POLICY ISSUE
NOTATION VOTE

November 24, 2004 SECY-04-0222

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations

SUBJECT: DECISION-MAKING FRAMEWORK FOR MATERIALS AND RESEARCH AND TEST REACTOR VULNERABILITY ASSESSMENTS

PURPOSE:

To gain Commission approval of the proposed vulnerability assessment (VA) decision-making framework and Commission direction on the associated policy issues.

SUMMARY:

The attached decision-making framework embodies the process and criteria the staff will use to evaluate and incorporate the results of VAs into future security measures for materials and research and test reactor (RTR) licensees. It includes criteria to screen out unrealistic

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Exemption number 2, 5

Nuclear Regulatory Commission review required before public release.
M. Weber, NSIR
Name and organization of person making determination

Date of Determination 11/18/04

Upon separation of Attachments 1, 5, and 6, this document is **OFFICIAL USE ONLY**

scenarios and consequences and a process to identify scenarios that warrant further consideration. It has been informed by several independent comprehensive VA methodologies including but not limited to the Risk Analysis and Management for Critical Assets Protection (RAMCAP) methodology developed by the American Society of Mechanical Engineers (ASME), for the U.S. Department of Homeland Security (DHS).

The current framework would employ the consequence criteria of prompt fatalities from radiation exposure and chemical effects associated with radioactive material processes (i.e., UF_6). However, the staff recognizes that including additional consequence criteria such as latent fatalities, land contamination, and non-process chemical risks in the framework may be warranted. The staff recommends that the Commission approve the proposed VA decision-making framework and requests a Commission policy decision on the need for consideration of additional consequence criteria.

With respect to engaging the regulated industry, the staff recommends that the Commission approve the staff engaging the Nuclear Energy Institute (NEI) as well as the fuel cycle and RTR licensees subsequent to screening the VAs through the framework and requests a Commission policy decision on the timing and extent of those interactions.

BACKGROUND:

On July 29, 2004, the Commission was briefed by the staff on the status of VAs for certain materials licensees and RTRs. The Commission provided guidance in a subsequent Staff Requirements Memorandum (SRM), SRM-040729B (ML042430412), dated August 30, 2004, that required, in part, development of a simple, clear decision-making framework for Commission approval. The Commission directed that this decision-making framework contain the process and the criteria that the staff will use to evaluate and incorporate the results of the VAs into any future security measures for materials and RTR licensees. Further, the Commission directed that the framework include criteria to screen out unrealistic and unreasonable scenarios and consequences and a process for the staff to independently identify scenarios that warrant further consideration. The staff was also directed to engage the regulated industry to validate scenarios and their significance, to obtain insights on reasonable mitigative strategies and to provide a realistic schedule to complete the VAs.

In response to the SRM, an NRC interoffice team was formed to collaboratively develop the required VA decision-making framework. The framework development team is composed of staff from the Offices of Nuclear Security and Incident Response (NSIR), Nuclear Reactor Regulation (NRR), Nuclear Material Safety and Safeguards (NMSS), and Nuclear Regulatory Research (RES).

Consistent with the Commission's direction, VA work was minimized, pending completion of the framework.

DISCUSSION:

The decision-making framework has been developed as a tool for NRC use to determine the appropriate level of mitigative strategies required for a given threat scenario. Threat scenarios were generated by the appropriate program office, in collaboration with NSIR's Threat Assessment Section, to ensure scenario realism (Threat Assessment for Non-Power Reactors and Non-Category I Fuel Cycle Facilities, Attachment 1). Use of the decision-making framework will lead the staff to one of three results: red, yellow, or green.

A red result indicates that additional assessment of the scenario is warranted. A yellow result indicates that maintaining the existing security requirements are warranted, and that the staff should evaluate the continued need for the additional security measures (ASMs) implemented since September 11, 2001. A green result for the selected consequence criteria indicates that current security requirements are adequate, and that the scenario may be eliminated from further consideration. The staff plans to assess results of the physical security reviews to determine if easy to implement, low-cost measures can be made that would improve detection, assessment, delay, or response to a security event. The results of the assessments and recommended actions will be provided to the Commission for consideration.

