UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
612 EAST LAMAR BLVD, SUITE 400
ARLINGTON, TEXAS 76011-4125

November 17, 2011

EA-11-142

Donna Jacobs, Vice President, Operations
Entergy Operations, Inc.
Waterford Steam Electric Station, Unit 3
17265 River Road
Killona, LA 70057-0751

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 - FINAL SIGNIFICANCE DETERMINATION OF WHITE FINDING; NRC INSPECTION REPORT 05000382/2011009

Dear Ms. Jacobs:

This letter provides you the final significance determination of the preliminary White finding discussed in NRC Inspection Report 05000382/2011009, dated August 24, 2011. The finding involved the failure to use effective engineering controls to reduce radioactive contamination and subsequent exposure. Waterford Steam Electric Station personnel failed to keep highly radioactive water from leaking onto the work areas around the reactor coolant pumps. This failure resulted in high levels of radioactive contamination and unexpected and unintended radiation dose to plant workers.

At your request, a regulatory conference was held on October 3, 2011, to discuss your views on this issue. A copy of the Waterford Steam Electric Station's presentation that was provided at the meeting is enclosed (see Enclosure 1). In addition, on October 13, your staff provided a written response (see Enclosure 2) to additional questions raised by the NRC during the regulatory conference. During the meeting, you and your staff provided perspectives on this finding. In particular, you indicated that Waterford Steam Electric Station personnel appropriately followed all of the as low as reasonably achievable (ALARA) procedures and that the additional radiation dose was related to equipment deficiencies. Therefore, you concluded that there was no performance deficiency and no finding. You maintained that the use of engineering controls to reduce contamination from leaking reactor coolant was beyond the ability of Waterford personnel to plan for because the equipment failures were beyond the control of your staff and could not be anticipated or predicted. However, as described in further detail below, the NRC determined that your staff should have anticipated leaking reactor coolant from one or more reactor coolant pump seals and then planned for and installed effective engineering controls to mitigate the spread of highly contaminated water.

The NRC reviewed all the information presented at the regulatory conference, as well as the supplemental information that your staff provided after the conference. The NRC staff determined that based on operating experience, including known fuel defects and a planned crud burst with anticipated seal leakage, there was sufficient information available to anticipate the likely consequences and plan accordingly. From as early as 2005, Waterford Steam Electric Station personnel had knowledge that the reactor coolant pump seals were likely to leak. At least one or more reactor coolant pump seals leaked during each shutdown/outage starting in 2005. Additionally, the NRC staff found that there was no supporting information provided by your staff that would mitigate the significance determination for the preliminary White finding.

In Refueling Outage 14, the leakage of radioactive water raised the dose rates in work areas around the reactor coolant pumps by 35 percent, according to the information provided by your staff. In planning for Refueling Outage 16, Waterford Steam Electric Station personnel had collected industry information and had planned for fuel failures because of fuel design changes. This was acknowledged by your staff and documented in NRC Inspection Report 05000382/2011009, Attachments 2, 3 and 4.

In spite of the known fuel defects and planned crud burst with anticipated reactor coolant seal leakage, Waterford Steam Electric Station personnel failed to install an effective leak collection system to collect and control the seal leakage. The resulting contamination of work areas caused unnecessary personnel dose well in excess of the original ALARA dose estimates.

Based on this, the NRC has concluded that the finding is appropriately characterized as White (i.e., a finding with a low-to-moderate importance to safety that may require additional NRC inspections). Using Inspection Manual Chapter 0609, Appendix C, "Occupational Radiation Safety Significance Determination Process," the finding was determined to be White because (1) this was an ALARA planning issue, (2) the site's 3-year average collective dose exceeded 135 person-rem and (3) one of the work activities accrued more than 25 person-rem or alternatively, the finding would still be White because there were more than four other occurrences in which the actual collective dose exceeded 5 person-rem, and the estimated/planned dose by more than 50 percent.

You have 30 calendar days from the date of this letter to appeal the staff's determination of significance for the identified White finding. Such appeals will be considered to have merit only if they meet the criteria given in the IMC 0609, Attachment 2. An appeal must be sent in writing to the Regional Administrator, Region IV, 612 East Lamar Boulevard, Suite 400, Arlington, TX 76011-4125.

The NRC has also determined that no violation of a regulatory requirement occurred. The Waterford Steam Electric Station, Unit 3, ALARA program was adequate and a violation of 10 CFR 20.1101 (b) did not exist. Additionally, the NRC did not identify an inadequacy associated with radiation protection procedures required by Technical Specification 6.8.1, Programs and Procedures," and Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)."

You are requested to respond to this letter by providing the corrective actions that have been taken or planned to correct this finding and prevent recurrence. If you have additional information that you believe the NRC should consider, you may provide it in your response to this finding.

Because plant performance for this issue has been determined to be beyond the licensee response band, we will use the NRC's Action Matrix to determine the most appropriate NRC response for this event. We will notify you, by separate correspondence, of that determination.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response, if you choose to provide one, will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction.

Sincerely,

Elmo E. Collins

Elmo E. Collins
Regional Administrator

Docket: 50-382
License: NPF-38

Enclosures:
1. Waterford Steam Electric Station, Unit 3
   Regulatory Conference Presentation
2. Waterford Steam Electric Station, Unit 3
   Response to The NRC's Regulatory
   Conference Questions

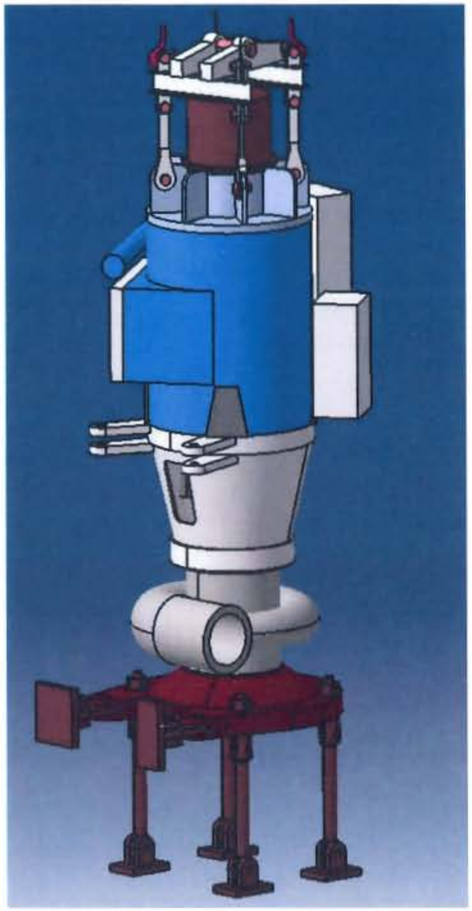
cc: Listserve (Waterford)

WATERFORD STEAM ELECTRIC STATION, UNIT 3, REGULATORY CONFERENCE PRESENTATION

October 3, 2011

Enclosure 1

Regulatory Conference
October 3, 2011



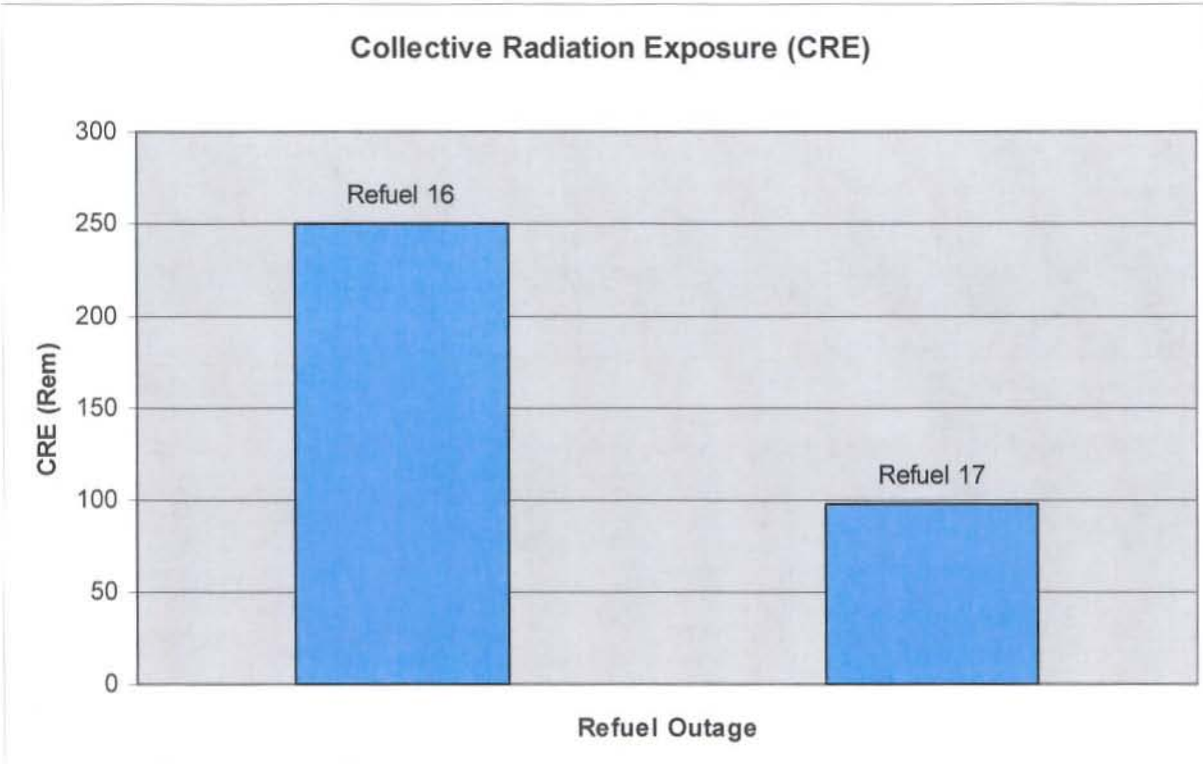
WATERFORD STEAM ELECTRIC STATION UNIT 3

NRC RADIATION SAFETY INSPECTION REPORT 05000382/2011009; PRELIMINARY WHITE FINDING

Opening Remarks
Waterford 3 Perspective

- Reactor coolant pump vapor seal destaging
- Waterford 3 has taken mitigating actions
- Waterford 3 has made significant improvements in current plant performance

