soon as the air/vacuum valve is closed, the pressure on both sides of the surge valve disc equalizes and the disc automatically returns to its open position. This means the air/vacuum valve does not need an incipient vacuum to open, but can open at any time the water level drops and line pressure approaches atmospheric and immediately have full re-entry flow of air into the pipeline before a vacuum can form.

The slow closing feature protects the air/vacuum valve itself and at the same time prevents the air/vacuum valve from creating a surge in the pipeline by slamming shut.

Removal of Vacuum Breaker # 2 (0CW136) and surge check valve internals

Vacuum Breaker # 2, 0CW136, will be removed from the CW System Blowdown Line. Removal of the vacuum breaker, under transient conditions, has been evaluated and found acceptable per Reference 18.

The surge check valve portion of 0CW136, Vacuum Breaker # 2, is not designed to pass the anticipated maximum IRAPS flow of 1000 gpm, according to the vendor (APCO Valve and Primer Corporation). With the internals removed, the surge check valve is effectively, an 8-inch pipe.

Since the surge check valve cannot be removed without disconnecting isolation valve, 0CW135, the internals of the check valve will need to be removed from the top of its body, after removal of the air/vacuum valve portion of 0CW136 (EC 360234, Reference 9).

Replacement piping/valve segment

The new piping/valve segment (per EC 360234, Reference 9) will consist of new 8 inch piping, fittings, two check valves and a support. This configuration was designed to be installed in place of Vacuum Breaker # 2 and attached to the Vacuum Breaker surge valve.

The 8 inch pipe and check valves are capable of passing 1000 gpm at flow velocities recommended to prevent pipe erosion. Per the check valve vendor (Crane), a minimum flow of 400 gpm is required. (Reference 28)

Piping and components shall conform to the requirements of Piping Design Table 100BB from Specification L-2739.

Any welding performed on site shall be performed in accordance with applicable Exelon procedures.

A support capable of supporting 500 lbs is required between the pipe and the new floor of the vault.

Piping configuration details and support location are provided in EC 360234. (Reference 9)

A hydrostatic test at 150 psig will be performed for the piping/valve segment.

Check valve flow orientation will be verified.

All components of this new piping/valve segment are designed for a working pressure greater than either the IRAPS or CW Blowdown Line.

The piping/valve segment will be connected to the Interim Remedial Action Pumping System by a 10 inch by 8 inch reducer.

EC 360112 provides an opening for the High Density Polyethylene (HDPE) pipe of the IRAPS to enter Vacuum Breaker # 2 vault. The vault will be appropriately sealed after the HDPE pipe entry into the vault is completed.

Effect of Interim Remedial Action Pumping System on the Blowdown Line and Lake Blowdown

Actions to Prevent Leakage from the CW BD Vacuum Breakers

The following actions are being taken to provide confidence that the vacuum breaker valves will not leak while executing the IRAP.

1. Each vacuum breaker valve was inspected prior to initially commencing the interim remediation operation, and in particular:
    - float integrity and seating surface components within each vacuum breaker valve were inspected to ensure the proper sealing of those components to prevent leakage.
    - replacement of any vacuum breaker release valves found faulty (Reference 31).
2. Plant Engineering performed a review to evaluate if vacuum breaker PMs require revision or addition due to the higher operating pressure when increased per SPP 06-003. It was concluded that the PM frequency for the vacuum breakers was adequate, and that the PM frequency for the air release valves would need to be updated for replacement every two years (Reference 32).

3. During the interim remediation pumping operation, the blowdown line will be operated 'pressurized' (pipe water solid) along the full length of the pipeline to ensure the vacuum breaker valves that are in service will remain seated (i.e., closed). 'Pressurization' will be accomplished by throttling a new 18 inch valve installed per EC 360114, "Add an Additional Valve to CW Blowdown Line 0CWC2CA18", at the end of the Blowdown line near the discharge point into the Kankakee River. (Reference 13)
4. SPP 06-003, 'CW BD Flow Throttled at Discharge Structure Test', will determine the amount of throttling required at 0CW150 and the achievable CW BD flow at the desired pipe pressure to fully seat the vacuum breakers. The CW BD flow at this pressure will be incorporated into a procedure revision to BwOP CW-12, 'Circulating Water Blowdown System Fill, Startup, Operation and Shutdown'. (Reference 3, #7)

Actions to Prevent Leakage from the Vacuum Breaker Enclosures

The vacuum breaker vaults will be modified to be watertight. Watertight manhole covers will be anchored to the concrete vault roof slab. A watertight gasket will be installed between the frame and the concrete roof slab to prevent water intrusion (W.O. 905126).

