# Tritium Management by Design

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# History

- **EPRI Report "Strategies for Managing Liquid Effluents – Options, Actions & Results"**
  - # 1008015 released in 2003
- Developed by EPRI & a team of industry experts
  - Liquid radioactive waste processing
  - Liquid and solid effluents
  - Chemistry
- The industry's liquid effluent activity continues to trend down. This is good!
- Sensible long-term liquid processing effluents strategy evaluation

# Balanced Effluents Program (BEP)

- EPRI Effluents Strategy Project
  - Reaffirmed the importance of balancing a site's liquid, solid, and gaseous effluents
- Tritium management is one area that many stations continue to struggle to manage
  - Production
  - Concentration
  - Control
  - Consequences
    - Environmental impact, site exposure, cost

# Historical “Solutions”

- Several stations use unique tritium strategies
  - Operational
  - Processing
- Not always coordinated with other programs
- Not always effective
  - Increased inventory
  - Spikes, increased plant exposure, etc.

# “Treatment” Options

- ‘Conventional’ disposal with solid waste
  - Can’t ion exchange, concentrate, cost effectively remove, place into solid form
- Release as Effluent
  - Liquid:  varies by site
  - Gaseous: used by all plants

# Issues

- Limiting ***production*** of H-3
- $^{3}H$ concentrations in coolant ***will*** increase
  - Later planned releases result in “obvious” spikes in liquid effluent activity
    - ANI premium impact
    - Public perception, risk becoming public opinion issue
- Managing effluent source mechanisms
  - Manage releases, temperature, humidity, air exchange
  - Airborne dose > Liquid dose

# Issues (continued)

- Plants were designed, constructed, and licensed to release liquid and gaseous effluents

  Zero ***release*** = zero ***production***

- Evaluating and comparing plants on the basis of liquid volume and activity discharged ***may***
  - Lead to erroneous performance evaluation
  - Impact cost effectiveness of program
  - Increase dose to workers
  - Increase dose to the public

- HOW DO I MAINTAIN A SUCCESSFUL, DEFENSIBLE PROGRAM?

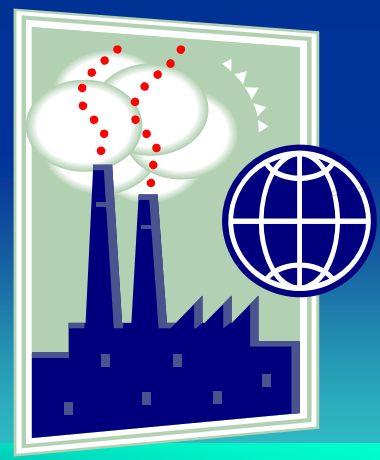
# The Plan

- EPRI tasked by utilities to develop an interactive tritium analytical software tool to evaluate actual or proposed program changes
- Project directed and supported by an ***industry expert team***

**Primary Goal**

Make informed decisions that support a

**Balanced Effluents Program**



# Objectives

- Develop interactive tritium analytical tool
  - Input actual and hypothetical plant data
  - Based on site ODCM and operating practices
- Use that information to:
  - Evaluate program changes
  - Track and trend data

# Objectives (continued)

- Provide graphical output display
  - Capture production, inventory, and effluents
- Real time or projected values for tritium concentrations
- Additional reports as recommended by a utility support team
- The tool not intended to replace existing pathway modeling software
  - Is intended to complement its effectiveness.

# ID Plant Design Performance

- Generic production mechanisms
- ID plant specific mechanisms
- Define plant specific boundaries
  - Design
  - FSAR
- Inventory

# Quantify Actual Performance

- Production Calculation
  - Quantify plant specific results
  - ID current plant goals
- Inventory
  - Plant values/ quantities
  - Known and design unknown (sumps, etc)
  - Other unknown (unidentified, analytical error)
  - Point of origin for tritium inventory
  - Inventory impact factors

# Quantify Actual Performance
(cont.)

- Effluents
  - Accountability by effluent stream
  - ODCM
  - NO PATHWAY MODELING IN THIS TOOL
- Mass Balance
  - Perform a mass balance
    - Production, inventory, and effluents
  - V&V model and define current state

# Evaluate Results
## (investigation phase)

- Benchmark plant effluent values with Industry Experience
  - Regulatory
  - EPRI
  - ANI
  - INPO
  - Possible link to Industry sources