Opening Remarks
Donna Jacobs – Waterford 3 Vice President



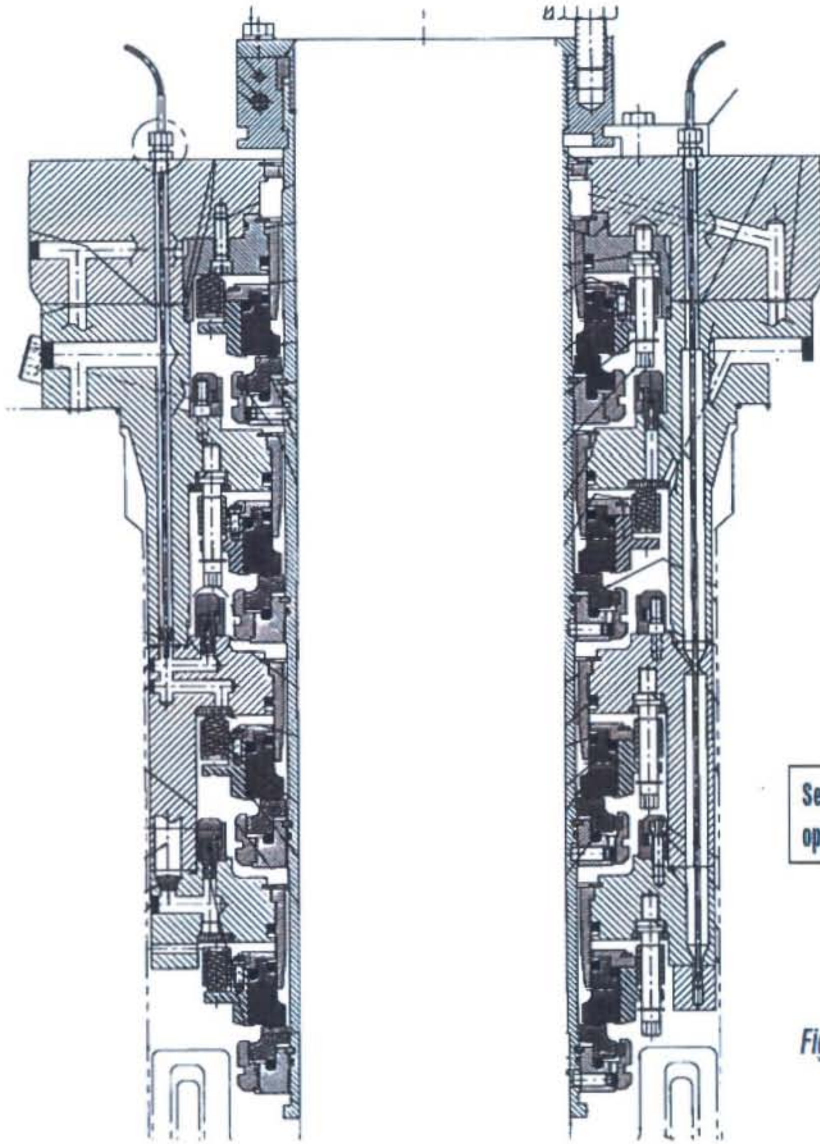
Opening Remarks
Presentation Outline

- Engineering – Bruce Proctor
- Refuel Conditions – Daryl Marse
- Radiation Protection – Jeff Brawley
- Regulatory Perspective - Billy Steelman
- Closing Remarks – Donna Jacobs

Waterford 3 Design

- Combustion Engineering 2 Loop Design
- Four Reactor Coolant Pumps
- Reactor Coolant Pump Vapor Seal Design

Reactor Coolant Pump Seals



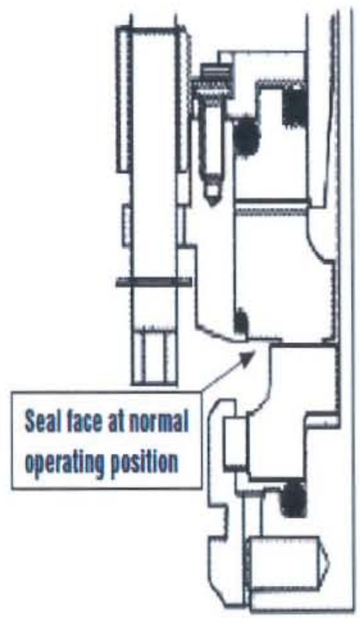


Figure 1. Normal operating position

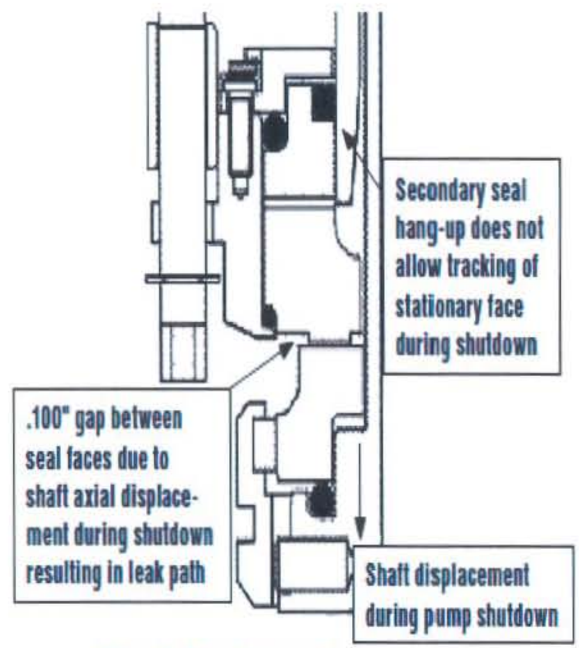


Figure 2. Secondary seal hang-up

Engineering

Reactor Coolant Pump Vapor Seal Summary

- September 2005 – Reactor coolant pump vapor seal destaging
- March 2006 – Operating procedure changes
- January 2007 – Vendor evaluation started
- September 2008 – Vendor evaluation and testing complete
- October 2009 – Reactor coolant pump seal installed at ANO
- November 2009 – Refuel 16 installed trough modification
- April 2011 – Refuel 17 two reactor coolant pump seal packages replaced

Engineering
Refuel 16 Modification

- Trough modification performed in Refuel 16
- Permanently installed engineered control
- Trough modification established at accommodate unexpected source terms

Waterford 3
Refuel 16 Planned Activities

- Pre-outage power reduction and clean up plan
- Reactor coolant system dose equivalent iodine and reactor coolant system degassing plan
  - Shutdown Cooling Purification
- Cobalt cleanup plans
- Operating Experience

Radiation Protection Pre-Outage ALARA Planning

- Reactor coolant pump Radiation Work Permit planning
- Radiation Work Permit expected conditions
- Reactor coolant pump vapor destaging pre-planned contingencies

Waterford 3
Refuel 16 Unplanned Conditions

- Reactor trip (moisture separator reheater)
- Fuel pin defects
- Additional cleanup
- Reactor coolant system acid reducing duration

Radiation Protection Unexpected Conditions Response

- Initiated Radiation Work Permit revisions
- Analyzed impact of emergent conditions
- Documented and briefed Radiation Work Permit revisions
- Executed ALARA contingency actions

Waterford 3
ALARA Improvements

- Installed trough modification
- Replaced two reactor coolant pump seal packages
- Purchased additional tungsten shielding including tungsten vests
- Increased the amount of shielding
- Added new shielding applications

Radiation Protection
ALARA Improvement Statistics

	RF16	RF17
Outage Dose	~250 Rem	~98 Rem
Personnel Contamination Events	128	21

Regulatory Perspective

- IMC 0308 Reactor Oversight Process (ROP)
- IMC 0609 Appendix C Occupational Radiation Safety Significance Determination Process

Closing Remarks

- Reactor coolant pump vapor seal leakage
- Waterford 3 took reasonable actions
- Waterford 3 has implemented ALARA improvements

WATERFORD STEAM ELECTRIC STATION, UNIT 3,

RESPONSE TO THE NRC'S REGULATORY CONFERENCE QUESTIONS

Enclosure 2

The NRC requested additional information during the Radiation Protection preliminary white finding regulatory conference. The questions and responses are provided below:

1) Provide the pre-refuel 15 predicted fuel defects and the actual as found number. Provide the pre-refuel 16 predicted fuel defects and the actual as found number.

   Response:
   The Refuel 16 (RF16) ALARA plan was developed considering the increased number of fuel defects expected at the beginning of RF16 versus the number of actual fuel defects at the beginning of RF15 as discussed below. This plan would have reduced the activity in the RCS during RF16 to the levels experienced during RF15 considering the increased number of fuel defects expected and, absent the reactor trip, would have successfully addressed the unexpected increase in the number of actual fuel defects found in RF16.

   Based on Chemistry isotopic concentrations, predicted vs. actual fuel failures for the Cycle 15 core were as follows:
   Predicted: 5-10 leaking fuel rods
   Actual: 11 leaking rods

   Based on Chemistry isotopic concentrations, predicted vs. actual fuel failures for the Cycle 16 core were as follows:
   Predicted (9/18/09): 40 leaking fuel rods
   Actual: 55 leaking fuel rods

2) From the chemistry planning perspective, how were the known fuel defects incorporated into the plan. How was the difference from refuel 15 and 16 addressed?

   Response:
   The chemistry cleanup plan was developed using the Reactor Coolant System (RCS) isotopic activity and RCS isotopic ratios as the measures to determine cleanup requirements. These measures were used to directly address the differences between the RF15 and RF16 fuel defect conditions. Additionally, using these measures addressed uncertainties in the projected number of RF16 fuel cladding defects and the limited information related to cladding defect size.