New concrete floors for the vaults are reinforced with welded wire fabric mesh and doweled into the manhole walls to prevent cracking and differential movement of the slab. A bentonite water-stop is installed at all joints and slab penetrations (floor slab to manhole wall, floor slab to drain pipe, floor slab to flange outlet) and a twelve inch wide strip of joint wrap has been applied around the vault wall at the wall to floor slab interface to preclude water movement into or out of the vault. The inside of the vaults were covered with suitable waterproof coatings installed per EC 360112 to contain any leakage within the vault. (Reference 12)

Remote Monitoring of Vacuum Breaker Integrity

Since all eleven vacuum breaker vaults were sealed, as described in the previous discussion, the source of any water within the vault will be from the CW BD and not from groundwater. A continuously monitored leakage detection system has been installed in all eleven of the vacuum breaker enclosures to promptly detect any such leakage.

This leakage detection system will consist of sensors placed at the bottom of the vacuum breaker enclosure that will be wired to a transmitting device installed next to the vacuum breaker. If a sensor detects water, its transmitter will send a signal via a cellular telephone network to Operators in the Braidwood Main Control Room. Upon receipt of notification from the system, operators will promptly take action, remotely or manually, to turn off the pump at the pond to secure the interim remediation operation. A simulated test determined that it would take approximately four minutes from water detection to remote pump shutdown (Reference 33).

The transmitting device is powered by a solar panel mounted outside of each vacuum breaker vault. A 6-day battery provides backup power and is charged by the solar panel.

Upon receipt of an alarm from the leak detection system, operators have two options.

1. connect via a web site (alarmagent.com) and remotely shut down the IRAPS pump at the pond, or
2. dispatch an equipment operator to turn off the pump at the pond to secure the interim remediation operation.

BwOP CW-28 will control operation of the remote leak detection system. Additionally, Operating will perform monthly verification that will ensure that the remote sensors and transmitters are functioning. The monthly check will verify power is available, the sensors are enabled and the transmitters are communicating with the website. (Reference 3, #25)

Local monitoring of Blowdown Line Integrity

On a weekly basis, the BD right-of-way will be inspected for signs of leaks. Personnel performing the inspection will notify the Braidwood Station Main Control Room (MCR) to secure the IRAPS pumping if signs of leakage are found. Specific details of the weekly inspection will be included in the operating surveillance procedure (Reference 3, #17).

Tritium concentration in Blowdown Line

Chemistry and Operations procedures include sampling and flow rate limitations to ensure that the composite concentration of tritiated water remains less than 200 pCi/l at all times. This limitation is governed by a table in BwOP CW-28, which lists maximum and minimum flow rates from the pond pump based on CW BD flow. See Attachment A. The maximum flow rates were determined by a dilution calculation using a Cooling Lake tritium concentration of 35 pCi/l, which was obtained via enhanced LLD (Lower Limit of Detection) analysis of the Cooling Lake water and an assumed maximum pond concentration of 3577 pCi/l. Weekly chemistry sampling of the pond will verify that the pond concentration remains below 80% of the assumed maximum concentration (2862 pCi/l). See Section 'Chemistry Procedure changes'.

Pond concentration was conservatively estimated based on tritium content in the groundwater plume being completely transferred into the pond volume. (Reference 14)

Note: This concentration limit is intended to apply to the IRAP as approved by various state agencies as documented in the "Agreed Preliminary Injunction Order," (Reference 26). This limit is not intended as regulatory commitment outside of the referenced Order.

Discharge from Station radioactive release tanks is administratively prohibited and controlled by maintaining Release Tank Discharge Header and Isolation Valves 0WX896 and 0WX353 out-of-service in the closed position.

The existing chemistry and radiation procedures provide monitoring of both NPDES and radiological releases at the River.