# Evaluate Design vs. Actual
## (investigation phase)

- Consequence Analysis
  - ODCM & R.G. 1.109 pathway analysis, dose
    - Identify each forms' contribution to environmental impact
  - Compare analysis results to model & design predictions
  - For each effluent stream and pathway analysis
    - Determine reason for discrepancies
    - Conduct source analysis of abnormal results

# Consequence Analysis (cont.)

- Evaluate current performance impact
  - Effluent values versus pathway impact
  - Effluent values versus on site exposure
  - Baseline cost analysis
  - Define intangible and soft issues

# Evaluate Options
## Improvement or Redirection

- Liquid
  - Recycle primary water
  - Recycle all waste
  - Alter release strategy
    - Develop strategic release protocol (feed and bleed)
- Solid waste
  - Treatment, VR, and disposition options
    - Solidify
    - Incineration
    - Pyrolosis
    - Direct burial environmental impact

# Evaluate Options
## Improvement or Redirection

- Airborne
  - Evaporator use
  - Inventory tanks/ pools
  - Release elevation
  - Atmosphere temperature
  - Humidity
  - Leaks
  - Containment purges
  - Stack flow rate
  - Dehumidify
  - Cooling towers
- SFP (impacts all three forms)
  - Inventory manipulation
    - Temperature, HVAC, humidity
- Investigate new technology

# Acceptability Determination
## Performance Options

- Evaluate acceptability of results
  - Benchmark, site specific results, consequences, investigation results, costs
- Identify improvement opportunities
- Define potential path forward
- Perform an impact analysis (sensitivity) for each option
  - Cost benefit
  - Consequence
  - Mass balance
  - Pathway analysis
  - Intangible/ soft issues/factors/benefits

# Completion Path

- Plan/Recommendation
  - Develop management plan
  - Prioritized actions
  - Goals – success measurement
  - Document plan with supporting documentation
- Approval
  - Peer group – sanity validation
  - Senior management – concurrence and resources
- Validation
  - Evaluate actual results versus plan projections

