# OUTAGE RADIOLOGICAL GOAL SETTING

Effective Date: 11/18/21

Approved: Cris Mingus for Gil Nordlund Cris S. Mingus 9/7/21

Program Manager Date

TABLE OF CONTENTS

## 1.0 PURPOSE

This procedure is to provide guidance on the development, tracking and forecasting of Nuclear fleet Outage Exposure Projection, Outage Exposure Goals and EPRI Personnel Contamination Event Level 2 and Level 3 Goals.

## 2.0 SCOPE

Establish site radiological goals that are consistent with the Nuclear fleet goals. Establish realistic As Low As Reasonably Achievable (ALARA) based exposure goals to achieve industry excellence.

### 2.1 Applicability

This Nuclear Operating Procedure (NOP) is applicable to all Nuclear Generating Facilities.

### 2.2 Exceptions

None

## 3.0 DEFINITIONS

3.1 Outage Exposure Projection – The sum of outage exposure based on person-hour estimates and expected dose rates and/or historical performance. The Outage Exposure Projection is used in lieu of the Outage Exposure Estimate in this procedure.

3.2 Outage Exposure Goal – The sum of the Outage Exposure Projection plus an allotment for emergent work.

3.3 Outage Exposure Stretch Goal – A target value used to drive improved station performance and for exposure tracking.

3.4 Site Standard Outage Template – Site standard or typical outage work scope and exposure based on historical performance.

3.5 Transport Mechanism – A path, process, or action that allows source term to relocate leading to changes in radiological conditions.

## 4.0 PROCEDURE DETAILS

### 4.1 Responsibilities

4.1.1 The ALARA Department is responsible for:

1. Development of outage exposure estimates and goals.
2. Preparation of Attachment 1.
3. Periodically communicating assumptions and risks for outage dose via the Site ALARA Committee (SAC) and at Outage Management Team (OMT) meetings.
4. Develop Contingency Plans for additional controls that may be required due to increases in source term.

4.1.2 Site ALARA Committee and the Site ALARA Sub-Committees are responsible for the following:

1. Review, challenge, and approve the station's Outage Exposure and Personnel Contamination Event (PCE) Goals.
2. Meet periodically throughout the outage to approve dose goal adjustments and review station dose performance.

4.1.3 Work Group and / or Project Managers are responsible to support development of site ALARA goals and implementation of site ALARA initiatives.

4.1.4 RP/Chemistry Manager is responsible for reviewing assumptions used to anticipate source term changes and provide a projection on source term and its potential effects.

4.1.5 Outage Manager is responsible for reviewing assumptions used to anticipate outage scope, contract resources, and emergent dose.

### 4.2 T-6 Month Preliminary Exposure Projection

NOTE:

Actual radiation fields from previous outage(s) for that specific unit should be used as the basis for the preliminary dose projections.

4.2.1 Preliminary outage dose projections are developed using a combination of the following:

1. Use the standard outage template as the basis for initial work scope.

   a. Sites should develop an outage exposure template based on recurring work scope as a basis for initial exposure projections.

2. Known deviations in work scope should be used to adjust the outage work scope template.

   a. Added or deleted scope.

   b. Planned projects.

   c. Planned Modifications.

3. Past outage performance.

4. Work order estimates.

   a. Wrench hour estimates (preliminary)

   b. Most recent survey results.

5. Consider the expected nuclear plant outage experience level of incoming workers compared to previous outages for impact on exposure projections.

6. Consider the projected shielding scope compared to previous outages for impact on dose rates in affected areas of the plant.

7. Evaluate trends in chemistry parameters. This evaluation should include the following at a minimum:

   a. Reactor (Rx) water Cobalt (Co) levels. If Rx water Co is trending upward consider impact to increasing dose rates.

   b. Rx Water Co/Zn (Cobalt to Zinc) ratio. Operating for an extended duration with levels > 2E-5 µCi/ml/ppb may result in increased dose rates.

8. Consider performance of Attachment 3 (BWR) or Attachment 4 (PWR). The appropriate attachment is completed on a voluntary

basis and can be used to determine if area dose rates will be higher or lower in respect to previous base outage dose.

4.3 Develop Attachment 1

> NOTE:
>
> Site exposure and/or RWP exposure estimates shall not be altered to establish lower Outage Exposure Goals or Outage Exposure Stretch Goals.