Blowdown Line Integrity

The CW BD is constructed of pre-stressed concrete 'Embedded Cylinder Pipe' (ECP) manufactured by Interpace Corporation, Design Class D with an internal design pressure of 110 psig. The CW BD is a 48-inch diameter, 4.5-mile long pipeline constructed of a reinforced concrete outer exterior, a carbon steel shell, and an inner concrete liner. The pipe is constructed in 20-foot segments. Pipe segments are joined with bell and spigot joints. There are approximately 1500 joints along the length of the pipe. The pipe is designed for operation at 75 psig, with a specified maximum pressure of 110 psig.

During IRAPS operation, the maximum pressure in the pipe will be approximately 35 psig at the low point. This is based on results from SPP 06-003 with approximately 10 psig at the line's high point and 35 psig at the line's low point near new throttle valve 0CW150 at the Kankakee River.

The pipe design has been evaluated for full internal vacuum and has been found acceptable (Reference 21). Based upon the discussion below on the testing and inspection of the piping, the substantial margin in the calculation and that it is unlikely that full vacuum can be achieved, the pipe in its present condition is acceptable for vacuum conditions. Per Reference 20, industry failures experienced for Prestressed Concrete Cylinder Pipe, such as the CW BD, have occurred due to:

- Mortar coating defects and damage
- Corrosive soils
- Inappropriate design
- Hydrogen embrittlement of reinforcement from cathodic protection practices
- Poor joint protection

- Overpressurization from transients
- Steel liner welding defects
- Improper bedding and backfilling

Today, after 25 years of service, the blowdown line is potentially susceptible to only some of these failure mechanisms.

For example, if the design of the pipe were inappropriate or the pipe had been bedded or backfilled improperly, a settlement failure would have previously manifested itself.

The Station procedurally controls changes in blowdown flow that could cause overpressurization transients and a recently performed hydraulic analysis (Reference 18) determined that the existing vacuum breakers adequately protect the concrete line for all transients within the Plant's design basis.

Since November of 2005, Exelon has taken several measures to determine the present condition of the blowdown pipe. A series of over 20 wells were drilled along the pipe from Vacuum Breaker 1 to beyond Vacuum Breaker 3, approximately 3500' (M-900, Sheet 2, Rev G, Reference 19). Groundwater level and chemistry data from these wells indicate that the detected concentrations of tritium in groundwater are not the result of an ongoing release from the Blowdown Line.

From Reference 27:

In December 2005 and January 2006, Braidwood Station Engineering performed acoustic testing of the CW Blowdown Line in an attempt to verify the integrity of the line. The acoustic method was chosen after reviewing a number of options, including a constant pressure test, installation of sample wells adjacent to the line, an acoustical leak detection test, an internal visual inspection, an internal robotic crawler test, and an external thermography test. The acoustic test was chosen based on the perceived sensitivity, ability to identify leak location, and lack of impact on Station blowdown operations.

The testing technology (Sahara system) is a non-destructive acoustical testing process that is capable of identifying a leak as small as 0.25 gallons/hour in a high-pressure pipeline. Given that the Blowdown Line is operated at low pressures, the line was pressurized above its normal operating pressure for the test to maximize the capability of the equipment to detect leakage. The test pressure ranged from 20 psig to approximately 60 psig, depending on elevation of the piping. The test induced a leak at two locations to determine the sensitivity of the testing system. Due to physical limitations of the pipeline arrangement, the induced leak could only be located at a greater distance from the sensor than the location of any actual leaks (60 inches vs. 24 inches). Thus, the tested sensitivity underestimates the actual sensitivity. The calculated sensitivity of the test performed is conservatively one gpm at the normal operating pressure of the pipe.

The testing results indicated only one potential area of concern near the Blowdown Line discharge structure at the Kankakee River past the concrete-to-steel pipe transition. This area is not located near any of the known areas of elevated tritium concentrations and excavation of the area, including the transition joint revealed that there were no leaks in the pipe. Since no leaks were discovered, the area of concern was evaluated as a non-issue. The excavation afforded an opportunity to perform a visual examination of the exposed concrete pipe at the transition joint. The concrete pipe was in excellent condition with no signs of cracking or spalling. Since the piping was operated at elevated pressures, the test effectively proved the pipe's ability to withstand pressures up to 60 psig at the low points.