The proposed decision-making framework does not include Category I fuel cycle facilities or nuclear power plants. These facilities are required to successfully protect against capabilities described in a design basis threat. Consequently, these facilities will not be subjected to the additional screening process called for in the decision-making framework.

Several methodologies for conducting and evaluating comprehensive VAs for different types of assets are currently under development. In particular, the ASME, in cooperation with numerous stakeholders, is funded by DHS to develop the RAMCAP methodology. This methodology is designed to inform the allocation of resources to protect infrastructure components. The methodology begins with consequence-only screening analysis for a specified asset category in consideration of an assumed threat. These consequences are quantified to the extent practicable to provide a basis for comparison of risks across industry sectors and to provide meaningful input to the decision-making process. The screening analysis offers the means to decide which assets should be further assessed using the detailed methodology contained in the RAMCAP guidance. In conjunction with this process, many industry sector organizations, including the American Petroleum Institute, the National Petrochemical and Refiners Association, and the American Institute of Chemical Engineers, are engaged in VA work.

Rather than adopting RAMCAP, the staff developed its own methodology that was informed by these methodologies. While the framework is not actually a risk assessment, as is the draft RAMCAP methodology, the overall methodology is consistent with the general considerations in the draft RAMCAP methodology with criteria established specifically for materials and RTR licensees. The framework is a three-step decision-making process summarized below.

The first step in the decision-making process is the determination of the asset attractiveness ranking. Five attractiveness factors, each valued one through five, are averaged to obtain the overall attractiveness ranking. The attractiveness factors are discussed in the Framework

Methodology, Attachment 2. The overall, numerical attractiveness ranking is converted to an alphabetical Attractiveness Category (A through E), shown in the attractiveness ranking matrix. Category A indicates greater asset attractiveness and category E indicates lesser asset attractiveness. Unrealistic and unreasonable scenarios would screen out whereas more attractive scenarios may warrant further consideration.

The second step in the decision-making process is the consequence category. The current process uses prompt fatalities as the sole consequence criteria, and in general, the prompt fatality consequences can be quantified for radiation and chemical effects for realistic threat scenarios. Security reviews and evaluations will be used to develop realistic activity-specific scenarios. Consequence evaluation criteria are discussed in Technical Basis for Acute Radiation Prompt Fatalities and Technical Basis for Chemical Related Prompt Fatalities, Attachments 3 and 4 respectively. The Consequence (Estimated Effect) Matrix in the framework is used to relate the number of prompt fatalities to a Consequence Category ranging from I to V. Category I relates to thousands of prompt fatalities, and category V relates to no prompt fatalities.

Note that the RAMCAP methodology highest consequence category is tens of thousands of prompt fatalities, while the staff highest category is in the thousands of prompt fatalities. Similarly the staff's proposed framework starts at one category lower than the RAMCAP methodology. Therefore, if NRC-licensed assets are to be directly compared with the RAMCAP generated results, adjustments would be needed. It should also be noted that consistent with the RAMCAP guidance, scenarios resulting in no prompt fatalities are screened out and are not put through the framework decision-making process.

The third step in the decision-making process uses the Attractiveness Category from the first step and the Consequence Category from the second step in a decision matrix to determine whether mitigative strategies are appropriate, as discussed in the framework. The decision matrix indicator (red, yellow or green) yields insights regarding the need for certain security requirements, beyond the established regulatory minimums, as well as where ASMs can be lessened, to allow for more efficient use of physical protection resources. Finally, the decision matrix may be used to prioritize NRC efforts on materials and RTR licensees.

The validity and value of the proposed VA decision-making framework can best be demonstrated through the application of the framework. Two example cases, Application of the Decision Making Framework to a Postulated Security Event Scenario at a Research Reactor and , Application of the Decision Making Framework to a Postulated Security Event Scenario at a Fuel Cycle Facility are provided as Attachments 5 and 6, respectively. These diverse examples demonstrate the scope of application of the VA decision-making framework.