   Based on the cleanup plan, months prior to the start of Refuel 16 (RF16), sixty hours were added to the outage schedule for extra RCS clean-up compared to RF15. This cleanup time was included in the time from when the reactor is secured to the time of hydrogen peroxide addition. The additional schedule time was added to delay hydrogen peroxide addition time, based on information found in the EPRI Pressurized Water Reactor Primary Water Chemistry Guidelines. The EPRI guidelines states that iodine is harder to remove once oxidized and can convert to iodate which can be an airborne hazard once the RCS is opened to atmosphere. Following the unplanned reactor trip this initial plan had to be adjusted to add even more RCS cleanup time prior to the hydrogen peroxide addition.

See Attachment 1 for the details of the RCS clean-up plan that was developed prior to the outage; a summary of the plan is reflected below.

PLAN SUMMARY

- Minimize impact to outage by reducing RCS iodine and cobalt activities.
- Remove Radioactive gases from the RCS, in particular Xe-133
- Enter RF16 with a the following to ensure clean-up capabilities:
    - Fresh 1.0 micron Chemistry and Volume Control (CVC) system filter
    - Two fresh CVC mixed bed ion exchangers
    - Contingency resin on site

- Plant down power preceding the shutdown for refueling to "wash out" the fuel pins to reduce RCS Dose Equivalent Iodine (DEI) spike following the plant shutdown approximately 5 days prior to the RF16 shutdown.

    - Come down to 80% reactor power.
    - Wait for the Xenon peak (4 to 6 hours)
    - Return to 100% power at 3% per hour

- RCS Fission Gas Plan

    - Reduce Gaseous Waste Management (GWM) system leakage.
    - Fix relief valve PSL-3091 and leakage from valve PSL-3061 to allow Pressurizer venting to the Volume Control Tank (VCT) vice Hold-Up Tank (HUT) A.
    - Prior to outage, conduct controlled venting of the VCT to reduce RCS Xenon gas activity
    - During outage, control vent the VCT to lower RCS Xe-133 to 0.16 uCi/ml, this equates to containment atmosphere of 0.03 Derived Air Concentration (DAC) noble gas if all Reactor Coolant Pump (RCP) vapor seals destage

- RCS clean-up to preset Iodine-131 target activity to reduce impact of RCS isotopic activity on RCP seal leakage.

    - Continue operation of 2 charging pumps up until plant shutdown.
    - After plant trip, run 3 charging pumps during plant cool down to ~350F and ~1100 psia.
    - Clean-up RCS Iodine-131 to 4.5 E-03 uCi/ml, this equated to 0.3 DAC in containment if all RCPs destage.
    - Place Shutdown Cooling (SDC) system in service and add Hydrogen Peroxide (H_2O_2) for forced oxidation of RCS cobalt

3) From the radiation planning perspective, how were the known fuel defects incorporated into the plan? How was the difference from refuel 15 and 16 addressed?

Response:

There were fuel cladding defects going into Refueling Outages 13, 14, and 15; however, the magnitude of the defects was comparatively lower than in RF16. In RF13, RF14, and RF15, the RCS isotopic activity was cleaned-up using on-going experience with past practices as a guide. Experience had shown that typical clean-up measures had been effective, with no markedly different actions needed to address the fuel cladding defects. That is, following each of those outages, RCS clean-up was effectively performed using the typical clean-up plans. However, during cycle 16, it was recognized that the amount of fuel cladding defects would require additional measures to manage the clean-up. This prompted the development of an RCS DEI and Bulk Water clean-up plan. Isotopic concentration has a direct correlation to dose rates and the plan was developed with this knowledge. Implementation of the plan was an integral aspect of controlling dose to ALARA, including the prevention of radioactive gas uptake.

The anticipated radiological impact due to the iodines and noble gasses from the anticipated fuel cladding defects was incorporated into the Refuel 16 ALARA Planning process. For example, Radiological Work Permits factored in the use of HEPA filtration and incorporated utilization of charcoal banks when applicable to mitigate the iodines. ALARA planning for Refuel 16 was predicated on chemistry results of the Reactor Coolant System (RCS) through the cycle that did not indicate a rise in Cobalt activity (hard gamma isotopes). ALARA planning considered a peak of 3 uci/ml of Cobalt 58 in the RCS after the H2O2 addition.

The RF16 plan established radiological precautions based on the assumption that the RCS DEI and Bulk Water clean-up plan would mitigate the additional iodines in the RCS along with noble gases discussed above. Refuel 15 was started with predicted 5-10 leaking fuel rods, which was less than the projected 40 leaking fuel rods in RF16. Since the RCS DEI and Bulk Water clean-up plan was comprehensive and actions from the plan were executed in the refuel schedule, the ALARA staff relied on the plan to mitigate the isotopic source term such that there would be no negative impact on the dose estimating process.

See Attachment 1 for details of the RF16 RCS clean-up plan that was developed prior to the outage. The information on the following page reflects the basic difference in the level of activities taken to clean-up the RCS between RF15 and RF16.

Key RCS Clean-up Plan Attributes

Pre-refuel 15

- Water Management Plan that included the following:
  - letdown ion exchanger strategy
  - letdown filter strategy
- CE-002-006, Maintaining Reactor Coolant System Chemistry, formalized direction on primary forced oxidation of cobalt and primary cleanup
- Projected Co-58 cleanup curve

Pre-refuel 16

- RCS DEI and bulk water degassing plan contained the following:
  - Iodine and crud cleanup philosophy
  - RCS gas removal plan
  - Pre-outage prep action time line
  - Letdown resin loading
  - Letdown ion exchanger strategy
  - Cleanup plan for down power to 80% power for iodine washout
  - Chemistry sampling and communications plan (beyond typical)
  - Projected RCS DEI cleanup curve
  - Projected RCS Co-58 cleanup curve
  - Timeline
  - RCS cleanup flow chart

- CE-002-006, Maintaining Reactor Coolant System Chemistry, formalized direction on primary forced oxidation of cobalt and primary cleanup

4) What would have prevented shroud dam installation prior to 350 psi? Provide the sequence from RCS pressure of ~600 psi down to where the shroud dams were actually installed.

   Response:
   Waterford 3 has four Reactor Coolant Pumps (RCPs) and the operations shutdown procedure secures two RCPs early in the shutdown process once power operations have concluded and the pumps are no longer needed. For refuel 16, two RCPs were secured at ~2250 psia. The remaining two RCPs are not secured until after shutdown cooling is placed in service.

   Shutdown cooling entry conditions are 392 psia and 350 F. Operations shutdown procedure uses two reactor coolant pumps for forced circulation until after shutdown cooling is initiated and appropriate plant conditions have been obtained. The operations shutdown procedure requires RCPs remain in operation during the cooldown and depressurization until Chemistry reports Cobalt-58 activity in RCS has peaked. For refuel 16, the last two RCPs were secured at ~350 psia.

Prior to installation of the RCP shroud dams, activities are completed to clearance tag the RCP for personnel safety. Additional impacts to installation of the shroud dams are the physical "heat stress" environment during this time due to ambient temperature from just shutting down the plant.

In Refuel 16, shroud dams and drain lines were installed in RCP 1A because this was the first RCP secured.

RCP 2A shroud dam installation did not immediately occur. Dose rates of 65-120 mRem/hr subsequently developed in the area from the leaking seals. The estimated dose to install the dam with this dose rate was approximately 600 mRem. Because of the dose rate, a decision was made based on ALARA to delay installation of the shroud dams until depressurization of the RCS and decontamination of the area had been completed. The shroud dams were installed following decontamination of the area and the area dose rates had lowered.

RCP 1B was secured at ~350 psia. When an attempt was made to start the shroud dam and drain line installation when the pump was secured, a dose rate of 200-300 mRem/hr precluded the installation. The estimated dose to install the dam with this dose rate was approximately 1500 mRem. The shroud dams were installed later following decontamination of the area and the area dose rates had lowered.

RCP 2B was secured at ~350 psia. Also, there were already high dose rates in the shroud area due to isotopic deposits from RCS leakage that occurred during Cycle 16. Actual dose rates measured during the start of RF16 were 350-700 mRem/hr; the estimated dose to install the dam with this dose rate was approximately 2900 mRem. Because of the 350-700 mRem/hr dose rate, a decision was made based on ALARA to delay installation of the shroud dams. The shroud dams were installed later, following decontamination of the area and the area dose rates had lowered..

5) For the Reactor Coolant Pump shroud dam installation, what was the pre-planned expected dose field and total dose if we had done the installations. What was the actual as found conditions and basis for not installing the Reactor Coolant shroud dams?

Response:
During refuel 16, RCP 1A and 2A were the first RCPs secured. RCP 1B and 2B were secured after shutdown cooling was initiated.

RCP 1A expected dose rates in the shroud from the as left surveys in RF15 were 6 - 8 mRem/hr (estimated dose for installation was 42 mRem), actual dose rates measured during the start of RF16 were 8 - 10 mRem/hr, estimated dose to install the dam in these dose was approximately 54 mRem. Waterford 3 did install the shroud dams on RCP 1A prior to the destaging of its vapor seal.

RCP 1B expected dose rates in the shroud from the as left surveys in RF15 were 15 -18 mRem/hr (estimated dose for installation was 100 mRem), actual dose rates measured during the start of RF16 were 200-300 mRem/hr, estimated dose to install the dam with this dose rate was approximately 1500 mRem. Waterford 3 did not initially install the shroud dams on RCP 1B prior to its vapor seal leaking because the pump was needed to operate to support plant conditions. By the time the pump was secured, its vapor seal had leaked and there was a dose rate of 200-300 mRem/hr (as indicated above). Because of the high dose rates, a decision was made based on ALARA to delay installation of the shroud dams. The shroud dams were installed later, following removal of the insulation and decontamination of the area to minimize recontamination of the area during plant startup. The consequence of the decision to delay installation of the shroud dams was evaluated, which concluded that the net outage dose would have been higher if the dams had been installed. Specifically, a review of the subsequent dose rate surveys showed no substantial changes in dose rates in the RCP shroud areas over the next several days. Thus, it is concluded that not having the dams in place did not cause the area dose rates to be higher. The delay resulted in lower dose to install the shroud dams because the dose rates had lowered following removal of the insulation and decontamination. The result was that there was lower dose received for this work.