In conclusion, while the continued integrity of the blowdown pipe cannot be guaranteed indefinitely, recent testing and inspections provide reasonable assurance that any pipe leak is below detectable limits and, therefore, insignificant and that the pipe is capable of withstanding pressures above the expected pressure during interim remediation.

Further, during SPP 05-012, 'CW BD Piping Leak Test' (Reference 34) that supported the inspection, the CW BD was pressurized to 19 psig at approximately 10 feet above the pipe's high point. This pressurization provides additional confidence in the pipe integrity. Reference 3, # 22, tracks completion of test sign-offs.

Since the CW BD flow will be throttled, for pressurization of the line, the flow rate, and thus the velocity in the line, will be reduced. No flow velocity-induced erosion will occur, since the flow rate, even with the additional 1000 gpm from the IRAPS is less than the flow rate during normal CW BD operation.

IRAPS Pump to CW BD Integrity

The HDPE piping connecting the IRAPS to the piping/valve segment replacing Vacuum Breaker # 2 will be hydrostatically tested at 150 psig prior to burial, per the construction testing. (The piping was buried a minimum of four feet for freeze protection, thus eliminating the need for heat tracing). The HDPE pipe is rated for 160 psig (design pressure).

The span of approximately seven hundred feet of HDPE piping, from the pumping system to the connection at Vacuum Breaker # 2, will not be observed by a daily walkdown, since the piping is new with a recently conducted hydrostatic test. Because of the measures taken during design and installation, no near term inspections are necessary. Future inspections or testing will be evaluated (Reference 3, #16).

HDPE pipe is made from high-density polyethylene, which is known for its flexibility, toughness and chemical resistance. Since HDPE pressure pipe is fusion welded together, the weld is as strong as the original pipe; it becomes a monolithic or one piece pressure piping.

Refer also to section 'Basic description of the IRAPS' for a description of 'fusion welding'.

Vacuum Breaker surveillance

0BwOS CW-A1, 'Circulating Water System Blowdown and Makeup Vacuum Breaker Valve Inspection', an annual Operating Department inspection, was last performed on 11/11/2005 to verify the integrity of the CW BD vacuum breakers and their manual isolation valves.

ER-BR-400-101, 'Unit Common Circulating Water System Blowdown and Makeup Vacuum Breaker Valve Annual Inspection', is an annual Plant Engineering inspection. Between the Operating and Plant Engineering inspections, the vacuum breakers are inspected twice every year, six months apart.

Transient Effects on the Blowdown Line

A transient analysis (Reference 18) of the CW BD was commissioned to determine the acceptability of pumping, using the IRAPS, through the VB#2 location (removed as previously discussed), at up to 1000 gpm.

A variety of potential events were postulated to bound the challenges to BD pipe integrity. Without analysis, one of the events (a passive failure of the 0CW047A, isolation valve at the River, stem to disc joint) was known to challenge the integrity of the pipe. The decision was made to remove the valve internals, rather than analyze the event.

All analyzed events have the flow throttled at the discharge structure to produce a pressure of 10±5 psig at ten feet above the pipe centerline at the VB #5 location (high point of the Blowdown Line).

The events analyzed per Calculation BRW-06-0073-M, 'Hydraulic Transient Analysis of the Circulating Water Blowdown Pipeline' included:

1. A loss of switchyard (and therefore all CW and CW Blowdown Booster pumps) with a starting condition of 25,000 gpm blowdown flow and coastdown of the pumps.
2. Closure of one of the 0CW049 butterfly valves on the discharge of the Blowdown Booster pumps with **both** Units blowing down at 12,500 gpm each. This transient was run with four sensitivities: 0.1 second closure, 1.0 second closure, 5 second closure and 30 second closure. The latter (30 second closure) would simulate the spurious hot short loss of

1/2CW018, an expected potential event. The other three sensitivities were to cover the passive failure mode of loss of stem to disc joint on the 0CW049 valve: these were recognized to be beyond design basis (single passive failure), but known to occur in the industry, and specifically at Braidwood Circulating Water inlet valves and LaSalle blowdown valves.