ASSOCIATED POLICY ISSUES:

Consequence Criteria

As discussed in this paper, the consequences considered are prompt fatalities from radiation exposure and those chemical effects associated with radioactive material processes (i.e., UF_6).

Past Commission policy and practice has varied with respect to consideration of consequence criteria. The proposed VA decision-making framework uses only prompt fatalities as a consequence criterion.

It is also recognized that other guidance, such as the draft RAMCAP methodology, uses other consequence criteria. For example, RAMCAP uses criteria such as economic, environmental, national security, symbolic and sociopolitical impacts, and loss of output or production capability as metrics for national level screening.

Other related radiological consequence criteria that could be incorporated in the framework include latent fatalities, land contamination, and chemical risks due to plant conditions which affect the safety of radioactive materials (e.g., ammonia tanks). Including some of these consequence criteria may also be consistent with the goal, in the NRC's Strategic Plan, to ensure protection of public health and safety and the environment, and also with the section on commercial nuclear reactors in the National Infrastructure Protection Plan. There are various points of view within the staff on the need for additional criteria, e.g., land contamination.

The staff also recognizes that exposure to certain radioactive materials, (e.g., well logging sources) would not result in a prompt fatality or the need for additional measures. However, using other consequence criteria (e.g., land contamination) may require additional security measures.

Note, if the Commission decides to add other consequence criteria to the staff's VA decision-making framework, integration of any of these consequence measures and associated thresholds into this framework would require further developmental effort, time and additional resources. Consequence metrics for these measures would need to be developed for Categories I through V, similar to the framework's prompt fatality consequence ranges. Additionally, recommendations on modifying security measures would be made after considering any additional consequence measures.

Communications with Licensees

The August 30, 2004, SRM stated that the staff should engage the regulated industry to validate scenarios and their significance and obtain insights on reasonable mitigative strategies. The SRM also stated that the Contractor VA reports should not be shared with anyone outside of NRC without Commission approval. The staff has had initial discussions with NEI on their role in the review of fuel cycle facility VAs. NEI expressed a desire to interact with the staff on the framework methodology and the implementation of that methodology on a site-by-site basis, as well as, provide input on the information in the fuel cycle VA reports.

The staff could engage the fuel cycle licensees prior or subsequent to screening the scenarios through the Commission-approved framework criteria. This could include interactions on the framework criteria as desired by NEI. The staff believes that the most efficient and effective use of resources would be to interact with the fuel cycle licensees and NEI on scenarios that did not screen out using the framework.

NEI's involvement would be limited to documents and discussions at the Safeguards Information level (SGI) based on their current security clearances and their "need to know". Discussions at higher classification levels would only take place with appropriately cleared fuel cycle licensee staff. Consistent with SECY-04-0093, "Sharing Vulnerability Assessment Information with Licensees and Certificate Holders Regulated by the Office of Nuclear Materials Safety and Safeguards", the staff will inform the Commission prior to sharing information with the industry.

The extent to which NRC interacts with NEI and the industry may impact both the resources needed to complete the VAs and the schedule. The staff also requests a Commission policy decision on the timing and extent of interactions with NEI, as well as, the fuel cycle and RTR licensees.

RESOURCES:

Implementation of the VA decision-making framework, as described in this paper and its attachments, for applicable licensees is expected to require approximately 5.8 FTE in FY 2005. These resources are not currently budgeted and would be expended in a coordinated effort as follows: NMSS (2.5 FTE), NRR (1.0 FTE), NSIR (2.2 FTE), and RES (0.1 FTE). These resource estimates include development of recommendation report for additions/reductions to security measures and interactions with NEI, licensees and other industry coordination. On the basis of framework approval as presented, the staff does not anticipate additional contractor funding.

Resources and associated impacts of the add/shed process to support these activities will be identified and sent to the Commission by December 3, 2004.