4.3.1 Preparation of Attachment 1 should begin at T-6 months.

4.3.2 Refine the work hour estimates used for the preliminary exposure projection.

4.3.3 The previous 4 refueling outages should be used for establishing historical exposure and for calculating average exposure in Attachment 1.

4.3.4 Standard outage template items will comprise the Outage Baseline Activities section. They shall be entered into Attachment 1 by work group or project.

4.3.5 Frozen scope above the standard outage template will comprise the Non-Repetitive Activities section and shall be entered into Attachment 1 by project.

4.3.6 Include contingent work activity exposure estimates in the outage estimate only if the likelihood of performing the work is rated high and the work is loaded into the outage schedule.

4.3.7 Validate trends or changes in chemistry parameters. This evaluation shall be aided by the RP/Chemistry Manager or designee.

4.3.8 Validate transport mechanisms. Review outage schedule and interface with Operations about system use. This evaluation shall be aided by the Manager of Work Management and should include:

1. Online System Operation. The movement of source term due to system operation shall be used to estimate changes in dose rates and contamination levels. This includes, but is not limited to: Reactor Scrams, Hydrogen Water Chemistry (HWC) system trips, Reactor Water Clean Up (RWCU) system trips (including demineralizer performance), unavailability of Zinc (Zn) injection, suppression pool cleanup, and Control Rod/Channel Bow testing. Consideration shall be made for the timing of these events and the proximity to the outage.

2. Outage System Operation. The movement of source term post system shut down shall be used to estimate changes in dose rates and contamination levels. This includes, but is not limited to: Reactor and reactor cavity flood-up, steam line fill, Shut-down cooling initiation and loop-swaps, RWCU blow-down, Fuel Pool Cooling, Source term flushes, and reactor cavity drain-down. Water quality and the timing of a crud burst in conjunction with operation of these systems may heavily impact the dose rate outcomes. Performance of these systems in previous outages should also be considered.

4.3.9 The sum of Outage Baseline Activities and Non-Repetitive Activities will equal the Outage Exposure Projection.

4.3.10 Determine the Outage Exposure goal.

NOTE:

There is additional risk associated with performing a fast track project in a restricted/high dose area (Drywell, Condenser, Reactor cavity, etc.). Factor in emergent dose above the recommended 20% commensurate with the level of uncertainty with the fast track projects level of planning.

1. Average the emergent dose from the previous 4 refueling outages.

2. The sum of the Outage Exposure Projection and the emergent dose calculation from step 4.3.10.1 will equal the Outage Exposure goal.

3. The Outage Exposure goal should not exceed 120 percent of the Outage Exposure Projection.

    a. With the approval of the Site ALARA Committee, sites may adjust the value for emergent work higher than 120 percent based on a review of site historical performance.

4.3.11 Determine the Outage Exposure Stretch Goal

1. Method 1:

    a. Multiply the Outage Exposure Projection by 0.9 to determine the Outage Exposure Stretch Goal. Installation of temporary shielding, improved Radworker behaviors, remote monitoring, remote tooling and use of mock-ups are examples of items that justify the use of a 0.9 factor.

2. Method 2:

   a. The Site may elect to use a more aggressive Outage Exposure Stretch Goal.

   b. Detailed justification shall be provided on Attachment 1 explaining how the Outage Exposure Stretch Goal was established.

   c. Justifications should be listed in the blocks for the individual Projects / Work Groups that will contribute to the lower Outage Exposure Stretch Goal. Dose reduction initiatives in ALARA and Micro-ALARA plans may provide these justifications.

4.4 Approval of Attachment 1

4.4.1 The preparer shall sign and date Attachment 1.

4.4.2 The ALARA Supervisor, RP Superintendent and RP Manager shall review, sign and date Attachment 1.

4.4.3 Attachment 1 shall be presented to the Site ALARA Sub-Committee. The SASC shall challenge and then approve Attachment 1 after challenges are resolved. SASC Chairman signature denotes approval.

1. Approval shall be annotated in the appropriate SASC meeting minutes.

4.4.4 Attachment 1 shall be presented to the Site ALARA Committee. The SAC shall challenge and then approve Attachment 1 after all challenges are resolved. SAC Chairman signature denotes approval.