RCP 2A expected dose rates in the shroud from the as left surveys in RF15 were 10 mRem/hr (estimated dose for installation was 60 mRem), actual dose rates measured on 10/25/09 after the seals had destaged were 65-120 mRem/hr, estimated dose to install the dam with this dose rate was approximately 600 mRem. Waterford 3 did not initially install the shroud dams on RCP 2A prior to its vapor seal leaking. As noted above, dose rates of 65-120 mRem/hr subsequently developed in the area from the leaking seals. Because of the high dose rates, a decision was made based on ALARA to delay installation of the shroud dams. The shroud dams were installed later, following decontamination of the area to minimize recontamination of the area during plant startup.

RCP 2B expected dose rates in the shroud from the as left surveys in RF15 were 8 - 15 mRem/hr (estimated dose for installation was 70 mRem), actual dose rates measured during the start of RF16 were 350-700 mRem/hr, estimated dose to install the dam with this dose rate is approximately 2900 mRem. Waterford 3 did not initially install the shroud dams on RCP 2B prior to its vapor seal leaking because the pump was needed to operate to support plant conditions. By the time the pump was secured, its vapor seal had leaked and there where dose rates of 350-700 mRem/hr in the area. Because of the high dose rates, a decision was made based on ALARA to delay installation of the shroud dams. The shroud dams were installed later, following decontamination of the area to minimize recontamination of the area during plant startup. The consequence of the decision to delay installation of the shroud dams was evaluated, which concluded that the net outage dose would have been higher if the dams had been installed. Specifically, a review of the subsequent dose rate surveys showed no substantial changes in dose rates in the RCP shroud areas over the next several days. Thus, it is concluded that not having the dams in place did not cause the area dose rates to be higher. The delay resulted in lower dose to install the shroud dams because the dose rates had lowered following removal of the insulation and decontamination. The result was that there was lower dose received for this work.

In summary, the pre outage RF16 planned dose to install dams in RCP 1A, 1B, 2A, and 2B shrouds was approximately 272 mRem. Based on the actual radiological conditions observed during the start of RF16 it would have cost approximately 4500 mRem.

The decision to defer installation of the shroud dams and drain lines on RCPs 1B, 2A, and 2B was made because the RCP seals had leaked onto the insulation packages and dose rates were elevated. A review of the dose fields showed that once the RCP vapor stages started leaking the dose rates elevated and remained at the elevated level until decontaminated occurred. Since, the dose rates prior to and after the planned shroud dam installation remained similar; the delay in shroud dam installation did not adversely affect the accumulated doses.

6) For the Reactor Coolant Pump work, provide an estimate of how much dose was due to dose equivalent iodine and how much was due to cobalt.

Response:
The following reflects RCS isotopic concentrations when the RCP's were secured during RF16. (ND = Not Detectable)

Isotope	**I-131 uci/ml**	**I-132 uci/ml**	**I-133 uci/ml**	**I-134 uci/ml**	**I-135 uci/ml**	**Co-58 uci/ml**	**Co-60 uci/ml**
When RCPs 1A and 2A were secured	6.44E-01	3.35E-01	7.26E-01	1.07E-01	4.65E-01	1.24E-01	2.07E-03
When RCPs 1B and 2B were secured	3.69E-02	ND	ND	ND	ND	4.70E+00	2.14E-02

Isotope	**Cs-138 uci/ml**	**Rb-88 uci/ml**	**Nb-95 uci/ml**	**Kr-85m uci/ml**	**Kr-87 uci/ml**	**Kr-88 uci/ml**	**Xe-133 uci/ml**
When RCPs 1A and 2A were secured	1.84E-02	2.11E-01	8.25E-03	5.62E-02	2.88E-02	9.14E-02	1.77E+00
When RCPs 1B and 2B were secured	ND	ND	ND	ND	ND	ND	1.65E-01

Isotope	**Xe-133m uci/ml**	**Xe-135 uci/ml**	**Fe-59 uci/ml**	**Mn-54 uci/ml**	**Ni-65 uci/ml**	**Sb-125 uci/ml**	**Zr-95 uci/ml**	**Zr-97 uci/ml**
When RCPs 1A and 2A were secured	4.26E-02	3.92E-01	9.58E-03	ND	8.58E-03	ND	1.00E-02	1.16E-02
When RCPs 1B and 2B were secured	ND	ND	ND	6.15E-03	ND	1.69E-02	ND	ND

7) Was it reasonable to know we were going to be in an acid reducing state for 96 hours instead of 60 hours? Should we have anticipated the delay? What was the basis for the 36 hours?

Response:
The time that it took to clean up the RCS to reduce RCS DEI down to 4.5e-3 uCi/ml has a direct correlation to the amount of time in the acid reducing phase. The acid reducing phase begins when Operations borates the RCS to high concentrations shortly after the plant is shutdown. The acid reducing phase ends once the H2O2 is added to the RCS. Any discussion on what prompted delays in adding the H2O2 also explains the extended time in the acid reducing phase.

The extra RCS clean-up time of 30 hours was added within 2 hours of the plant trip leading into RF16. The plant tripped ~30 hours earlier than the planned shutdown was to commence. A decision was made to take advantage of this period to clean the RCS, especially since it was known that the trip caused an unexpected, higher crud burst that would need additional time to clean-up. Note that actual duration was 36 hours due to continuing efforts to clean RCS DEI.

The original RCS clean-up time of 60 hours was based on two inputs: a prediction of the end of cycle RCS DEI values, known clean-up rates, and expected plant conditions. How this was calculated follows:

The end of cycle RCS DEI values were predicted based on the existing cycle 16 RCS DEI trend extrapolated to the end of cycle. The projected RCS DEI at shutdown, along with known clean-up rates and plant conditions, were then used to determine the time needed to get the RCS DEI down to the target level of 4.5e-3 uCi/ml. Achieving this value would limit containment atmosphere iodine to < 0.3 DAC if the RCPs destaged.

Post trip RCS DEI was based on taking the RCS end of cycle DEI value and multiplying it times a calculated constant. The constant is comprised of the ratio of historical RCS post trip DEI concentration peaks against historical end of cycle RCS DEI concentrations (see below for equation).

Post trip DEI prediction = (EOC DEI)(Historical post trip DEI/ historical EOC DEI)*

Once the RCS post trip DEI was estimated, known cleanup rates were used to estimate cleanup time to RCS DEI to 4.5e-3 uCi/ml. Achieving this value would limit containment atmosphere iodine to < 0.3 DAC if the RCPs destaged.

Was it reasonable to know before the outage that we were going to be in the acid reducing state for 96 hours? Prior to RF16, Waterford 3 could not have known we were going to be cleaning up the RCS DEI for 96 hours. The initial plan included 60 hours of clean-up. The plant trip prompted the addition of 30 hours clean-up time. The nature of the trip, cycle history of elevated RCS DEI and fission gases and the elevated level of RCS DEI post trip required additional RCS fission product cleanup time. The additional time is directly connected to the plant trip. The plant trip could not have been predicted therefore the extension of the cleanup time could not have been predicted.

Should we have anticipated the delay? The plant trip was unexpected and could not have been foreseen. The decision to add additional cleanup time was made following the trip. Prior to the outage Waterford did not know the exact number and size of the fuel defects. This information is only known after fuel has been removed from the reactor and inspected. The size and number of fuel defects are important factors in how much and when fission products will be released from leaking fuel pins. Since this information is only known after fuel inspections and the trip was unexpected, any delays in RCS fission product cleanup could not have been predicted.

What was the basis for the extra 36 hours? Following the Reactor trip from 100% power, 30 hours were added in order to remove iodine from the RCS prior to securing the RCPs. The plant tripped ~30 hours earlier than the planned shutdown was to commence. A decision was made to take advantage of this period to clean the RCS, especially since the trip caused an unexpected, higher crud burst. The time added delayed the hydrogen peroxide addition, for reasons listed in question 2. As the RCS was depressurized, the fuel continued to leak fission gases into the RCS bulk water; thus, the final six hours of cleanup following the previously added 30 hours.

8) When was the first Radiation Work Permit (RWP) 20090513 revision? What was factored in?

Response:
RWP 20090513, RCP 1A Motor and Driver Mount Removal and Replacement, including all Supporting Activity

Task 1 for Rigging was revised on 11/10/09. The revision for Task 1 factored in higher dose rates than projected due to high RCS activity.

Task 2 for RCP Motor Work was also revised on 11/10/09. The revision for Task 2 factored in higher dose rates than projected due to high RCS activity.

Task 3 for Driver Mount Work was also revised on 11/10/09. The revision for Task 3 factored in issues associated with working with the jacking mount tooling used to separate the driver mount from the pump. The driver mount experienced thermal binding with the pump casing.

Task 4 was for the associated Inspections; it was not revised during revision 1 because the actual dose received was within the RWP estimates. Also, there was a limited amount of work performed under that task at time of the RWP revision.

Revisions to this RWP were performed in accordance with fleet procedure, EN-RP-105, Radiological Work Permits. RWP revisions are required prior to exceeding 125% of the dose estimates. The original dose estimated in the RWP was 13.590 Rem, and the accumulated dose was 10.190 at time of the first revision. The first revision occurred at approximately 75% of the initial RWP dose estimate.

Attachment 1

RCS CLEAN UP PLAN FOR REFUEL 16

RF16 DEI Cleanup Window Optimization Plan

Purpose- Provide basis, limits, and instructions for RCS cleanup, to minimize effects of de-staging Reactor Coolant pumps, and subsequent release of reactor coolant into containment. Cleanup limits are 4.5E-3 uCi/ml for RCS DEI and 1.6E-1 uCi/ml for RCS Xe-133.