RECOMMENDATIONS:

The staff recommends that:

A. the Commission approve the proposed VA decision-making framework using prompt fatalities. A realistic schedule for providing the VA recommendation reports is eight months after the Commission approves the framework.

B. the Commission approve the process of conducting the screening, consulting with the Commission the results, and then engaging NEI as well as the fuel cycle and RTR licensees to validate scenarios, potential consequences and mitigative strategies, subsequent to screening the VAs through the framework.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection.

The Office of the Chief Financial Officer has reviewed this Commission paper for resource implications and has no objection.

/M. Virgilio acting for/
Luis A. Reyes
Executive Director
for Operations

Attachments:
1. Threat Assessment for Non-Power Reactors and Non-Category I Fuel Cycle Facilities
2. Framework Methodology
3. Technical Basis for Acute Radiation Prompt Fatalities
4. Technical Basis for Chemical Related Prompt Fatalities
5. Application of the Decision Making Framework to a Postulated Security Event Scenario at a Research Reactor
6. Application of the Decision Making Framework to a Postulated Security Event Scenario at a Fuel Cycle Facility

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Commission Paper Accession No. ML043080303
Attachments Accession Nos:
Attachment 2 ML042300720
Attachment 3 ML043200729
Attachment 4 ML043200761

* See previous Concurrence.

OFC	NSIR:VAIR	NMSS:TSG	NRR:	NMSS:	NSIR:
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Threat Assessment for Non-Power Reactors and Non-Category I Fuel Cycle Facilities (U)

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Framework Methodology

The staff's framework to assess the need for mitigative strategies for potential vulnerabilities has been developed considering the assessment guidance proposed for the Department of Homeland Security (DHS).[1] The DHS ranking and assessment process uses estimates of potential consequence in conjunction with estimated likelihoods of attack. The staff's decision-making framework will utilize estimates of potential consequences, in terms of prompt fatalities for various security event scenarios, in conjunction with asset attractiveness, instead of estimated likelihood of attack.

Only the activities that passed an initial screening will be considered in the staff's decision-making framework. The asset attractiveness will be categorized using a qualitative assessment that considers several factors. The values of the asset attractiveness and estimated consequences are used in a decision matrix (see Figure 1, "Decision Matrix") to determine whether mitigative strategies are necessary.

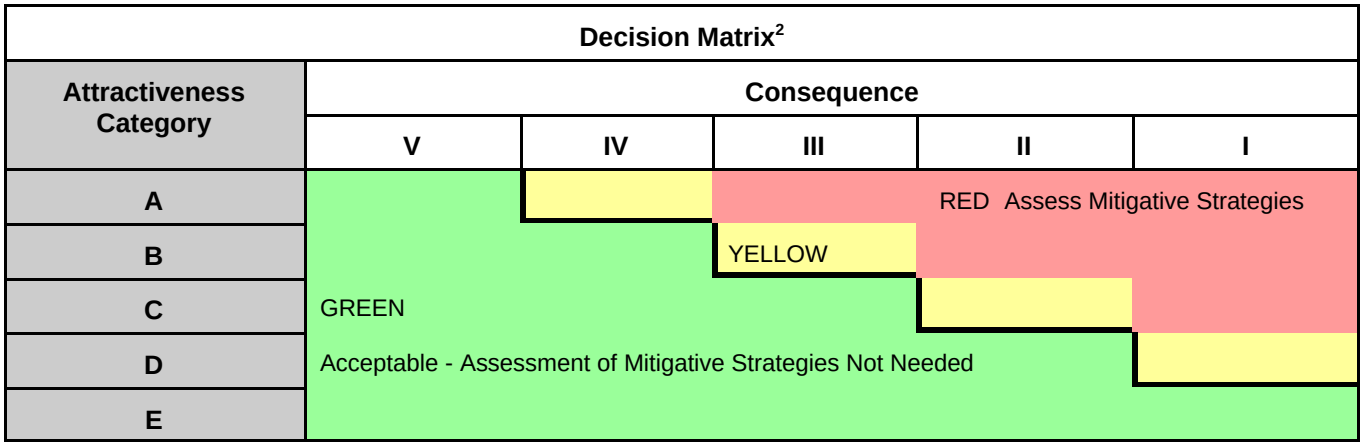

Figure 1

The scenarios that fall in the **RED** range will be assessed for activity-specific mitigative strategies and options. For scenarios in the **GREEN** range, current security requirements are adequate and no further action will be required. The activities in the **GREEN** for the selected