1. Approval shall be annotated in the appropriate SAC meeting minutes.

4.4.5 Attachment 1 shall be approved in time to meet the respective Outage Milestone closure requirement.

4.5 T-0 Outage Execution

4.5.1 Exposure estimates should be reevaluated using post shut down surveys performed in accordance with EPRI or Site guidance and adjusted, if needed. For instance, if projected source term reductions are not achieved, revision of the Outage Exposure Goal should be considered.

1. If Outage Exposure Goal increases due to elevated dose rates, compensatory plans shall be initiated. Additional compensatory plans should be developed based on any other unexpected conditions.

2. If a compensatory plan cannot be implemented such that the Outage Exposure Goal will be achieved, then the station should consider changing the Outage Exposure Goal.

3. If it is determined that the Outage Exposure Goal cannot be achieved, initiate a Condition Report and present the revised Outage Exposure Goal to SAC.

4.6 Exposure Tracking

4.6.1 Track Outage Exposure performance against the Outage Exposure Stretch Goal.

4.6.2 Tracking reports (See Attachment 2 for an example) should be established for the following as a minimum:

1. RWP or major evolution

2. Cumulative Outage

3. Daily outage projections

4.6.3 Update and distribute tracking reports at least once per 12-hour shift.

5.0 RECORDS

5.1 Records Handling

None

5.2 Quality Records

None

5.3 Non-Quality Records

None

5.4 Non-Records

Attachment 1

6.0 REFERENCES

6.1 Discretionary

NOP-OP-4107, Radiation Work Permit (RWP)

6.2 Obligations

None

7.0 SCOPE OF REVISION

Total rewrite

## ATTACHMENT 1: OUTAGE RADIOLOGICAL GOALS WORKSHEET GUIDE



Use the Activity Description only as a guide for your outage. Fill in with projects, specific and routine activities for your station.

**OUTAGE BASELINE ACTIVITIES**

| Activity Description / Notes / Justification | Historical Exposure in mrem | Average Exposure in mrem | Estimated Exposure in mrem |
|---|---|---|---|
| Operator Rounds<br><br>Notes:<br>• *Activities that have been or can be tracked / estimated with some high degree of accuracy*<br>• *These may be grouped together with a listing of tasks or activities recorded from historical RWP's.*<br>• *No emergent work activities may be considered here unless the issue consistently has a history. An example would be a pump seal that fails every year.*<br>• *As many notes and details may be placed in this area as needed*<br><br>Justification: Dose rates are projected be consistent with 21R. | 18R – 240<br>19R – 226<br>20R – 215<br>21R – 185 | 217 | 172 |
| I&C Surveillances<br><br>Notes:<br><br>Justification: The Department believes they can perform this task in the mid-nineties | 18R – 92<br>19R – 96<br>20R – 97<br>21R – 94 | 95 | 95 |
| Radwaste Resin/DAW processing and shipping<br><br>Notes:<br>Justification: Station has a long history of expenditures for this activity. Station is going to ship the following - 3 Class B primary HIC's – 12 DAW Containers – 2 Shielded Filters | 27 / Class B HIC<br>9 / DAW<br><br>122 / Filter | 81<br>108<br><br>244 | 433 |
| Refueling (outage avg. last 5yrs)<br><br>Justification: 22R outage is similar scope of work as previous outages however, the 22R outage is scheduled for less duration than previous outages | 18R - 8930<br>19R - 7340<br>20R - 7435<br>21R - 6711 | 7604 | 6,040 |

ATTACHMENT 1: OUTAGE RADIOLOGICAL GOALS WORKSHEET GUIDE
Page 2 of 3

| **NON-REPETITIVE ACTIVITIES** | | | |
|---|---|---|---|
| **Activity Description / Justification** | **Historical Exposure in mrem** | **Average Exposure in mrem** | **Estimated Exposure in mrem** |
| Fuel Pool Re-Rack<br>Note: Other sites have performed this for < 2 rem<br>Average is 1810 mrem | N/A | 1,810 | 1,850 |
| Projected Exposure | 8,590 mrem | | |
| Emergent Work | 18R – 750<br>19R – 832<br>20R – 887<br>21R – 712 | 795 | 795 |
| Outage Exposure Goal<br>Example: Projected exposure plus emergent average | 8,590 | 795 | 9,385 |
| Outage Exposure Stretch Goal<br>Example: Projected exposure times 0.9. A more conservative stretch goal may be established with justification. | 8,590 | X 0.9 | 7,731 |
| | | | |
| Station Personnel Contamination Event (PCE) Goal for EPRI Level 2 and 3 | < 3 | | |