Plant Conditions- Following reactor shut down, three charging pumps will be placed in service to raise available letdown flow to ~120 gpm. Operations will commence a slow cool down to between 350 and 365F. This will maintain the plant in Mode 3 and allow three charging pump operation. A slow cool down will maintain a high (100 gpm) letdown flow rate by minimizing shrinkage of the Pressurizer volume. RCS Pressure will be reduced to between 1000 and 1200 PSIA to maintain control of letdown flow and provide margin to the de-staging pressure of the RCP Seals (~600 PSIA).

Key Assumptions- End of cycle and peak RCS DEI and RCS Xe-133 values are predicted based on previous cycle histories. RCS DEI is projected to peak at .06 uCi/ml to 0.3 uCi/ml. This is based on assumption that power reduction will lower post shutdown spike activities similar to those observed in RF15.

Plan Goals:

- Minimize impact to outage by reducing RCS iodine and cobalt activities.
- Remove Radioactive gases from the RCS, in particular Xe-133
- Maintain a reducing environment during the majority of RF16 acid reducing conditions, i.e. prior to peroxide addition
- Establish pre-planned communications and decision logic tree for Outage Control Center Personnel (See **Figure 1**, attached)
- Enter RF16 with a the following:
  - Fresh 1.0 micron CVC filter
  - Two fresh CVC mixed bed ion exchangers
  - Fresh Spent Fuel Pool Ion Exchanger.

PLAN SUMMARY

- Plant down power preceding the shutdown for refueling.
  - Come down to 80% power.
  - Wait for the Xenon peak (4 to 6 hours)
  - Return to 100% power at 3% per hour
  - ~5 days prior to RF16 shutdown
  - Purpose to "wash out" the fuel pins to reduce the DEI spike following shutdown for RF16.

- RCS cleanup to preset Iodine-131 target activity to reduce impact of RCP seal leakage.
  - Continue operation of 2 charging pumps up until plant shutdown.
  - After plant trip run 3 charging pumps during plant cooldown to ~350F and ~1100 psia.
  - Cleanup Iodine-131 to 4.5 E-03 uCi/ml (0.3 DAC).
  - Go on 1 train of SDC and add H2O2 (second cleanup).

- RCS Gas Plan
  - Reduce Gaseous Waste management (GWM) leakage.
  - Vent PZR steam space to VCT, burps of VCT beginning ~4 weeks prior to shutdown
  - Continue burping VCT to reduce RCS Xenon gas activity.
  - Calculated target value 0.16 uCi/ml (0.03 DAC noble gas)

- Other work was also evaluated to start early and the following list of activities will be pulled up into this window:

1. WO 52023395 MT A deluge
2. Tagout FP-004
3. S/D00016 SHUTDOWN CEDM MG SETS
4. S/D00027 VENT SITS TO 235 - 300 PSIG IF CONTAINMENT ATMOSPHERIC CONDITIONS ALLOW
5. Hang 1R16-1/MT -002-A-MT B -> Work Orders: 00186925-01, 00153330-01 (NEED TO CHANGE Tagout boundaries
6. SECURE SCW PER OP-03-022
7. Hang CD-026, and CD-027
8. WO 52022793 MT Deluge Testing
9. WO 186137 UAT Deluge Testing
10. OP-903-033 FW MVAAA173 A, 00086217-10, 00181035-04, 00182700-07, 00185389-06
11. OP-903-033 FW MVAAA173 B 00197308-01, 00197308-02, 00182554-07, 181034-06

12. OP-903-033, FW MVAAA166A, 00186196-01,
13. OP-903-033, FW MVAAA166B, 00181868-08, 181040-06
14. OP-903-033, MS MVAAA116A, 00200679-04,
15. OP-903-033, MS MVAAA116B 00200679-03
16. WO 00186295-01, OP-903-126 SECT 7.1 (ATT 10.1) COMM SYS AND ALARM TESTING
17. 51644159-02, OPS TO REMOVE & RESTORE CEAC CHNL "2" FROM SERVICE FOR MAIN
18. Tagout SSD-004 and SSD-005 temp power (should be online)
19. WO 186138 UAT deluge testing
20. Tagout MT-0001 A (Boundaries need to be changed)
21. Tagout FHS-003
22. Hang 1R16-1/CED -003- -EPNL0002 UF -> Work Orders: 00185725-01
23. Hang 1R16-1/CED -004- -EPNL0004 UF -> Work Orders: 00185739-01
24. Hang 1R16-1/7KV -001- -1B OUTAGE -> Work Orders: 00154028-01, 00154028-02, 00154028-05, 00182142-01, 00182143-01 (NEED TO CHANGE Tagout boundaries)
25. Hang MS-004 WO 153498 (NEED TO CHANGE Tagout boundaries)
26. Hang ES-001, (need to change boundaries)
27. Hand MS-022, (need to change boundaries)
28. Hang 1R16-1/CD -013- -EREL1371 B-> Work Orders: 51662303-01

It may be possible to start work on the Polar Crane Pre-Service Inspection if ambient temperatures are lowered enough using containment purge. A trigger point of 92 F wet bulb temperatures has been set to start this work. If this trigger is reached, work will begin on the polar crane pre-service inspection.

Precautions and Limitations:

Fuel leaks have resulted in elevated RCS iodine, cesium and xenon activities. Based on industry OE, this will result in delays getting into containment for outage start and possible large number of personnel contaminations and containment evacuations during RF16 if not properly cleaned up.

EPRI, PWR Chemistry Guidelines, section 2.4.2.2, indicates that iodine must be removed from the primary coolant prior to peroxide addition. Based on Operating Experience from ANO and Calvert Cliffs, we can anticipate the potential of the Chromatograph Effect. The Chromatograph Effect follows the RCS going from reducing to oxidizing, which coverts Iodide to Iodate and starts to migrate through the ion exchanger and eventually elutes from the vessel. This lesson learned was factored into the ion exchanger strategy.

Based on end of cycle RCS DEI-131 projection along with post shutdown DEI-131 spike, RCS DEI-131 is expected to spike above technical specification limit of 1.0 uCi/ml. Plant Management, Licensing, and Emergency Planning were notified and CR-WF3-2009-2866 was generated. Currently EP is working on revision to the EAL Procedure being tracked by CR-WF3-2009-2959 CA2, which would change the Unusual Event entry criteria to 60 uCi/ml.

Plan is designed to lower baseline Reactor Coolant noble gas activity to reduce the likelihood of containment noble gas concentration exceeding 0.3 DAC following leakage from the Reactor Coolant pump seals. A spike in RCS noble gas activity will most likely occur following the plant shutdown and depressurization of the RCS to atmospheric pressure. Venting may begin earlier to minimize any effect on potential plant shutdown. Once Volume Control Tank venting is started, venting should continue every three to four days to prevent re-equilibrium of Reactor Coolant gas activities back to pre venting levels. Venting interval may require check and adjusts as we proceed.

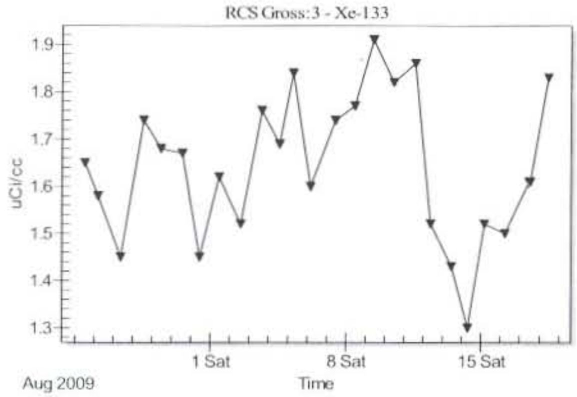
Pre Outage Conditions:

- CVC Filter 1.0 micron Scheduled for replacement 10/8/09
- CVC IX A Purification In Service 8/28/09
- CVC IX B Isolated Scheduled for replacement 9/18/09
- CVC IX C Delithating Used Nightly
- FPIX Purification In Service 8/29/09

Current IX Performance:

CVC IX A DF is 3379
CVC IX B DF is Isolated
CVC IX C DF is 1121
FPIX DF is 2, low DF is due to low activity on influent.

System Gas Behavior:



RCS gas concentrations come to equilibrium in 3 to 4 days. Volume Control Tank venting at frequencies greater than 4 days will not take advantage of gas equilibrium in the Reactor Coolant System. Previous vent removed 30% of RCS Xe-133 activity.

Plan Objectives:

- Venting the RCS to reduce RCS Gas Inventory
- Iodine removal by running elevated letdown prior to the outage
- Optimizing the use of the CVCIX to have efficient removal of Iodine and Cobalt isotopes.
- Manipulating plant power and shutdown rate (based on input from Reactor Engineering), five days prior to the outage, to reduce isotopic production and to allow time for cleanup prior to containment entry.
- Hard gamma, principally Co-58, from crud burst will be cleaned up using pre-established Chemistry procedures.

Iodine & Crud Cleanup:

CVC filter is scheduled for replacement on 10/8/09 with a 1.0 micron filter for use during RF16 shutdown. This will allow un-interrupted filtration during crud burst portion of RF16.

Having two CVC ion exchangers available at shutdown (B& C) will achieve an optimal environment for Iodine and Cobalt removal as needed once Increased Shutdown Cooling flow is achieved.

Running 80 gallons per minute of charging has cut pre-outage RCS DEI in half.

Removal of CVCIX A (Lithiated Purification Bed) to be removed from service prior to shutdown, reserved as contingency or available for startup.

RCS Gas Removal Plan:

Plan calls for venting to drive RCS gas activity down prior to activity coming back to equilibrium. Plan also removes Pressurizer steam space activity via the Volume Control Tank. Plan is optimized to provide the lowest Reactor Coolant System gas activity immediately prior to RF16, thus no venting is required in August. Initial activities on the initial VCT burp will be used to determine a RCS gas inventory which will be used to alter the venting plan if necessary.