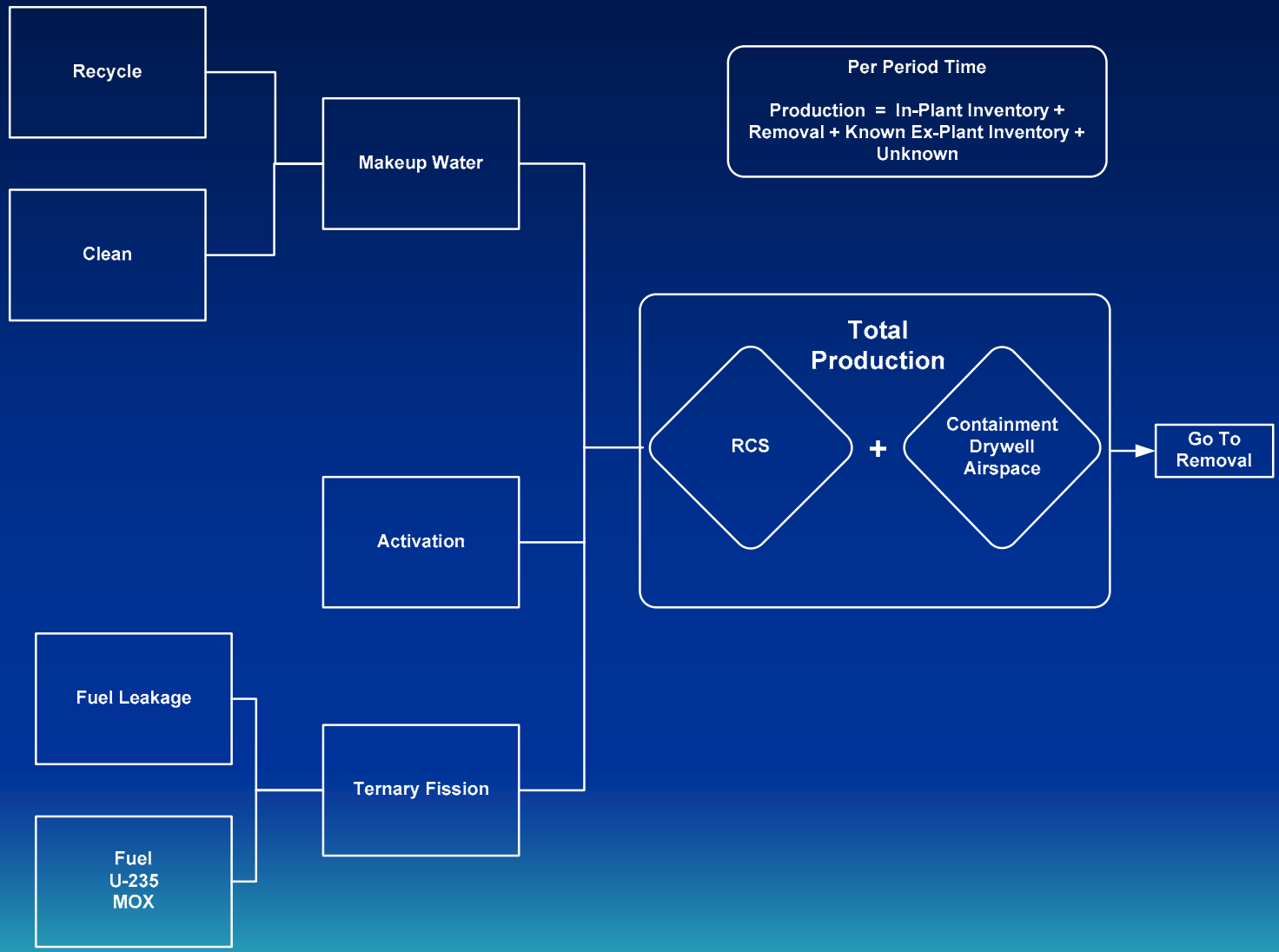
# Multi Year Project

- Driven by utility sponsorship
- 2004
  - Developed a technical skeleton for software
  - Team concept
    - EPRI
    - Utilities – 16 involved!
    - DOE WSRS
    - Contractors
    - ANI
  - One meeting conducted in 2004