ATTACHMENT 1: OUTAGE RADIOLOGICAL GOALS WORKSHEET GUIDE
Page 3 of 3

Site Recommended Goals:

Recommended Outage Exposure Goal is _____ mrem

Recommended Outage Exposure Stretch Goal is _____ mrem

Recommended Outage Level 2 and Level 3 PCE Goal is _____ PCE's

Completed by:_____ Date: ____/____/____

ALARA Supervisor Review by:_____ Date: ____/____/____

RP Superintendent Review by:_____ Date: ____/____/____

RPM Review by: _____ Date: ____/____/____

Presented to Site ALARA Sub-Committee during SASC Meeting #_____ Date: ____/____/____

Reviewed By:_____ Date: ____/____/____
SASC Chairman

Presented to Site ALARA Committee during SAC Meeting #_____ Date: ____/____/____

Approved By:_____ Date: ____/____/____
SAC Chairman

Approved Outage Exposure Goal is _____ mrem

Approved Outage Exposure Stretch Goal is _____ mrem

Approved Outage Level 2 and Level 3 PCE Goal is _____ PCE's

## ATTACHMENT 2: OUTAGE EXPOSURE SUMMARY

# OUTAGE EXPOSURE SUMMARY

**As of:** 0:00

| RWP NUMBER | DESCRIPTION | RWP STATUS / OWNER | Last 12 hrs. (mrem) | ACTUAL EXPOSURE (mrem) | EXPOSURE GOAL (mrem) | PERCENT OF GOAL |
|---|---|---|---|---|---|---|
| **REFUELING** | | Tyler Dileo | | | | |
| 116-4022 | Reactor Core Offload / Reload | | 0 | 0<br>0 | 0<br>0 | 0% |
| **STEAM GENERATOR MAINTENANCE** | | Gary Alberti | | | | |
| 116-0501 | Ship SG Equipment / SL Trailer | | 0 | 0<br>0 | 0<br>0 | 0% |
| **INSERVICE INSPECTIONS** | | Dave Grabski | | | | |
| 116-0504 | Inservice Inspections-PAB | | 0 | 0 | 0 | 0% |
| **MOTOR OPERATED VALVES** | | Matt Wimmel | | | | |
| 116-0502 | MOVATS Testing | | 0 | 0<br>0 | 0<br>0 | 0% |
| **SNUBBERS** | | Dan Thompson | | | | |
| 116-0503 | Snubber Testing & Repair | | 0 | 0 | 0 | 0% |
| **TYPE 'C' AND OTHER TESTING** | | Jack Patterson | | | | |
| 116-0505 | Type C and Other Testing | | 0 | 0 | 0 | 0% |
| **I&C MAINTENANCE** | | Jan Kunz | | | | |
| 116-4005 | Outage I&C Maintenance | | 0 | 0<br>0 | 0<br>0 | 0% |
| **ELECTRICAL MAINTENANCE** | | Tom Saska | | | | |
| 116-4004 | Outage Electrical Maintenance | | 0 | 0 | 0 | 0% |
| **MECHANICAL MAINTENANCE** | | Fran Trusky | | | | |
| 116-4003 | Outage Mechanical Maintenance | | 0 | 0<br>0 | 0<br>0 | 0% |
| **CONSTRUCTION MAINTENANCE** | | Julie Martin | | | | |
| 116-4007 | Outage Construction Maintenance | | 0 | 0 | 0 | 0% |
| **OTHER SIGNIFICANT WORK** | | | | | | |
| 116-0506 | Operations Functions - PAB | Dave Gibson | 0 | 0 | 0 | 0% |
| 116-4000 | Radiation Protection Functions | Eli Crosby | 0 | 0 | 0 | 0% |
| 116-4001 | Chemistry Sampling - RBC | Dr. Winters | 0 | 0 | 0 | 0% |
| 116-4002 | Operations Functions - RBC | Eric Loehlein | 0 | 0<br>0 | 0<br>0 | 0% |
| | All Other RWPs | | 0 | 0 | 0 | 0% |
| **PROJECTS** | | | | | | |
| 116-0516 | Radiography | | 0 | 0<br>0 | 0<br>0 | 0% |

| | | |
|---|---|---|
| **Last Shift's exposure:** | **0 mrem** | **(Including Emergent)** |
| **Last Shift's Goal:** | **0 mrem** | |
| **9/27 Goal:** | **0 mrem** | |