The time line page which follows in this report outline the actions necessary to result in as low as reasonably achievable RCS bulk water noble gas concentrations. A target limit of 1.6E-1 uCi/ml Xe-133 RCS bulk water limit has been established to result in less than 0.3DAC noble gas once dispersed in CTMT Atmosphere from the estimated leakage from RCP destaging.

Gas Decay Tanks A & C should remain in service while hydrogen over pressure is on the Volume Control Tank.

Gas Decay Tank B should be placed in service when nitrogen is place on Volume Control Tank as necessary to maintain non-explosive mixtures of Hydrogen and Oxygen gas.

Pre-Outage Preparation Action Time Line Table:

DATE	ACTION	STATUS	OWNER	TRACKING
5/15/09	Perform RCS Particle Size Study	**Complete** Results recommend maintaining 0.45 micron filtration until month before outage then replace with 1.0 micron.	Jeff Bourgeois	LO-OLW-2009-139-92
5/23/09	Reload CVC IX C with Delithating Resin	**Complete**	OPS	Plant Schedule
6/16/09	Start 2nd Charging Pump	**Complete** RCS DEI was cut from 3.2E-02 uCi/ml to 1.6E-02 uCi/ml within 30 hours.	Jeff Bourgeois	N/A
7/8/09	Place CVC IX A & B in Series	**Complete** However, CVCIX B had to be removed from service on 7/11/09, due to an OPS procedure issue to facilitate efficient Delithating with CVCIX C going forward.	Jeff Bourgeois	N/A
7/15/09	Rinse CVCIX C and place in service for Delithiation	**Complete** CVCIX C is operating as expected with DF of 855 when in use.	Jeff Bourgeois	N/A
8/24/09	Ensure OPS procedures will support cleanup plan	**Complete** Ensure/verify Operations Procedures will allow for Chemical Volume Control Ion Exchangers B and C to be place in service in parallel approximately 24 hours prior to the start of RF16 with either 1, 2, or 3 charging pumps running. Also ensure/verify that when Shut down cooling purification is aligned that both CVCIX B & C can stay in parallel	David Jory	**LO-OLW-2008-139 CA100** OPS procedure can not support parallel operation. Plan revised.
8/4/09 – 10/15/09	Submit EAL change to NRC and revise EAL limit from 1 to 60 uCi/ml RCS DEI	**In Progress, NRC is challenging the station, and this change may not happen.**	Bob Murillo	CR-2009-2959 CA02

8/28/09	Sluice & Reload FPIX	**Complete** 8/28/09 WR-167095 (10cu ft C-381-H & 25 cu ft NR-35LC) Resin is in Gramercy and available within 24 hours	Jeff Bourgeois	Plant Schedule
8/27/09	Sluice & Reload CVC IX A	**Complete** 8/26/09 WR-167093 (35 cu ft NR-20LC) Resin is staged on RAB +21.	Jeff Bourgeois	Plant Schedule
8/28/09	Rinse CVC IX A and place in service as Purification IX	**Complete** OPS performs as requested by Chemistry	Jeff Bourgeois	Plant Schedule
8/29/09	Place FPIX in service	**Complete** OPS performs as requested by Chemistry	Jeff Bourgeois	Plant Schedule
9/18/09	Sluice & Reload CVC IX B	**Scheduled 9/18/09 (On track)** WO 202560 (35 cu ft NR-6LC)	Jeff Bourgeois	Plant Schedule
10/8/09	Replace CVC Filter with 1.0 micron	**Scheduled 10/8/09 (On-track)** WO 197893 Filter is in stock	Daryl Marse	Plant Schedule
1012/09	Off load Spent Resin Tank	RP is handling the off load of the SRT following the sluice of CVCIX B and the start of RF16	Cullie Miller	**LO-OLW-2008-139 CA101**
10/14/09	Shutdown ramp rates/de rate unit per RXE input	**Complete** Evaluate Down power to 80% 5 days prior to RF16.	Leia Milster	80% Down power approved 5 days prior to RF16
10/20/09	Start ARRS, Airborne Radiation Removal System	**Scheduled**	Ron Stanley	Plant Schedule

SFP and CVC Resin Loading:

FPIX (Ready for RF16 in service 8/29/09)
15 cu ft of Macro reticular (C-381-H) &
20 cu ft of NR-35LC (2:1 Marco Cation to Gel Anion)

This loading gives a good balance Cation to Anion removal which will control Iodine, Cesium, and Cobalt in the SFP and RX cavity during the outage. The Sluice and Reload late August should ensure capacity through the Refuel.

CVCIX A (Ready for RF16 in service 8/28/09)
35 cu ft of NR-20LC (1:1 Gel Cation to Gel Anion) Lithiated Resin

This Loading will improve Iodine, Cesium, and Cobalt removal going into RF16, and will not remove Lithium from the RCS, therefore not affect pH. It can be taken out of service just before RF16 and saved for start up for cycle 17.

CVCIX B (Sluice & Reload Scheduled 9/18/09)
35 cu ft of NR-6LC (1:1 Gel Cation to Gel Anion)

This Loading will be effective at Anion Removal more targeted at Iodine and Cesium, with reasonable balance for Cobalt and Hard Gamma Emitters. CVCIX B will be the main Ion Exchanger used for Iodine Cleanup the first part of the Refuel.

CVCIX C (Ready for RF16 in service 7/16/09)
15 cu ft of Macro reticular (C-381-H) &
20 cu ft of NR-35LC (2:1 Marco Cation to Gel Anion)

This Loading will be effective at Cation Removal more targeted at Cobalt and Hard Gamma Emitters, with reasonable balance for Anions such as Cesium and Iodine. CVCIX C will serve as a ready ion exchanger post peroxide add, and the main ion exchanger for cobalt cleanup.

CVC Ion Exchanger Strategy:

1. 24 hours prior to shutdown remove CVCIX A from service
2. 24 hours prior to shutdown place CVCIX B in service
3. Cleanup to 4.5E-3 uCi/ml RCS DEI
4. Place one train of Shut down Cooling in service
5. Bypass CVCIX B for Peroxide Add
    a. Add Peroxide to the RCS
6. Verify RCS is Oxidizing
    a. Place CVCIX C in service
7. Monitor and Determine Cobalt Peak
    a. Secure Reactor Coolant Pumps
    b. Cool Down Pressurizer
8. Place Shut down Cooling Purification in Service
9. Place CVCIX B in service (Parallel with CVCIX C)
10. Monitor CVCIX Effluent
    a. If Iodine starts to rise on CVCIX B Effluent then Isolate CVCIX B
    b. If CVCIX B gets isolated, make decision on need for contingent sluice and reload

Hard Spot: CVCIX B will be sluiced and reloaded on 9/18/09, it will require rinsing to be placed in service 24 hours prior to shutdown. Suggest using increased level in VCT during VCT burps as RCS inventory to periodically rinse CVCIX B prior to outage while boron is still relatively high.

Solution: Since Boron is low it is estimated the rinse will take about 10-12 hours of total rinse time to get Boron in specification with the RCS. Operations Outage Liaison has agreed the Operations can support periodic rinses of CVCIX B in combination with the scheduled VCT burps on every other Sunday leading up to the outage, which will reduce the final rinse time prior to placing in service. This has been incorporated into the plant schedule.

CVC Ion Exchanger Basis:

CVCIX A can not be used during the shutdown as it would put Lithium in the RCS and cause the system to go reducing after going oxidizing. By removing CVCIX A prior to the outage allows CVCIX A to rinse on startup and we can startup with a Purification Ion Exchanger for Cycle 17.

CVCIX B being placed in service 24 hours prior to shutdown will remove lithium, and is loaded with resin capacity and selectivity to be efficient at Iodine removal. Bypassing CVCIX B during the Peroxide add is a precaution and is recommended in the Failed Fuel Guidelines. The Primary Chemistry Guidelines do not require this, and this will be a difference from ANO and Calvert Cliffs.

Due to the Chromatograph effect seen at Calvert Cliffs, CVCIX C will be used mainly after the Peroxide addition.

ANO did not see the "Chromatograph Effect", which is an increase on their IX Effluent. Waterford Chemistry will monitor the IX Effluent of CVCIX B once placed back in service. When SDC Purification is placed in service, CVCIX B will be used again to support 240 GPM cleanup flow in parallel with CVCIX C.

If CVCIX B Effluent rises above 4.5E-3 on Iodine on two samples, it should be removed from service and implementation of contingency for resin replacement considered.

