2009 UPDATE OF THE

QUANTITATIVE RISK ASSESSMENT FOR THE STATE-LICENSED DISPOSAL AREA

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West Valley Citizen Task Force Meeting
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2009 SDA QRA UPDATE

- **QRA IS AN ITERATIVE PROCESS**
- **EVOLUTION OF 2008 DRAFT STUDY**
- **RE-EXAMINE IMPORTANT TECHNICAL ISSUES AND UNCERTAINTIES IN THE 2008 DRAFT RESULTS**
- **QRA TEAM INSIGHTS FROM 2008 ANALYSES**
- **PUBLIC INPUT AND COMMENTS**

RELEASE MECHANISMS

1 Liquid releases via groundwater flow through the Unweathered Lavery Till (ULT) and Kent Recessional Sequence (KRS) layers

2 Liquid releases via groundwater flow through the Weathered Lavery Till (WLT) layer

3 Trench overflow and liquid releases via surface water runoff

4 Physical breaches of the trenches and releases of liquids and solid materials

5 Extensive physical disruption of the site with airborne releases

2008 DRAFT QRA RESULTS
RELEASE MECHANISM CONTRIBUTIONS TO RISK

• RELEASE MECHANISM 1	53%
• RELEASE MECHANISM 2	39%
• RELEASE MECHANISM 3	6%
• RELEASE MECHANISM 4	2%
• RELEASE MECHANISM 5	< 0.1%

2008 DRAFT QRA RESULTS
RELEASE SCENARIO CONTRIBUTIONS TO RISK
(INDIVIDUAL SCENARIOS > 1% OF TOTAL)

- **Lateral groundwater flow through the WLT when trench water levels are at the top of the trenches (39%)**
- **Lateral groundwater flow through the ULT when trench water levels are at the WLT / ULT interface (35%)**
- **Lateral groundwater flow through the ULT when trench water levels are at the top of the trenches (16%)**
- **Trench overflow when trench water levels are at the WLT / ULT interface (5%)**
- **Vertical groundwater flow downward through the ULT and laterally through the KRS to Buttermilk Creek (3%)**

2009 QRA UPDATE ENHANCEMENTS

- **IMPROVED EVALUATION OF TRENCH WATER LEVEL PROBABILITIES**
- **IMPROVED EVALUATION OF BUTTERMILK CREEK WATER SAMPLING**
- **IMPROVED EVALUATION OF UNCERTAINTIES IN SDA TRENCH LIQUID RADIONUCLIDE CONCENTRATIONS**
- **IMPROVED CORRELATIONS OF INCIDENT PRECIPITATION, TRENCH OVERFLOW FLUID VOLUMES, AND CREEK FLOW RATES**
- **ASSESSMENT OF POTENTIAL NUCLEAR CRITICALITY**
- **SENSITIVITY ASSESSMENT OF TERRORIST ATTACKS AND DELIBERATE ACTS OF DESTRUCTION**
- **SENSITIVITY ASSESSMENT OF EFFECTS FROM CLIMATE CHANGE**

TRENCH WATER LEVEL PROBABILITIES

- **2008 ANALYSES BASED ON EXPERT ELICITATION RESULTS**
- **MORE COMPREHENSIVE ANALYSES IN 2009**
  - **EXAMINATION OF SITE TOPOGRAPHY**
  - **EVALUATION OF HISTORICAL TRENCH LEVEL DATA, BEFORE AND AFTER GEOMEMBRANES INSTALLED**
  - **ANALYSIS OF CAUSES FOR GEOMEMBRANE DAMAGE AND QUANTIFICATION OF GEOMEMBRANE UNAVAILABILITY**
  - **USE OF METEOROLOGICAL DATA TO QUANTIFY FREQUENCY OF PRECIPITATION EVENTS THAT MAY INCREASE TRENCH LEVELS IF GEOMEMBRANES ARE NOT INTACT**