3. Closure of one of the 0CW049 butterfly valves on the discharge of the Blowdown Booster pumps with a **single** Unit blowing down at 12,500 gpm (as in an outage situation). This transient was run with four sensitivities as Item 2 above.

The results demonstrated that, for blowdown with flow throttled at the River, all design basis events (Case 1, and the 30 second closure of the butterfly valve in Cases 2 and 3) were acceptable with 1000 gpm pumped through VB#2 (VB#2 Out of Service). Additionally, normal Blowdown flow with VB#2 removed and no flow from IRAPS was evaluated. All transient pressures were within the Blowdown Line design pressure of 110 psig.

For the more rapid closure of the butterfly valve (beyond-design-basis events), the blowdown line pressures up to VB#1 were beyond the concrete blowdown line design pressure. This postulated failure is upstream of the connection point for EC 360234 at Vacuum Breaker #2 and, therefore, would not release tritium contaminated water offsite (i.e., Vacuum Breaker #1 is within the Owner's controlled area of the Plant). Additional studies are recommended to address the optimal protection for this portion of the line, removal of some of the existing vacuum breakers, and restoration to unthrottled flow at the river. This issue is being processed through IR 483011, 'Hydraulic Analysis Reveals Blowdown Line Vulnerability'.

Failure Modes

IRAPS piping (HDPE) failure is improbable, as explained in section 'IRAPS Pump to CW BD Integrity' above.

Failure of a check valve, in the piping/check valve segment which replaced Vacuum Breaker # 2, is improbable since the valves are new and were tested prior to installation. However, should one check valve fail, the second check valve provides redundancy. In addition, there is a third check valve on the pump discharge at the pond. Therefore, backflow from the BD Line to the Exelon Pond is prevented.

Since the shutoff head of the IRAPS pump is less than the design pressure of the HDPE pipe, there is no concern of over pressurization.

Braidwood Station Cooling Lake Chemistry

Water chemistry of the Cooling Lake is controlled by the blowdown and make-up process by means of the Kankakee River.

Operation of the IRAPS may require a reduced lake blowdown flow rate from current values, due to measures taken to ensure the Blowdown Line is maintained 'water solid'. The effect of a potential reduction in lake blowdown flow due to increased blowdown line pressure using the newly installed throttling valve was evaluated.

The actual reduction in flow will be determined following completion of SPP-06-003; however, a potential reduction from 25,000 gpm to 20,000 gpm was chosen as a conservative estimate. Reduction to a value below 20,000 gpm is unlikely.

Based on the Braidwood Cooling Lake chemistry model, there will be no quantifiable effect on the risk of a precipitation event (precipitation of calcium carbonate that could affect heat exchanger performance), assuming that the current treatment protocol for the lake is maintained. Additionally, since lake chemistry is continuously monitored and changes slowly over time, mitigation strategies can be employed if lake chemistry is developing adverse trends. Such strategies could include reducing or stopping pond pumping until adverse trends are reversed. The chemistry model will be updated (Reference 3, #21) to reflect the reduced Blowdown flow rate. Also, as a potential long term solution, the ability of operating the Blowdown Line with all of the vacuum breakers isolated will be evaluated. Operation without the vacuum breakers would potentially eliminate the need to operate the line water solid and allow the operation at the nominal 25,000 gpm flow rate.

The potential blowdown flow reduction will potentially increase the hydraulic cycle on the lake from 1.76 to 1.95. This increase will require additional chemical treatment costs of $36,000 in the remainder of 2006, and additional costs of $80,000 in 2007 (Reference 30).

Monitoring of Kankakee River

Offsite Dose Calculation Manual (ODCM)

The following ODCM (Reference 7) changes will be made (Reference 3, #10):

- Sections 10.2.1.2 "Liquid Release" has been added to the liquid release section in Chapter 10 to define the flow path, monitoring, and controls for the Exelon Pond Remediation process.

- Section 10.2.3.1.2.2 "Release Limits" was added to describe the Administrative Limit (200 pCi/L) for the remediation.
- Figure 10.3 was changed to include the Exelon pond and the flow path into the CW BD.
- Table 12.3-1 to document the continuous monitoring, frequency (weekly, monthly, quarterly) and type of sampling (gamma, tritium, I-131 etc.)