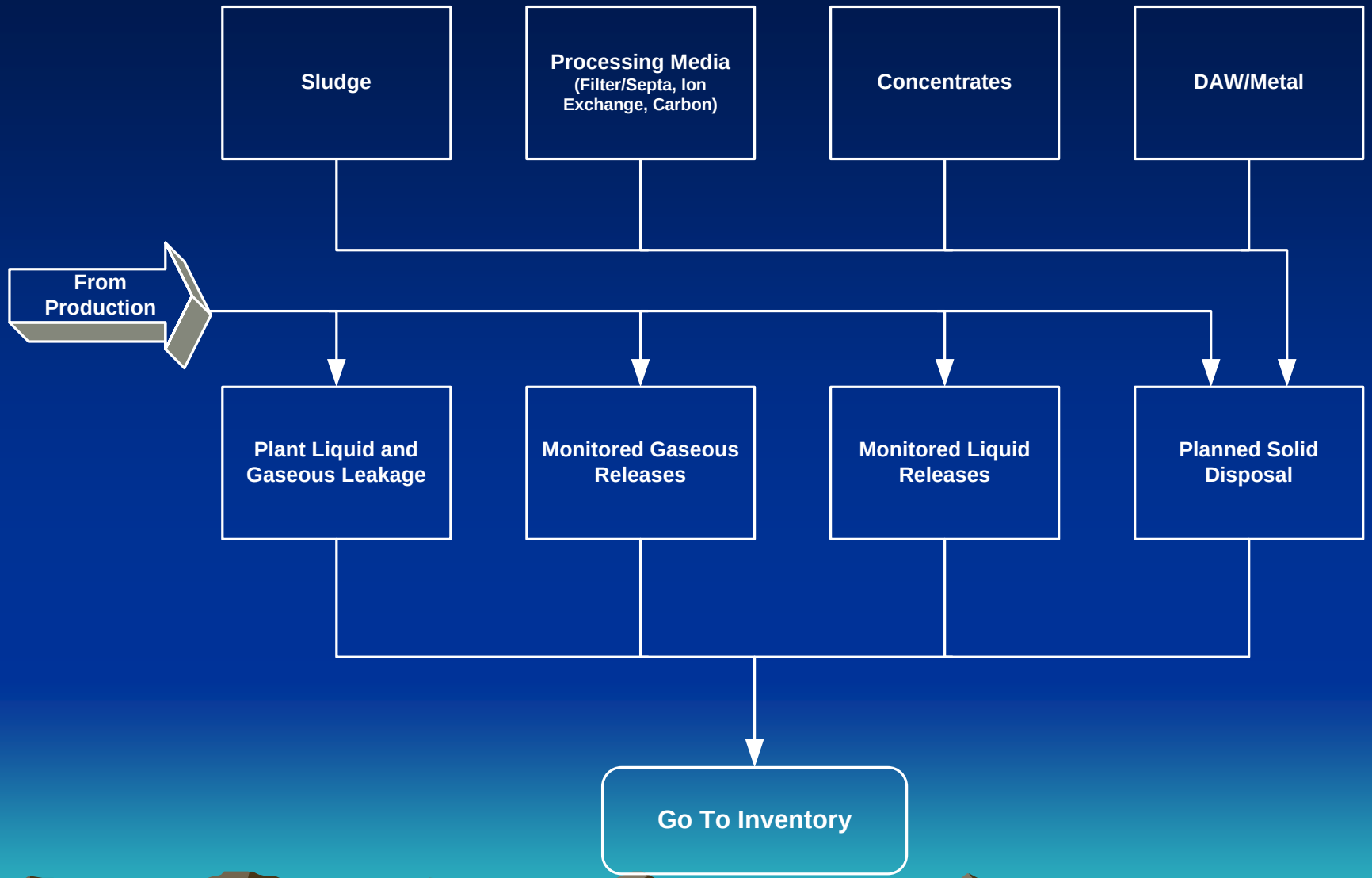
# 2005

- One meeting hosted by Duke Energy
- Focus
  - Tritium management tool for delivery to utilities
  - Document development
  - Model outline and functionality
- Final document with working spreadsheet based model due December 2005.

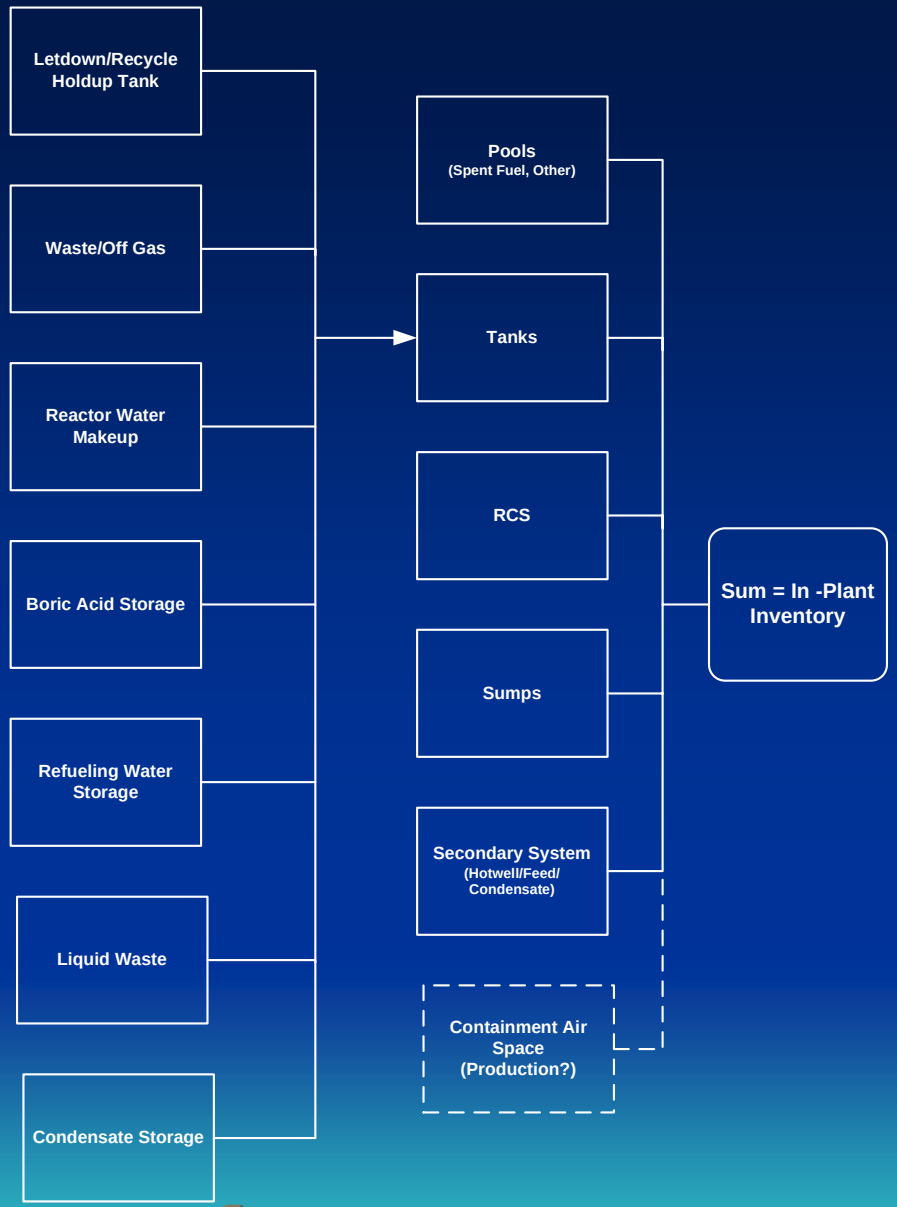
# Model Outline - Production



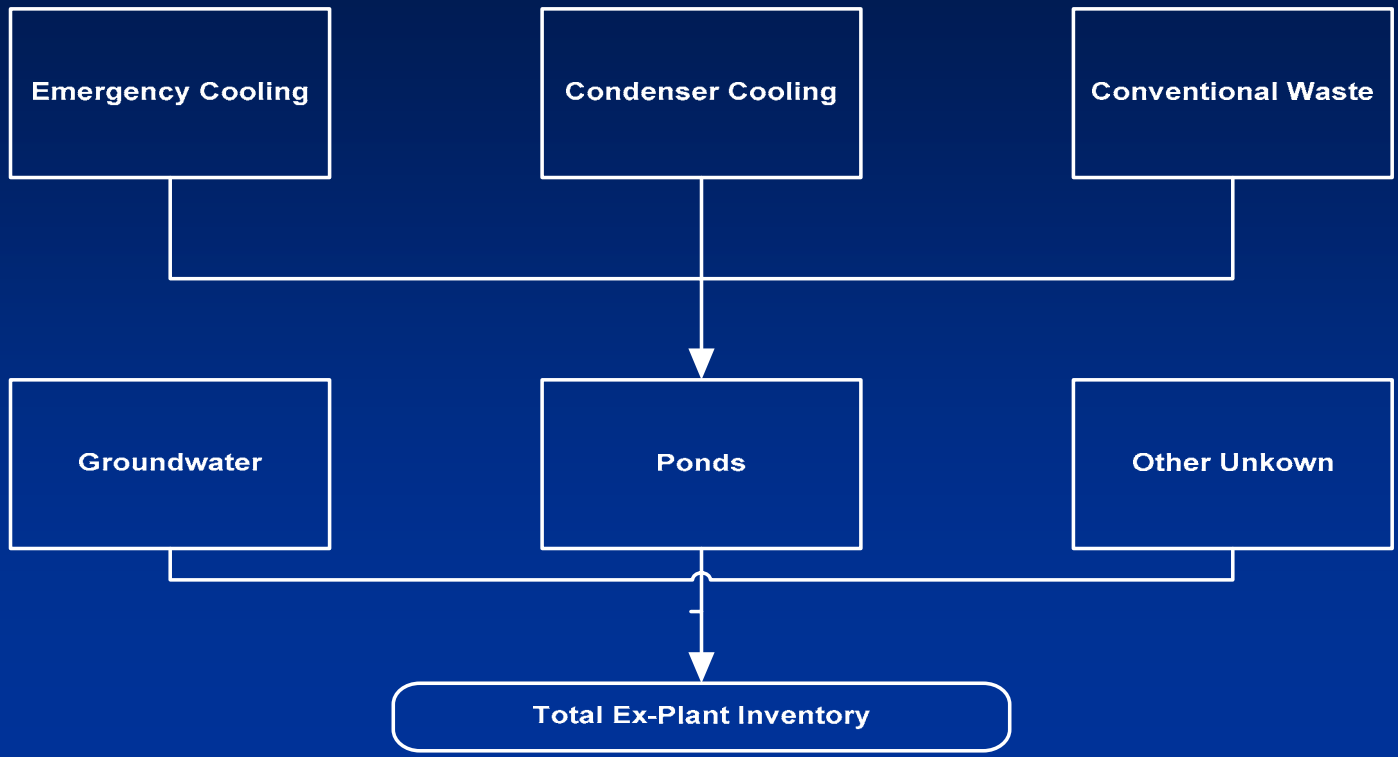
# Model Outline - Removal



# Model Outline - Inventory



# Model Outline – Ex-Plant Inventory




Per Period Time

Production = In-Plant Inventory + Release + Known Ex-Plant Inventory + Unknown

# Environment-to-Plant Interface Considerations

- Environmental samples
- ODCM impact
- Downstream cooling water intakes
- Plant HVAC intakes
- Groundwater
- Surface runoff

# Long Term Impact Considerations

- Decommissioning
- Ground water monitoring
  - Wells
  - Where
  - How often
- Current leakage mitigation versus future monitoring and remediation

# Path Forward

- **2006?**
  - Software has not been funded to date
  - Requires utility support through EPRI fund direction
- **Ideas?**
- Questions?
- Concerns?