**Goal To-date**
**0 mrem**

**Exposure To-date (Including Emergent)**
**0 mrem**

**0 mrem**
**Outage Exposure Goal**

**% Outage Goal**
**0.0%**

# ATTACHMENT 3: EXAMPLE – BWR RISK MATRIX

Page 1 of 2

**For Outage: (T-6 Estimate)** **Date Completed:**

| PI Name | Rate or Dose | Definition | Significance Factor | Risk Criteria | Risk Value and Color | IF PREVIOUS COLUMN Grn=1, Wht=2, Ylw=3, Rd=4 | Tool Total |
|---|---|---|---|---|---|---|---|
| **On-line Chemistry Parameters** | | **Chemistry Department Responsible for Data (unless otherwise noted)** | | | | | |
| Soluble Cobalt | R | Cycle Median Soluble Cobalt in uCi/ml | 3 | % change from previous cycle Green < - 20%, WHT - 20% to <+5%, Yellow 5% to <+20%, Red > +20% | -15 | 2 | 6 |
| Insoluble Cobalt | R | Cycle Median Insoluble Cobalt in uCi/ml | 3 | % change from previous cycle Green < - 20%, WHT - 20% to <+5%, Yellow 5% to <+20%, Red > +20% | 0 | 2 | 6 |
| Cobalt to Zinc Ratio | R | Cycle Average Ratio (Goal = < 2 E -5) | 3 | Green = < 2 E-5, WHT = 2 to 5 E-5, Yellow = 5E-5 - 1E-4, Red = > 1 E-4 | 5.76E-06 | 1 | 3 |
| Cobalt Carryover | R | Cumulative total Cobalt transported in Curies; calc: RxH20 uCi/mL*mL in period through MSL (~E13)*fractional MCO (use Na-24 - similar) for 6-months prior to outage. | 3 | Green = < 5 Ci, WHT = 5-10 Ci, Yellow = 10-20 Ci, Red = > 20 Ci Total curies 6 months prior to outage | 2.0 | 1 | 3 |
| Feedwater Iron | R | Cycle Average Iron in PPB (Goal = 0.1 - 0.5 ppb) High Fe reduces zinc effectiveness, low Fe results in crud bursts | 1 | Green = 0.1 - 0.5 / WHT 0.0 - 0.1 and 0.5 - 2.0 / Yellow >2.0 | 0.60 | 2 | 2 |
| On-line Nickel | S | Cycle Average Feedwater Nickel | | | | | |
| On-line Copper | S | Cycle Average Feedwater Copper | | | | | |
| Hotwell Co-60 levels | S | Hotwell total Co-60 6-months prior to outage | | | | | |
| RCS Zinc | S | Cycle Average Reactor Water Zinc (ppb) | | | | | |
| FW Zinc | S | Cycle Average Feedwater Zinc (ppbm) | | | | | |
| ECP or Molar Ratio (calculated) | R | Cycle Average ECP (mV) or Calculated Molar Ratio (Hydrogen:Oxygen) [Goal ECP <-400, Molar Ratio 3:1] | 1 | ECP: Green = <-400, White = -350 to -400, Yellow >-230 to -350, Red > -230 Molar Ratio: Green = > 4:1, White = 3:1, Yellow > 2:1, Red <2:1 | -491 | 1 | 1 |
| MCO | S | Cycle Average MCO in % (Goal <0.10%) | | | | | |
| Other | S | Plant Specific Chemistry Parameter | | TBD | | | |
| **Source Term Transport Mechanisms** | | **Chemistry Department Responsible for Data (unless otherwise noted)** | | | | | |
| Classic Noble Chem previous outage | R | Yes or No | 3 | Green = No, Red = Yes | No | 1 | 3 |
| On-Line Noble Chem since previous outage | R | Yes or No | 2 | Green = No, Yellow= Yes | Yes | 3 | 6 |
| HWC System Performance (1) | R | Number of system trips for 12-mo period before outage | 2 | Green = <=1, WHT = 2-3, Yellow = 4-5, Red = > 5 | 1 | 1 | 2 |
| Cycle length | R | # of Operating days | 1 | % change from last cycle Green <-20%, WHT >-20% to <+5%, Yellow >+5% to +> +19%, Red > +20% | 4 | 2 | 2 |
| RWCU System Performance | R | System Availability Percentage during last 6-mos of cycle. | 2 | total flow thru demins/total possible flow Green = > 95%, WHT = 90-95%, Yellow = 85-90%, Red = < 85% | 99 | 1 | 2 |
| Excessive draining / flushing to Supp. Pool / | R | Total Cobalt-60 in Curies to torus during prev refueling outage. (volume X activity = Ci) | 1 | Green = < 1 Ci, WHT = 1-2 Ci, Yellow = 2-3 Ci, Red = > 3 Ci | 0.2 | 1 | 1 |
| Other | S | Plant Specific Source Term Transport Mechanism | | TBD | | | |