Chemistry Procedure changes

New Chemistry Department procedures will be created for the IRAPS process (Reference 3, #11):

- BwCP 1003-14, 'Exelon Pond Weekly Discharge'.
- BwCP 1003-15, 'Exelon Pond Monthly Discharge'.
- BwCP 1003-16, 'Exelon Pond Quarterly Discharge'.

These new procedures describe the weekly, monthly, and quarterly composite and grab sample requirements, frequencies etc.

BwCP 1003-14 also includes steps for comparing weekly grab sample tritium concentrations from the Exelon Pond to the calculated maximum concentration that the Exelon Pond is expected to reach to ensure that we do not exceed the 200 pCi/L CW BD outfall limit.

The weekly, monthly and quarterly 0BwCSR 12.3.1.b.1-1, 0BwCSR 12.3.1.b.1-2, 0BwCSR 12.3.1.b.1-3, will be revised to ensure that the composite samples are pulled, tabulated and quantified. (Reference 3, #11)

An inline monitor is not required for the Exelon Pond remediation. This is based on environmental groundwater gamma isotropic analysis results from the plume characterization project of less than the lower limit of detection. That is, no gamma producing radionuclides were detected. Furthermore, gamma isotropic analysis will be performed for the Exelon Pond samples as required by the procedures listed above. (References 23, 24 and 25)

Effect on Wilmington Pumping Station

The CRA evaluation considered the effect of introducing tritium into the CW BD on the Kankakee River, particularly the effect on the Wilmington public water intake. Tritium releases to the Kankakee River are allowed in concentrations up to the limits specified in the Offsite Dose Calculation Manual (ODCM) i.e., 1E6 pCi/l. The concentration of tritium discharged to the Kankakee River under this interim remediation plan will be less than 200 pCi/l, well within limitations of the ODCM. Even without considering any further dilution from river flow, this concentration would not have any adverse effect on the Wilmington public water supply or any private wells close to the river. (Reference 15 and 16)

NPDES

The IRAP will utilize the existing NDPES permit allowing discharge of the water to the Kankakee River through the Blowdown Line, therefore eliminating the need for additional agency permitting. Verbal concurrence provided to Ken Ainger (Exelon Corporate Licensing Manager) has been obtained from the IEPA (Al Keller, EPA Permitting Section) supporting this position.

Braidwood Chemistry considers this discharge a sub-waste stream (the same as the Cooling Lake) of the Blowdown Line and therefore no specific reportable NPDES monitoring of the discharge would be required. The non-supervised monitoring per existing Procedure BwCP 323-18 at the outfall at the Kankakee River remains in effect.

Approvals for Exelon Pond discharge

Illinois Attorney General permission to implement the pumping plan has been received.

This approval was required from the parties involved in the Complaint filed March 6, 2006, against Exelon. These parties include Illinois Attorney General (representing Illinois Environmental Protection Agency) and the Will County State's Attorney. This approval is in the form of an "Agreed Preliminary Injunction Order," signed by Exelon and the parties involved in the complaint. (Reference 26)

Relevant portions of the Order follow:

12. To halt the further migration of the tritium plume emanating from vacuum breakers No. 2 and No. 3 into groundwater on and offsite, Exelon Generation has developed a plan titled, "Interim Remedial Action Plan," which is attached hereto as Exhibit A and incorporated by reference herein. Within twenty one (21) days of entry of this Preliminary Injunction Order, and receipt by Exelon of all necessary permits (if any), Exelon Generation shall initiate pumping of the Exelon pond in accordance with that plan.

14. As described in the Interim Remedial Action Plan, Exelon Generation will discharge the water pumped from the Exelon pond by means of the blowdown line. At all times when discharging such water through the blowdown line, Exelon Generation shall:

    a) conduct a weekly visual inspection, or alternative method of monitoring, of the pipeline corridor to check for signs of pipe failure and document its findings. This documentation shall be available for inspection by the Plaintiff;

b) install monitoring wells at the mid-point between vacuum breakers. Exelon Generation shall on a monthly basis sample these wells, and one existing down gradient shallow monitoring well located adjacent to each vacuum breaker, for tritium, chloride and sodium; and shall provide these results to the Illinois EPA on a quarterly basis;

c) maintain a continuous monitoring system in each vacuum breaker vault to warn Exelon Generation of any water discharges from the vacuum breakers. Exelon Generation shall immediately cease pumping water from the Exelon pond into the blowdown line if such discharge(s) are identified;

d) maintain the impermeable barriers it recently installed at the base of each vacuum breaker pit;

e) operate the blowdown line in a flooded condition; and

f) *take all other necessary steps to ensure that water from the* Exelon pond, and any other wastewaters, are not discharged at any point other than the permitted outfall to the Kankakee River.

In addition, the NRC has asked to review our plan for interim remediation, although no formal approval is required. A letter to the NRC, dated April 4, 2006, describes the plan. (Reference 17) Prior to beginning of pumping, the Tritium Team Project Manager will verify the NRC has no unresolved concerns with the plan (Reference 3, #12).

EC EVAL Preparation and Approval (Washington Group International)

Prepared by: ______________________ Date: ____________

John M Damron

Reviewed by: ______________________ Date: ____________

Bruce Acas

Approved by: ______________________ Date: ____________

Edmund Stukas

References

1. 'Interim Remedial Action Plan', Exelon Generation Company LLC - Conestoga-Rovers & Associates (CRA), dated March 2006
2. 'Interim Remedial Action Pumping System' Project 45065-01, Conestoga-Rovers & Associates, Drawings:
   - CS-01
   - EF-01, 'Engineering Flow Diagram Legend'
   - EF-01, ''Engineering Flow Sheet 1'
   - ST-01, 'Site Plan'
   - ST-02, 'Valve Station Pad'
   - ME-01, 'Piping @ Valve Station'
   - E-01, 'Electrical Panel'
   - E-02, 'Panel Schematic Wiring Diagram'
3. Action Tracking Item 448107, Action Items for Interim Remediation Action Plan, assigned to Exelon personnel.
4. SPP 06-003, 'CW BD Flow Throttled at Discharge Structure Test'
5. BwOP CW-28, Rev 0, 'Operation of the Exelon Pond Pump'
6. BwOP CW-12, 'Circulating Water Blowdown System Fill, Startup, Operation and Shutdown'.
7. Offsite Dose Calculation Manual, CY-BR-170-301
8. NPDES Permit IL0048321
9. EC 360234, Rev 0, 'Piping Connection at CW Blowdown Line Vacuum Breaker #2'
10. 'Interim Remedial Action Pumping System Dilution Calculation', Excel spreadsheet, Attachment A to EC 361017.
11. CRA drawings for vacuum breaker vault leak detection:
    - "Vacuum Breaker Valve Leak Detection Vault Installation Wiring Diagram", Figure 1
    - "Vacuum Breaker Valve Vault Installation Details", Figure 2
    - "Vacuum Breaker Valve Leak Detection System", Figure 6.3
12. EC 360112, 'Waterseal of Vacuum Breaker Vaults'

13. EC 360114, 'Add an Additional Valve to CW Blowdown Line 0CWC2CA-18"'
14. 'Tritium Concentration in Pond', e-mail from N. Smith/P. Harvey (CRA) to A. Haeger (Exelon) dated February 28, 2006.
15. 'Estimate of Groundwater Level Drawdown in the Shallow Sand Aquifer in the Vicinity of the Exelon Pond During Interim Remediation', Memorandum from P. Harvey (CRA) to A. Haeger (Exelon) dated April 4, 2006.
16. 'Simulated Groundwater Drawdown in the Shallow Sand Aquifer at Private Well Locations When Pumping from the Pond', CRA Drawing 45065-01(PRES001)GN-WA001, dated March 31, 2006.
17. 'Groundwater Tritium Interim Remediation', letter to US Nuclear Regulatory Commission from K. Polson (Exelon) dated April 4, 2006.
18. Calculation BRW-06-0073-M, 'Hydraulic Transient Analysis of the Circulating Water Blowdown Pipeline'.
19. M-900 series of Braidwood Station Piping and Instrument Drawings
    - Sheet 2, REV G, Outdoor Piping Arrangement Braidwood Station Units 1 & 2
    - Sheet 3, Rev C, Outdoor Piping Arrangement Braidwood Station Units 1 & 2
    - Sheet 4, Rev B, Outdoor Piping Arrangement Braidwood Station Units 1 & 2
    - Sheet 5, Rev B, Outdoor Piping Arrangement Braidwood Station Units 1 & 2
    - Sheet 6, Rev A, Outdoor Piping Arrangement Braidwood Station Units 1 & 2
    - Sheet 13, REV I, Blowdown piping to outfall structure Braidwood Station Units 1 & 2
20. 'Proposal for Investigation and Evaluation of Prestressed Concrete Cylinder Pipe (PCCP) Water Pipeline for Braidwood Nuclear Power Station', from Construction Technology Laboratories, Inc. to J. Gastouniotis, dated July 10, 1992.
21. 'Full Vacuum Condition Design For Prestressed Concrete Steel Cylinder Pipe', Interpace Project No. SB-77-27 dated April 4, 2006
22. M-44 Sheet 3A, Braidwood Station Piping and Instrument Drawings
23. BwCP 1003-14, 'Exelon Pond Weekly Discharge'.
24. BwCP 1003-15, 'Exelon Pond Monthly Discharge'.