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[1]American Society of Mechanical Engineers in collaboration with: American Institute of Chemical Engineers, American Nuclear Society, American Petroleum Institute, American Society of Civil Engineers, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Institute of Electrical and Electronics Engineers Nuclear Energy Institute, "Risk Analysis and Management for Critical Asset Protection: General Guidance," July 30, 2004, Draft, section3.3.2. "Level 2: Quantitative Risk Analysis Screening"

[2]This matrix has fewer categories than those recommend in foot note1, because it is not practical for most NRC-licensed facilities to reach the more severe consequence categories or the more likely categories noted by the reference. Consequence category of I is more severe than II and so forth, and attractiveness category of A is more probable than B and so forth.

consequence criteria will then be screened from further consideration. For activities that fall in the **YELLOW** range, the staff will evaluate the need to maintain compensatory measures and will consider adding those measures to relevant security requirements (e.g., incorporated into security plans).

Attractiveness

Several factors will be qualitatively assessed to determine the attractiveness category for an activity. The factors, identified in Table 1, "Activity-Specific Attractiveness Category Ranking Matrix," are iconic value (ICON), complexity of planning (CP), resources needed (RN); execution risk (ER), and public protection measures (PM). (It should be noted that for threats with an immediate release of radioactive material, there is insufficient time in the scenario for public protection measures to have any impact on scenario completion, and this factor does not contribute to the attractiveness ranking. In this case, there are only four factors to determine the Activity Specific Attractiveness Category (see foot note for Table 2)). The documentation of this qualitative assessment will form the basis for selecting a numerical value (1 through 5) for each specific category. For example, if a value of 3 is assigned for the category resources needed (RN) the qualitative assessment will have to reasonably demonstrate that it would take several adversaries, heavily armed, with explosives, and combat tactical training to achieve their goal.

Once the individual numerical values for each attractiveness factor are determined, they are averaged to determine the overall attractiveness value. This value is converted to category A, B, C, D, or E using Table 2, "Alpha-numeric Conversion for Determining Attractiveness Category."

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Ex "7
p3-

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Table 2 - Alpha-numeric Conversion for Determining Attractiveness Category					
Attractiveness Value Range	0 - 1.0	1.0 -2.0	2.0-3.0	3.0 -4.0	4.0 - 5.0
Category Conversion	A	B	C	D	E

Estimated Consequences

The radiological consequences caused by an event are estimated in terms of prompt fatalities caused by direct exposure to radiation, inhalation of radioactive material, or chemical exposure. The calculated consequence estimate can be used in Table 3, "Consequences" to determine the appropriate consequence category. For example, estimated fatalities, from a given scenario, in the single digits would be classified as a Level IV consequence event.

Table 3 - Consequences[3]	
Prompt Fatalities	Consequence Category
Thousands	I
Hundreds	II
Tens	III
Single Digits	IV
None	V

Decision - Making

Upon determining the attractiveness category and the consequence level, Figure 1, "Decision Matrix" will be used to determine if a scenario falls into the red, yellow, or green areas. The color is then matched up with the mitigative strategy assessment actions in Table 4, "Need to Develop Mitigative Strategies." For example, if the activity specific attractiveness category was determined to be an "A" and the consequence was estimated to be "Level II", the overall attractiveness would be a **RED** condition. Table 4 would then direct the analyst to assess and develop activity specific mitigative strategy options, beyond existing security/general requirements, and recommendations for Commission consideration.