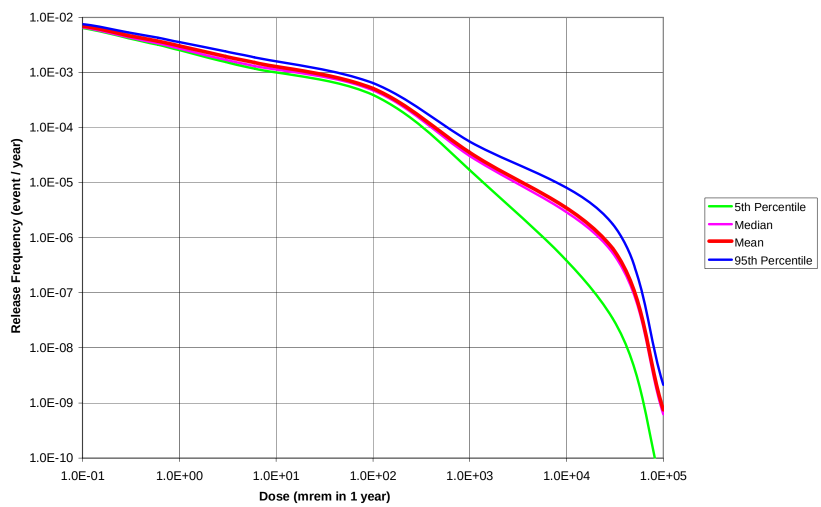
TRENCH WATER LEVEL PROBABILITIES

Water Level	2008 Estimated Probability	2009 Quantified Probability
Top of Trench	10%	0.1%
WLT / ULT Interface	30%	1.4%
Current Level	55%	93.5%
Trench Bottom	5%	5%

TRENCH OVERFLOW ANALYSES

- **IMPORTANT FACTORS**
  - **PRE-EXISTING TRENCH WATER LEVELS**
  - **STATUS OF GEOMEMBRANES**
  - **CONDITION OF COMPACTED CLAY CAPS**
- **PRECIPITATION REQUIRED TO FILL TRENCHES FROM PRE-EXISTING LEVEL TO HIGHER LEVEL**
  - **SEVERE STORMS (DAMAGING WINDS AND STRONG RAIN)**
  - **INTENSE PRECIPITATION (EROSION OF EXPOSED CLAY CAPS)**
  - **NORMAL PRECIPITATION IF SITE SURFACE IS DISRUPTED**
  - **CUMULATIVE PRECIPITATION**
- **CORRELATION OF PRECIPITATION WITH STREAM FLOW RATES AND DILUTION VOLUMES**

2009 QRA RESULTS
SDA RISK CURVES



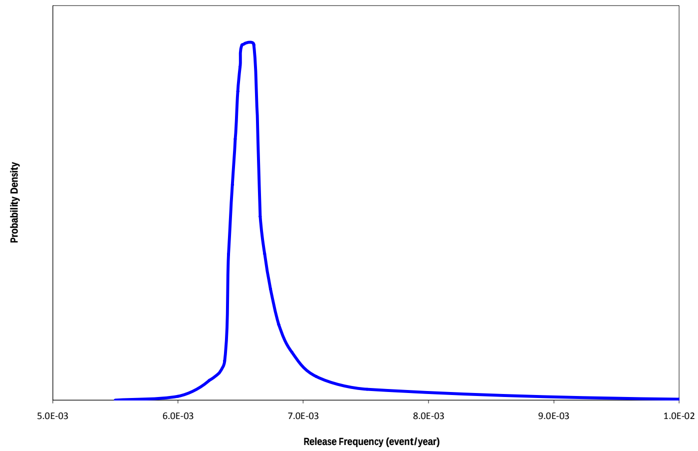
2009 QRA RESULTS
WHAT DO THE RISK CURVES MEAN?

- The SDA risk curves represent the combination of all of the analyses of all of the threat conditions, release scenarios, receptors, trench water levels, precipitation events, landslides, earthquakes, tornadoes, fires, floods, aircraft crashes, meteorite impacts, trench overflow events, and general, everyday groundwater transport from the trenches.
- The risk curves present the potential number of releases per year that result in a particular dose to the public, including explicit treatment of our uncertainty in both the frequency and consequences of those releases.
- The risk curves show that there is a higher frequency of "events" that could cause low doses and a lower frequency of "events" that could cause high doses.

2009 QRA RESULTS
WHAT DO THE RISK CURVES MEAN?

- How many "events" in a year would result in a dose exceeding 0.1 mrem?
- Vertical "slice" through the risk curves at the dose value of 0.1 mrem
- Mean (expected) frequency is 0.0070 event per year (1 event in 145 years)
- 90% confidence range is between 0.0078 and 0.0064 event per year (between 1 event in 130 years and 1 event in 155 years)

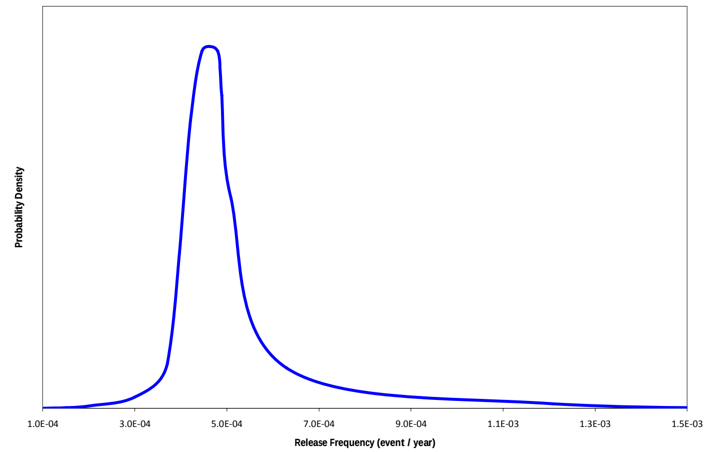
2009 QRA RESULTS
FREQUENCY OF DOSE ≥ 0.1 mrem IN 1 YEAR



2009 QRA RESULTS
WHAT DO THE RISK CURVES MEAN?

- How many "events" in a year would result in a dose exceeding 100 mrem?
- 100 mrem per year limit specified under "Radiation Dose Limits for Individual Members of the Public" in Part 380 of the State of New York Codes, Rules, and Regulations (6 NYCRR Part 380) and in Part 20 of Title 10 of the Code of Federal Regulations (10CFR20)
- Vertical "slice" through the risk curves at the dose value of 100 mrem
- Mean (expected) frequency is 0.00051 event per year (1 event in 2,000 years)
- 90% confidence range is between 0.00064 and 0.00039 event per year (between 1 event in 1,600 years and 1 event in 2,600 years)

2009 QRA RESULTS
FREQUENCY OF DOSE ≥ 100 mrem IN 1 YEAR



2009 QRA RESULTS
RELEASE MECHANISM CONTRIBUTIONS TO RISK

• **RELEASE MECHANISM 1**	**45%**
• **RELEASE MECHANISM 2**	**10%**
• **RELEASE MECHANISM 3**	**9%**
• **RELEASE MECHANISM 4**	**36%**
• **RELEASE MECHANISM 5**	**< 0.1%**

2009 QRA RESULTS
RELEASE SCENARIO CONTRIBUTIONS TO RISK
(INDIVIDUAL SCENARIOS > 1% OF TOTAL)

- **Lateral groundwater flow through the ULT when trench water levels are at the WLT / ULT interface (30%)**
- **Liquid releases from breached trenches caused by landslides or seismic events when trench water levels are at the current values (23%)**
- **Solid material releases from breached trenches caused by landslides or seismic events (12%)**
- **Lateral groundwater flow through the WLT when trench water levels are at the top of the trenches (10%)**

2009 QRA RESULTS
RELEASE SCENARIO CONTRIBUTIONS TO RISK
(INDIVIDUAL SCENARIOS > 1% OF TOTAL)

- **Lateral groundwater flow through the ULT when trench water levels are at the current values (7%)**
- **Trench overflow when trench water levels are at the WLT / ULT interface (6%)**
- **Vertical groundwater flow downward through the ULT and laterally through the KRS to Buttermilk Creek (4%)**
- **Lateral groundwater flow through the ULT when trench water levels are at the WLT / ULT interface (4%)**
- **Trench overflow when trench water levels are at the top of the trenches (2%)**

2009 QRA CONCLUSIONS

- The QRA results confirm that the public health risk from operating the SDA for the next 30 years is well below widely applied radiation dose limits, such as the 100 mrem per year limit specified in 6 NYCRR Part 380-5.1 and 10CFR20 "Dose Limits for Individual Members of the Public".
- There is extremely high confidence that potential releases of radioactive materials from the SDA which may result in a one-year dose to any member of the public of 100 mrem, or more, will occur much less often than once in 30 years.
- This low level of risk will be maintained only if NYSERDA continues to operate the SDA according to its current physical and administrative controls.

2009 QRA CONCLUSIONS
(continued)

- There is very large uncertainty about several of the most important risk contributors. The three most significant sources of uncertainty are:
  - Models and analyses for the groundwater release pathways
  - Estimation of radionuclide concentrations in the trench leachate
  - Evaluation of SDA slope stabilities and non-seismic slope failures

2009 QRA RECOMMENDATIONS

- Continue to monitor and, if necessary, actively maintain trench water levels below the ULT / WLT interface level, regardless of the status of the geomembranes and other activities at the site.
- Minimize the amount of time that the geomembrane covers are not intact, and the surface of the trench soil caps is exposed. This includes expedited repairs or replacement of damaged geomembrane sections, and minimizing the time and area of uncovered trench surfaces during planned geomembrane replacements.
- Formalize emergency preparedness plans and guidelines for responses to the types of release scenarios that are evaluated in this study. The risk from specific scenarios is affected significantly by the credit that has been applied for these intervention and mitigation responses.
- Consider the benefits from a program to periodically sample the water in each trench and monitor the concentrations of radionuclide species.