# ATTACHMENT 3: EXAMPLE – BWR RISK MATRIX

Page 2 of 2

| Outage Schedule / Scope / Resources | | Work Planning / Work Control Responisble for Data (unless otherwise noted) | | | | | |
|---|---|---|---|---|---|---|---|
| Emergent Dose Budget | D | Comparison of emergent dose budgeted to 3 outage rolling average | 3 | Green = <-5% , WHT = -5 <-2 %, Yellow -2 < +5%, Red >+5% | -1.9 | 3 | 9 |
| AOV and MOV in containment | D | % Above baseline | 1 | Green = Up to 10% above baseline, Yellow = Baseline >10% but <25%, Red >25% | 10 | 1 | 1 |
| Primary systems valves being breeched | D | Above baseline -Total Additional Dose | 3 | Green = <1 Rem, White = 1 but <5 Rem, Yellow = 5 but <10 Rem, Red >10 Rem | 4 | 2 | 6 |
| First time, High Dose Projects | D | Number and magnitude of first time or rarely (>10 yr frequency) performed projects estimated at >= 3 Rem | 3 | Green = 0, WHT = 1, Yellow = 2, Red = >=3 | 0 | 1 | 3 |
| Scope added after BP Goal established | S | Added Scope after T6 in Rem | | Green = < 5, WHT = 5-7, Yellow = 7-10, Red = >10 | | | |
| Contracted Craft Experience Level | D | Percentage of P1s to P2s (at time of tool calc) | 3 | Green = < 10%, WHT = 10-20%, Yellow = 20-30%, Red = >30% | 15 | 2 | 6 |
| Contracted Craft Numbers | D | Number of contractors above / below previous 3 outage baseline | 2 | Green = < 5%, WHT = 5 to <10%, Yellow = 10% to <20%, Red = >20% | 8 | 2 | 4 |
| RWP Estimate Vs. Goal GAP | D | % Delta between RWP detailed estimates and Stretch Goal in Rem **(RP to provide Data)** | 3 | Green = < 10%, WHT = 10% but < 20%, Yellow = 20 but < 25%, Red = > 25% | 3 | 1 | 3 |
| RWCU during outage | D | Time system shutdown during outage (as scheduled) | 3 | Green = System ON maximum hours, YELLOW = System OFF <8 hours when baseline schedule would have system ON, RED =System OFF >8hrs | 0 | 1 | 3 |
| In vessel work | S | Risk of work | | | | | |
| Working crew effectiveness | S | Combined crews for working efficiencies | | Subjective "side" item | | | |
| Fuel Pool Demin Performance | D | % Availability planned | 2 | Green = 100%, Yellow 90% but <100%, Red = <90% | 100 | 1 | 2 |
| In water Refueling platform use | D | % of use above baseline based on historical and expected person hours. | 1 | Green =0%, Yellow = Up to 20%, Red >20% | 0 | 1 | 1 |
| Outage Duration | D | Days Greater than 17 | 2 | Green = 0, White = 1 but <2, Yellow = 2 but <3, Red = >3 | 1 | 2 | 4 |
| Drywell scheduled open longer than baseline | D | Days greater than baseline | 2 | Green = 0, White = 1 but <2, Yellow = 2 but <3, Red = >3 | 1 | 2 | 4 |
| Confidence in estimated dose | S | One time projects with OPEX data | | | | | |
| # of fuel bundles being moved | D | % (+ or -) of average past fuel move baseline with current or expected changes factored in. The concern is the crud released during transfer and additional time/dose for movements. | 2 | Green = 0 to 10%, YELLOW = 10% to <25%, RED = >25% above baseline | 5 | 1 | 2 |
| Significant rework | S | | | | | | |
| Deviations from shutdown template | S | Shutdown Co-60 peak from previous cycle needs to be considered | | | | | |
| **Fuel Effects** | | Reactor Engineering / Nuclear Fuels Responisble for Data (unless otherwise noted) | | | | | |
| Axial / Radial Power Peaking | S | | | | | | |
| # of suppressed bundles | R | Time in cycle<br>Number of fuel bundles suppressed by Control Blades within 4 months before RF outage. | 2 | Green = 0 , White = 1 to 12, Yellow = 13 -24, Red = >24 | 0 | 1 | 2 |
| Control rod Testing (channel distorotion, scram | R | Percent number of total control blades moved for testing within 4 months before RF outage. | 1 | Green = 0 , White = 1 -20%, Yellow = 21 - 40%, Red = >40% | 16 | 2 | 2 |
| Downpower length and depth | R | Number of power reductions during the cycle in which power is less than 85% RTP for greater than 24 hours within 4 months before RF outage. | 3 | Green = 0, White = 1- 3, Yellow= 4 - 6,<br>Red = > 6 | 2 | 2 | 6 |
| Fuel Washout | R | Projected factor of RW I-131 increase at EOC due to failed fuel (I-131 @ EOC due to fuel defect/I-131 prior to defect) | 3 | Green = < 0, White = 1 - 5, Yellow = 6 =10,<br>Red = > 10 | 0 | 1 | 3 |
| **Implementation of BP Gap Reduction** | | RP/OP's Responsible for Data | | | | | |
| New Shielding | S | | | | | | |
| Flushing | S | | | | | | |
| MSL Fills | S | | | | | | |
| Soft Shutdown | S | | | | | | |
| **Overall Score & Color** | | **Assessment of Outage Risk** | | | | **where: Grn =<100, Wht = 100 - <160, Ylw =160 - <220, Rd** | **98** |
| 1) Go up one color change if event(s) occurred within 60 days of outage. | | | | | | | |
| 2) Go up one color change if Hard Scram | | | | | | | |

# ATTACHMENT 4: EXAMPLE – PWR RISK MATRIX

Page 1 of 2

**Example – PWR Outage Risk Matrix**

| Parameter | Definition | Geographic Multiplier (SRMP, Basepoints, or Both) | Significance Factor | Risk Criteria | Base Cycle | Evaluated Cycle | Calculation (compared to base cycle) | Scoring | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **On-line Chemistry Parameters** | | | | | | | | | |
| Cobalt 58 (uCi/gm) | Cycle Average Cobalt 58 in uCi/ml | | 0 | Trend Only. EPRI data indicates no correlation with dose rates | 2.32E-03 | 2.98E-03 | | | |
| Cobalt 60 (uCi/gm) | Cycle Average Cobalt 60 in uCi/ml | | 0 | Trend Only. EPRI data indicates no correlation with dose rates | 6.19E-05 | 1.26E-04 | | | |
| Cycle Co58/Co60 Ratio | | Both | 5 | Value compared to previous cycle | 37.5 | 23.7 | -0.37 | -3.7 | |
| Zinc Exposure (ppb-months) | ppb-months compared to last cycle | SRMP | 6 | Value compared to previous cycle (+/- 10%) | 46.2 | 68.1 | 0.47 | 5.7 | |
| End of Cycle Boron (ppm) | EOC boron concentration | SRMP | 2 | Value compared to previous cycle | 10 | 21 | 1.10 | 4.4 | |
| Days of coastdown at zero boron | Number of days | Both | 4 | Value compared to previous cycle | 0 | 0 | 0.00 | 0.0 | |
| Dose Equivalent Xenon | Cycle DEX trend | | 0 | Trend Only. No correlation with dose rates has been established | | | | | |
| Cobalt 58 Crud (uCi/gm) | Cycle average crud trend | | 0 | Trend Only. EPRI data indicates no correlation with dose rates | | | | | |
| RCS Elevated Modified pH program | Elevated modified pH implemented | SRMP | 2 | Yes / No | No | No | no change | 0.0 | |
| Cycle letdown flow rates (gpm) | Cycle average flow rate | Basepoints | 4 | Value compared to previous cycle (+/- 10%) | 115 | 114 | 0.00 | 0.0 | |
| RCS Nickel (Average - ppb) | Cycle average nickel (ppb) | | 0 | Trend Only. EPRI data indicates no correlation with dose rates | 3.6 | 2.5 | | | |