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[3]Consequence evaluation of prompt fatalities related to radiological (or chemical) exposure resulting from facility sabotage, theft of material used as a radiological exposure device or radiological exposure, or transportation sabotage will be developed by the respective programs within NMSS and NRR.

Table 4 - Need to Develop Mitigative Strategies	
Red Conditions	Assess and develop activity specific mitigative strategy options, beyond existing security/general requirements, and recommendations for Commission consideration.
Yellow Conditions	Maintain existing security/general requirements. Evaluate the need to maintain Compensatory Measures. Add required Compensatory Measures to the relevant specific requirements.
Green Conditions	Acceptable - Screen from further consideration and maintain existing security requirements. Eliminate unnecessary compensatory measures.
Activity Specific Conditions	Assess results of the activity specific security enhancement assessments to determine if easy to implement low cost measures can be instituted that would improve detection, assessment, delay, or response to a security event.

TECHNICAL BASIS FOR CHEMICAL RELATED PROMPT FATALITIES

Chemical effects differ from radiation effects in several key characteristics:

- Chemical effects are deterministic and predispose towards certain conditions and mortality.
- Chemical effects are receptor dependent - healthy adult workers respond differently than the general population. The public includes an age spectrum, and susceptible and hyper-susceptible individuals (e.g., asthmatics) who experience adverse symptoms at much lower concentrations.
- Chemical concentrations and effects are inversely related to exposure times (i.e., in general, people can tolerate higher concentrations for shorter durations).
- Chemical exposure effects are nonlinear and chemical specific.
- A maximum chemical concentration limit usually exists; beyond this, the probability of fatality is very high.

The airborne chemical levels selected for the VA framework are called Acute Exposure Guideline Levels, or AEGLs for short. Derivation of AEGL values occurs through a Federal Advisory Committee process that includes participation from the National Academy of Sciences, the EPA, and stakeholders. AEGLs represent threshold exposure limits below which the stated adverse health effects are not likely to occur for most members of the general public. Three levels - AEGL-1, AEGL-2, and AEGL-3 - are developed for each of five exposure time periods (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours). The VA framework uses the AEGL duration that was determined to best correspond to the timeframe of the specific scenario under consideration. Each AEGL level represents an increasing level of severity of the effects; AEGL-1 represents a level above which notable discomfort and/or irritation are experienced, AEGL-2 represents a level above which irreversible or long-lasting adverse effects are experienced, and AEGL-3 represents the level above which life-threatening effects or death are experienced. Final AEGL values have been published for uranium hexafluoride and hydrogen fluoride; interim values are available for other chemicals of interest at fuel cycle facilities.

Uranium uptake uses the value of 230 mg from NUREG-1391 for 50% lethality. The NRC/PNL document on uranium uptake identifies a range of 200-300 mg for lethality; 200 mg approximates the onset of lethality and 300 mg represents a high percentage of potential fatalities in the exposed population.

Chemical concentrations and effects are deterministic to individuals. However, for a simple rating scale based upon exposure observations, the following levels were used in the VA:

Level I: Likely fatalities, many may be prompt. The basis is the specific value from the AEGL Technical Support Document on the chemical of interest, adjusted to different times by the ratio of the AEGL-3s. For a 10 minute HF exposure, this is 260 ppm; for a 30 minute exposure, this is 95 ppm; and for a 60 minute exposure, this is 67 ppm. Uranium intake exceeds 300 mg.

Level II: Probable fatalities - approximately the lethal level for 50% of the population. Some fatalities may be prompt. The basis is exceeding AEGL-3. For a 10 minute HF exposure, this is 170 ppm; for a 30 minute exposure, this is 62 ppm; and for a 60 minute exposure, this is 44 ppm. Uranium intake exceeds 230 mg.

Level III: Onset of fatality range - increased risk/potential for a few offsite fatalities in large offsite populations. The basis is exceeding AEGL-2. For a 10 minute HF exposure, this is 95 ppm; for a 30 minute exposure, this is 34 ppm; and for a 60 minute exposure, this is 24 ppm. