U.S. DEPARTMENT OF ENERGY

Use of Plutonium Equivalent Curies for Measuring Risk

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August 27, 2013

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Acronyms

ARF:	Airborne Release Fraction
DCF:	Dose Conversion Factor
DOE-SR:	Department of Energy, Savannah River
DR:	Damage Ratio
LPF:	Leak Path Factor
MAR:	Material at Risk
PEC:	Plutonium Equivalent Curies

Question

Should Plutonium Equivalent Curies (PEC) be used as a Measure of Relative Risk Between Nuclear Facilities at SRS?

DOE-SR Perspective

PEC does not Adequately Describe or Represent Risk.

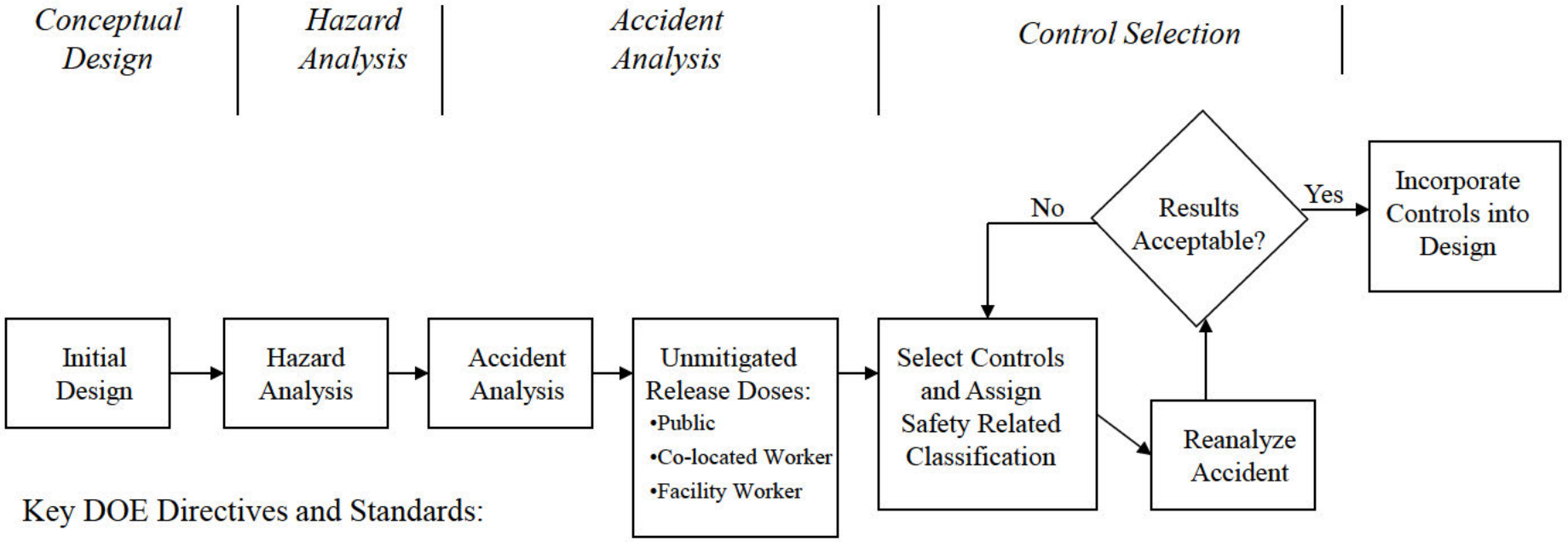
Definition of Risk

- **Risk is Defined as the Possibility of Suffering Harm or Loss**
  - Definition implies a probability in conjunction with a consequence
  - Mathematically:
    - *Risk = probability of a bad thing happening x consequences of a bad thing*

Risk Management and the Safety Based Design Process

- **Start with a Conceptual Design for a Facility or Process**
  - For example, a facility to neutralize waste and turn it into glass
- **Risk Determination Begins with Hazard Analysis**
  - Identifies potential hazards present within a facility or process
- **Risk Determination Matures with Accident Analysis**
  - Indication of potential bounding consequences (dose) without measures to prevent or reduce hazards
- **Controls are Selected to Manage Risks (Prevent/Mitigate)**
- **Controls are then Classified According to Safety Function**
  - *Safety Class* to prevent/mitigate offsite consequences
  - *Safety Significant* to prevent/mitigate worker consequences
  - *Safety Significant* to provide significant defense-in-depth
- **Design Requirements Based upon Safety Function**

Hazard Analysis & Control Selection Process



Key DOE Directives and Standards:

Conceptual Design	Hazard Analysis	Accident Analysis	Control Selection	
DOE O 420.1	DOE STD 3009	DOE STD 3009	DOE STD 3009	DOE STD 3009
DOE G 420.1-1	DOE STD 1189	DOE STD 1189	DOE STD 1189	DOE STD 1189
	DOE STD 1027	DOE STD 1027	DOE STD 1020	DOE STD 1027
	DOE G 420.1-1	DOE G 420.1-1		DOE STD 1020
				DOE G 420.1-1

Accident Analysis Consequences

- **Define a Scenario from Hazard Analysis Results**
  - May combine several events into a single event
- **Determine Unmitigated Dose (Consequences) to Maximally Exposed Offsite Individual**
  - Highest dose to hypothetical member of public closest to the site
- **Compare to Offsite Evaluation Guideline**
  - Results drive the need for design features
- **Identify Controls to Prevent or Mitigate Offsite Consequences**
  - Assures public and worker protection

Calculating Dose Consequences

- **Unmitigated Dose Consequences must be Reasonably Conservative**
  - Material at Risk (MAR) – This is the quantity of radiological material susceptible to a release. Form (liquid, powder, etc.) and quantity (e.g., PEC) should be reasonably bounding
  - Damage Ratio (DR) – Amount of MAR actually impacted by event; again, should be reasonably bounding
  - Airborne Release Fraction (ARF) – This is the fraction of MAR that, once released, can go into the air. Bounding estimates are established in DOE handbook
  - Leak Path Factor (LPF) – Amount of airborne MAR released from the facility
  - Dispersion – Based upon bounding meteorology
  - Dose Conversion Factor (DCF) – Converts quantity inhaled to radiological dose

Dose = MAR * DR * ARF * LPF * Dispersion * DCF

Plutonium Equivalent Curies and Risk

- **Plutonium Equivalent Curies does not Adequately Describe or Represent Risk**
- **Plutonium Equivalent Curies is an Expression of "Material at Risk"**
  - One of six terms used to calculate radiological consequences
    - *Plutonium Equivalent Curies is one Component of a Component of Risk*
- **Plutonium Equivalent Curies used as a Risk Surrogate Neglects Several Important Factors in Determining Risk**
  - Equipment malfunction/damage allowing some material to be released
    - *Very few events have the potential to release all of the material at risk*
  - Is it dispersible?
    - *Powder versus glass logs*
  - Energy available for dispersion
  - Leakage from the facility
  - Likelihood of event occurrence

QUESTIONS?