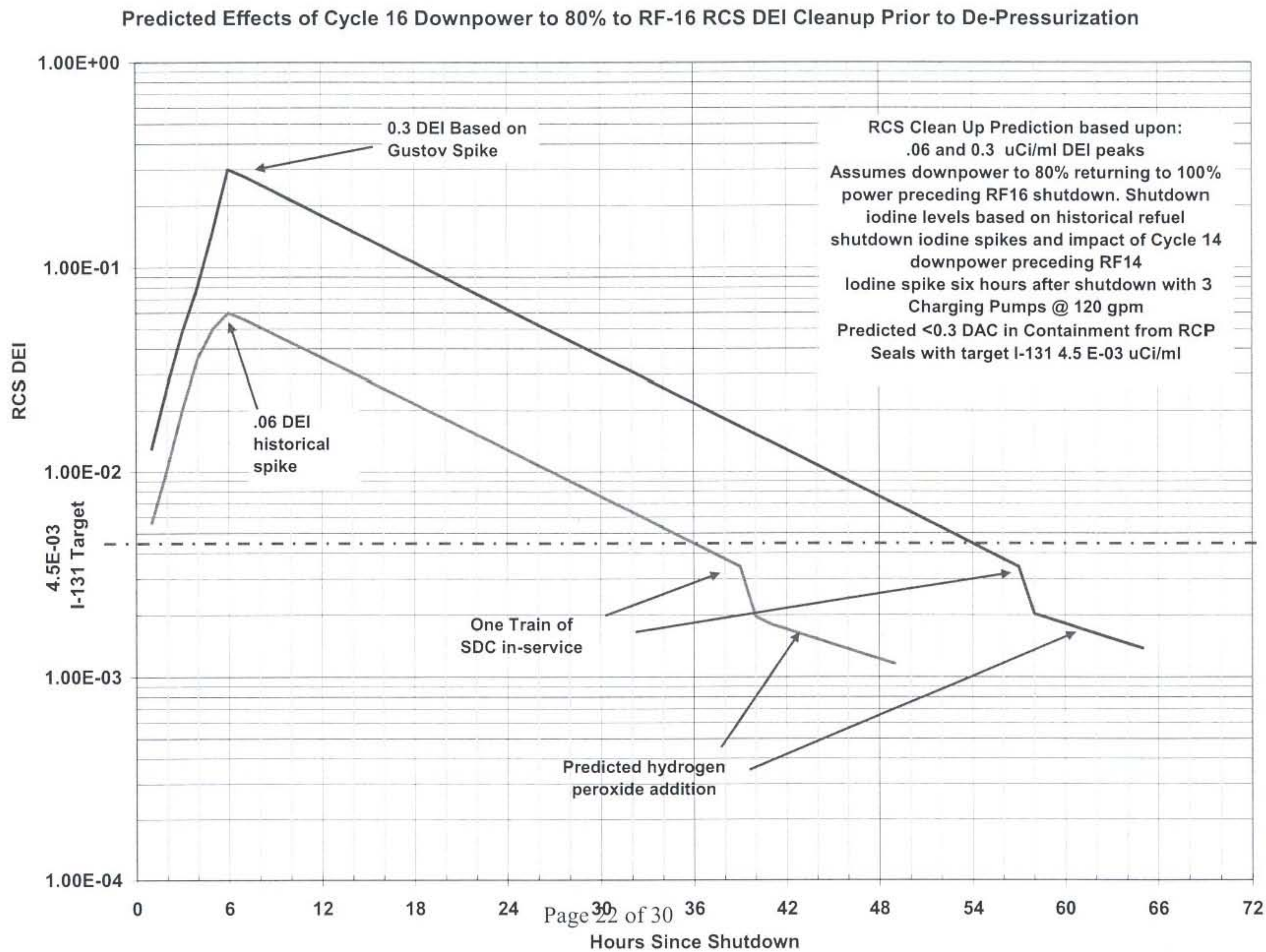
Contingencies:

During RF16, if CVC filter exhausts based on dose or differential pressure, filter should be changed out with new filter. Size to be determined by Chemistry based on plant conditions at time of occurrence. CVC filter replacement is scheduled during RF16; this package could be moved up in the outage as needed.

If CVC IX exhausts, ion exchanger should be sluiced and reloaded with new resin. **(LO-OLW-2008-139 CA 102**, assigned to chemistry to ensure 15 cu ft of Macro reticular (C-381-H) & 20 cu ft of NR-35LC (2:1 Marco Cation to Gel Anion) is on site during RF16 as a contingency item. **(LO-OLW-2008-139 CA104)**, assigned to RP to ensure a contingency package for CVCIX Sluice and Reload is planned and ready.

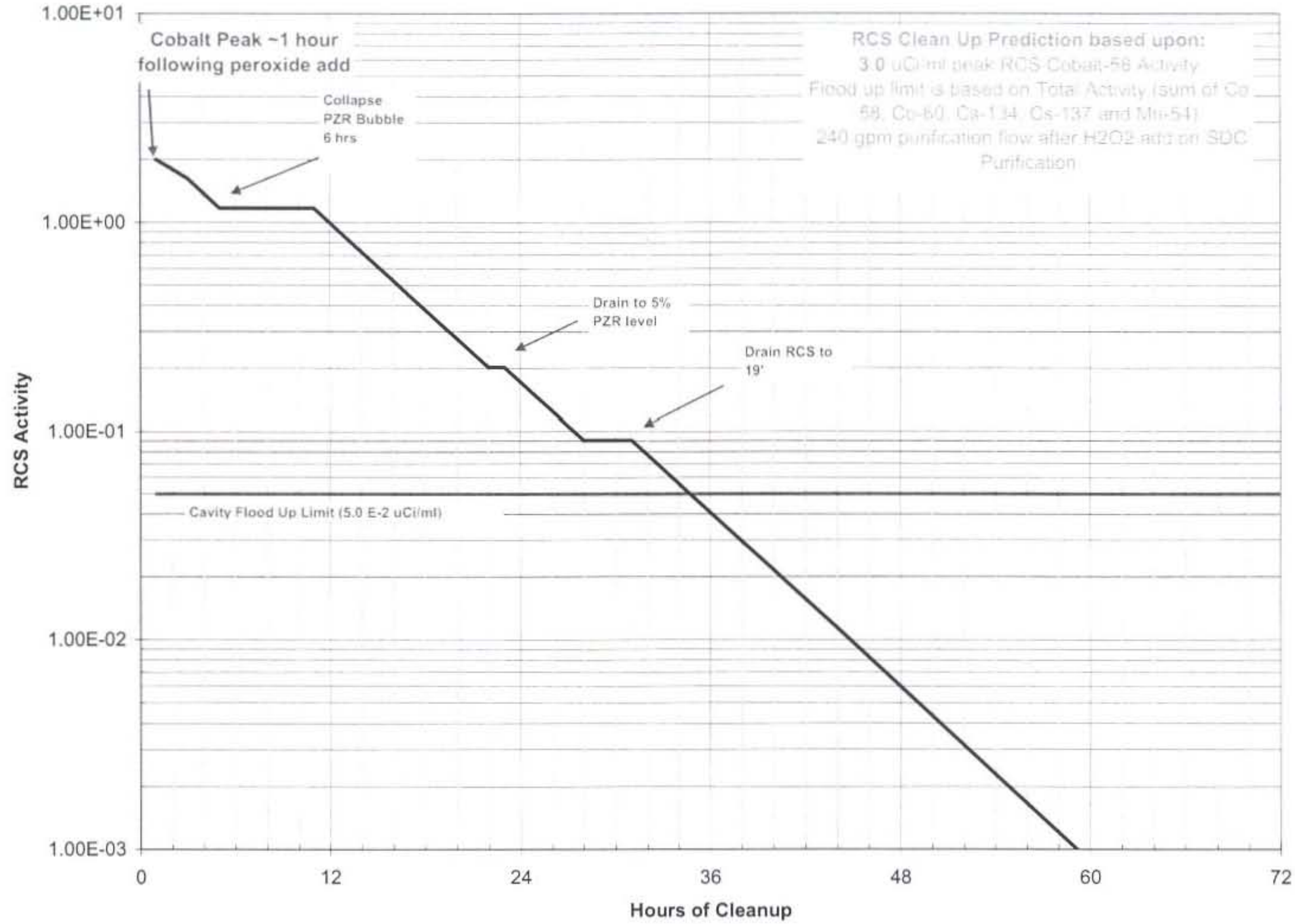
Unexpected Plant Shutdown:

- Line up Pressurizer Steam Space to Volume Control Tank
- Burp Volume Control Tank based on Chemistry input
- Secure Pressurizer Steam Space to Volume Control Tank when VCT venting is adequate.
- CVCIX are available for use and should be placed in/out of service based on Chemistry recommendations and conditions of the plant shutdown.



Predicted Effects of Cycle 16 Downpower to 80% to RF-16 RCS DEI Cleanup Prior to De-Pressurization
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
RCS DEI
4.5E-03 I-131 Target
0.3 DEI Based on Gustov Spike
.06 DEI historical spike
RCS Clean Up Prediction based upon: .06 and 0.3 uCi/ml DEI peaks Assumes downpower to 80% returning to 100% power preceding RF16 shutdown. Shutdown iodine levels based on historical refuel shutdown iodine spikes and impact of Cycle 14 downpower preceding RF14 Iodine spike six hours after shutdown with 3 Charging Pumps @ 120 gpm Predicted <0.3 DAC in Containment from RCP Seals with target I-131 4.5 E-03 uCi/ml
One Train of SDC in-service
Predicted hydrogen peroxide addition
0
6
12
18
24
30
36
42
48
54
60
66
72
Hours Since Shutdown

RF-16 RCS Cleanup (3.0 uCi/ml peak) Following DEI Cleanup



Timeline:

Before RF16:

Sept 14	Sample VCT and RCS for gas activity
Sept 15	Line up Pressurizer Steam Space to Volume Control Tank per CE-003-327
Sept 18	Sluice and Reload CVCIX B (WO-202560)
Sept 19	Secure Pressurizer Steam Space to Volume Control Tank per CE-003-327
Sept 19	Burp Volume Control Tank
Sept 21	Sample VCT and RCS for gas activity
Sept 21	Line up Pressurizer Steam Space to Volume Control Tank per CE-003-327
Sept 22	Secure Pressurizer Steam Space to Volume Control Tank per CE-003-327
Sept 23	Burp Volume Control Tank
Sept 27	Burp Volume Control Tank
Sept 27	Rinse CVCIX B (Use water from VCT burp, do not place IX in service)
Sept 28	Sample VCT and RCS for gas activity
Sept 30	Burp Volume Control Tank
Oct 4	Burp Volume Control Tank
Oct 4	Rinse CVCIX B (Use water from VCT burp, do not place IX in service)
Oct 5	Sample VCT and RCS for gas activity
Oct 6	Line up Pressurizer Steam Space to Volume Control Tank per CE-003-327
Oct 7	Burp Volume Control Tank
Oct 11	Burp Volume Control Tank
Oct 11	Rinse CVCIX B (Use water from VCT burp, do not place IX in service)
Oct 12	Sample VCT and RCS for gas activity
Oct 14	Burp Volume Control Tank
Oct 16	Plant will down power to facilitate cleanup
Oct 16	RCS DEI samples every 4 hours to profile Iodine behaviors during down power.
Oct 18	Burp Volume Control Tank as much as possible following return to 100% power
Oct 18	Rinse CVCIX B (Use water from VCT burp, do not place IX in service)
Oct 19	Reduce VCT pressure to maintain RCS Hydrogen to 25-30 cc/kg
Oct 19	Sample VCT and RCS for gas activity
Oct 20	Secure CVCIX A
Oct 20	Place CVCIX B in service (final rinse if necessary)

All above activities were verified by PS&O to be in the plant schedule as of 9/10/09.

Outage:

Oct 21	Multiple Volume Control Tank burps while maintaining hydrogen greater than 15 cc/kg in the Reactor Coolant System
Oct 21	OPS Maximizes Purification Flow (3 Charging Pumps when possible)
Oct 21	Chemistry Sample & Analyze in accordance with Sampling and Communication Plan
Oct 22	Reach 4.5E-3 uCi/ml RCS DEI
Oct 22	Place one train of Shutdown Cooling in service
Oct 22	Bypass CVCIX B
Oct 22	Switch in service Gas Decay Tank to B as necessary based on Hydrogen/Oxygen
Oct 22	Add Hydrogen Peroxide per CE-002-006
Oct 22	Chemistry verify RCS oxidizing
Oct 22	Place CVCIX C in service
Oct 22	Chemistry monitor for Cobalt Peak
Oct 22	Secure Reactor Coolant Pumps
Oct 22	OPS cool down Pressurizer
Oct 23	Place SDC purification in service
Oct 23	Place CVCIX B in service (in parallel with CVCIX C)
Oct 23	Utilize SDC Increased Purification Flow to 240 gpm with CVCIX B & C in Parallel
Oct 23	Chemistry Monitor CVCIX Effluent for Iodine Exhaustion
Oct 23	Chemistry sample every 4 hours for hard gamma cleanup monitoring and communicate results to OCC with updated cleanup curves.

All above activities were requested to be verified by PS&O Refuel to be in the outage schedule on 9/10/09.

Chemistry Sampling & Communication Plan:

Primary Sampling Plan:

Purpose: Monitor RCS DEI, RCS Xenon, RCS Boron, RCS Hydrogen, & VCT Hydrogen to provide technical data for monitoring of Primary side cleanup for RF16.

Resources:

Days: Chemistry Techs: *Ronnie Lacy (Lead) & Gene Plaisance (Support)*
Chemistry Supervisor: *Jeff Bourgeois*

Nights: Chemistry Techs: *Chad Jackson (Lead) & Aimey Tregre (Support)*
Chemistry Supervisor: *Daryl Marse*

Responsibilities:

Chemistry Techs: Sampling & analysis of Primary systems in accordance with site procedures at frequencies designated by this plan, CDMS, plant/outage schedule, and Chemistry Supervision request.

Chemistry Supv: Reviewing Primary Data as it is generated, updating cleanup curves, communicate primary sample results to the OCC as defined by this plan, site procedures and OCC communications protocol.

Sampling & Analysis Table:

NOTE: This table will not include any routine analysis designated by plant mode & CE-001-004 Periodic Scheduling & Analysis Program; requirements of CE-001-004 still apply. The Resources necessary for the completion of the ordinary Primary sampling and analysis have been factored into the technician resources allocated to the primary side of the plant.

RCS Boron will be sampled and analyzed to support OPS request, historically about 30 times within the first 36 hours of the shutdown.

4 hours prior to shutdown:

- Sample RCS for Gross (Gases) & Degas (Iodine) for ODMI
- Sample VCT for baseline Activity & Hydrogen

At shutdown:

- Sample & Communicate RCS for Gross (Gases & Iodine) for spike and recovery every 30 minutes until four data points are obtained in the downward direction for both Xe-133 & DEI.
- Sample RCS for DEI 2-6 hours following thermal power change of 15% in one hour for TS, this sample should be a Degas sample, this sample can substitute one of the 30 minute samples in the previous bullet.
- Sample RCS per Chemistry Supervisor recommendations for RCS conditions to verify RCS achieves and maintains an acidic reducing environment. See CE-002-006 for monitored parameters.
- RCS should be monitored for Hydrogen at least 4 times per shift, at approximately 0200, 0800, 1400, & 2200 until Peroxide Addition occurs. Communication of this data to the OCC will occur on next routine update following the analysis results being available.
- VCT should be sampled for Activity & Hydrogen twice per shift at approximately 0200, 0800, 1400, & 2200 for the first 48 hours of RF16, and then Chemistry Supervision may extend sampling frequency based on trend data and plant needs. Communication of this data to the OCC will occur on next routine update following the analysis results being available.

Once downward trend is established for Xenon & Iodine:

- Extend Sampling & Communication to an hourly frequency for RCS Gross (Gases & Iodine).
- Once trend data and projected estimates conclude that Iodine target of 4.5E-3 uCi/ml DEI will be reached within 6 hours, sample frequency for RCS Gross (Gases & Iodine) should return to once per 30 minutes.

Once 4.5E-3uCi/ml DEI in RCS is reached, then transition to Cobalt Cleanup Monitoring:

- Following Peroxide addition to the RCS, Sample and Analyze RCS for Cobalt Peak every 30 minutes until two data points indicate a lowering trend on Cobalt 58. Results will be communicated to the OCC
- Following Cobalt Peak determination extend sample and analysis frequency to once per two hours. Also monitor CVCIX Effluent for Iodine break.
- Once Cavity Flood up limit of 5.0E-2 uCi/ml Hard Gamma Emitters has been reached, follow CE-001-004 and Chemistry Supervision Guidance for additional sampling.

Communicating Sample Results:

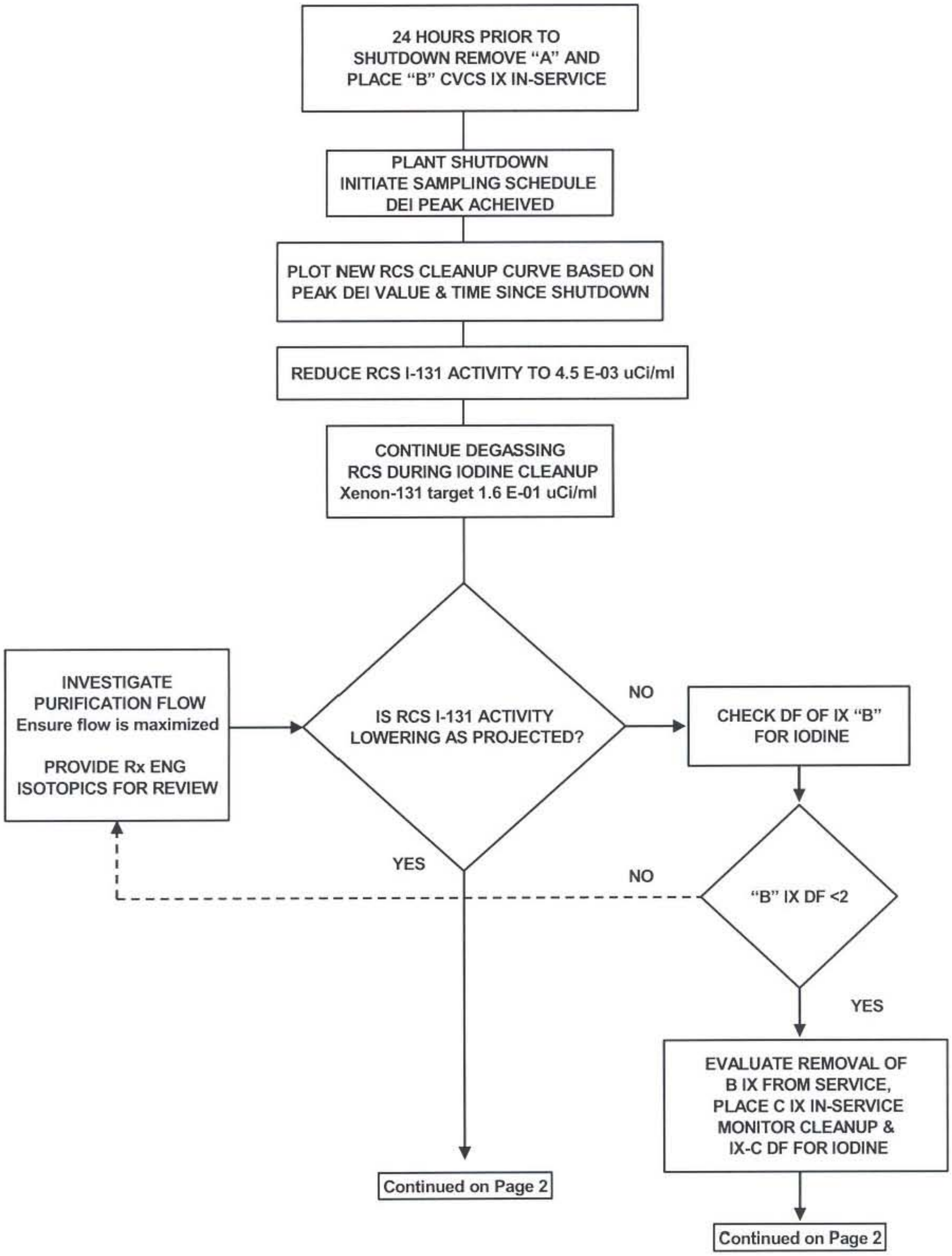
Results will be communicated to the OCC by the Primary Chemistry Supervisor Jeff Bourgeois (Days) & Daryl Marse (Nights). Once peak Iodine & Cobalt values are determined, projections will be recalculated and communicated via, phone to the RP/CHEM OCC lead at x3299. An updated graph for Iodine & Cobalt will also be sent via email. Other related parameters will be communicated by email on Table 1; example is on the next page.

Table 1 Chemistry Results Communicated to OCC

Date	Time	RCS Gas Act (uCi/ml)	RCS Xe-133 (uCi/ml)	RCS Boron (ppm)	RCS H2 (cc/Kg)	VCT Act (uCi/ml)	VCT H2 (%)	RCS Acidic? (YES/NO)	RCS Reducing? (YES/NO)

Figure 1

RCS CLEANUP FLOWCHART



RCS CLEANUP FLOWCHART