## ATTACHMENT 4: EXAMPLE – PWR RISK MATRIX (Continued)

Page 2 of 2

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Source Term Transport Mechanisms** | | | | | | | | | |
| Control Rod Movement more than 5 steps with boron < 100 ppm | Number of times there was control rod movement > 5 steps with boron < 100 ppm | Basepoints | 4 | Number of control rod groups with movement > 5 steps with boron < 100 ppm | 4 | 4 | no change | 0.0 | |
| Plant Shutdowns within last 6 months of cycle | Number of shutdowns and type (hard or soft) during last 6 months of cycle | Both | 3 | Yes / No | no | yes | 1 | 6.0 | |
| Significant Down Powers within last 6 months of cycle | Number of down powers > 15% during last 6 months of cycle | Basepoints | 3 | Yes / No | No | No | no change | 0.0 | |
| Fuel Cleaning | | | 0 | Trend Only. EPRI data indicates no correlation with dose rates | No | No | no change | | |
| Stellite inventory | Calculated release rate (grams per cycle) | Both | 2 | Value compared to previous cycle (+/- 10%) | same | same | no change | -4.0 | |
| Past outage valve internals work scope | Number of valves opened | Both | 2 | Value compared to previous outage (+/- 10%) | 4 | 7 | 0.75 | -3.0 | |
| Shielding package compared to previous outages | Deviation from standard outage shielding package | | 0 | Value compared to previous outage (+/- 10%) | 48 - (120k lbs) | 39 - (80k lbs) | | | |
| Sheilding (as pounds of lead) | | Basepoints | 3 | | 120000 | 80000 | -0.33 | -2.0 | |
| Planned flushing scope | changes to planned outage scope (more or less flushing) | Basepoints | 3 | Value compared to previous outage (+/- 10%) | same | same | no change | 0.0 | |
| RCS piping Co-60 trend from gamma scans | Direction of trend | Basepoints | 5 | increasing (or no data), decreasing, not changing | No Data | No Data | No Data | -20.0 | |
| CV Letdown dose rate Trends | CV Letdown dose rates above the average | Basepoints | 3 | Percent change compared to base cycle | 200% increase during last 4 weeks of cycle | 150% increase during last 4 weeks of cycle | 25% | 1.5 | |
| **Outage Schedule / Scope / Resources** | | | | | | | | | |
| Core Boil Area (ft2) | Cycle maximum from BOA report | Both | 5 | Value compared to previous cycle | 3856 | 3975 | 0.31 | 3.1 | |
| # Channels > 300 lbm/hr-ft2 | Cycle maximum from BOA report | Both | 3 | Value compared to previous cycle | 71 | 69 | -0.28 | 1.7 | |
| # Channels > 500 lbm/hr-ft2 | Cycle maximum from BOA report | Both | 5 | Value compared to previous cycle | 63 | 61 | -0.32 | 3.2 | |
| **ALARA Planning** | | | | | | | | | |
| Confidence in historical dose rate data on unit of interest | Is there significant scope for which we don't have decent historical data? | Both | 5 | Yes / No - Uncertainty input only. Lower historical confidence increases uncertainty in results | yes | No | -1 | -100.0 | |
| **Data Analysis** | | | | | | | | | |
| Total Score | Red indicates that dose rates are likely to Increase | | | Total score: Green >0, White = 0, Red = <0 | | | | -10.3 | |
| Average Score | Red indicates that dose rates are likely to Increase | | | Average Score: Green >0, White = 0, Red = <0 | | | | -0.3 | |
| Uncertainty | High uncertainty indicates that contingency plans for dose increase should be developed | | | Uncertainty Rating | | | | High Uncertainty | |

A. When the total and average scores are both negative, dose rates will likely be higher compared to the base outage. The dose projections should be adjusted by a factor based on the magnitude of the score.

B. If the uncertainty ranking is high, the possibility that dose rates could be higher than the base outage

C. The results should be presented to the station ALARA committee (SAC)