25. BwCP 1003-16, 'Exelon Pond Quarterly Discharge'.
26. "Agreed Preliminary Injunction Order", People of the State of Illinois vs. Exelon Corporation, dated May 24, 2006. (AR 493242)
27. Evaluation Report of 'Nondestructive Pipeline Condition Assessment of 48 " Concrete Blowdown Line', The Pressure Pipe Inspection Company Ltd., DCI-REP-20060131-S2H0, January 2006.
28. Email from S. Tritch to J. Damron dated 5/22/06.
29. Email from J. Gosnell to B. Acas dated 5/30/06.
30. Email from H. Hannoun to A. Haeger dated 4/28/06.
31. Email from M. Anjum to J. Gosnell dated 5/23/06.
32. Email from M. Anjum to J. Gosnell dated 5/23/06.
33. Email from J. Gosnell to B. Acas dated 5/30/06.
34. SPP 05-012, 'CW BD Piping Leak Test'

Ref 1 Interim Remedial Action Plan.pdf

Ref 2 Drawings-Interim Remedial Action.pdf

Ref 3.pdf

Ref 10.pdf

Ref 11 Vacuum Breaker Valve Drawings.pdf

Ref 14 Email-Tritium concentration in Pond.pdf

Ref 15 Drawing-Groundwater Level Drawdown.pdf

16 Memo-Groundwater Level Drawdown.

Ref 20 CTL Proposal J. Gastouniotis.pdf

Ref 21.pdf

Ref 27 Pressure Pipe Inspection Co.pdf

Ref 28 Duocheck.pdf

Ref 29.pdf

Ref 30.pdf

Ref 31Vacuum Breaker Refurb.pdf

Ref 32 EVAL list of questions.pdf

Ref 33.pdf

Attachment A
Interim Remedial Action Pumping System Dilution Calculation

Blowdown Flow (GPM)	Cooling Lake Background (pCi/L)	Maximum IRAPS Pump Flow (GPM)
25000	35.1	1153
24000	35.1	1106
23000	35.1	1060
22000	35.1	1014
21000	35.1	968
20000	35.1	922
19000	35.1	876
18000	35.1	830
17000	35.1	784
16000	35.1	738
15000	35.1	692
14000	35.1	645
13000	35.1	599
12000	35.1	553
11000	35.1	507
10000	35.1	461
21691	35.1	1000
21148	35.1	975
20606	35.1	950
20064	35.1	925
19522	35.1	900
18979	35.1	875
18437	35.1	850
17895	35.1	825
17352	35.1	800
16810	35.1	775
16268	35.1	750
15726	35.1	725
15183	35.1	700
14641	35.1	675
14099	35.1	650
13557	35.1	625
13014	35.1	600
12472	35.1	575
11930	35.1	550
11388	35.1	525
10845	35.1	500
10303	35.1	475
9761	35.1	450

Enter a Cooling Lake tritium concentration or Pond tritium concentration.

Cooling Lake (pCi/L)	plus/minus
35.09	0.957

Pond (pCi/L)
3,777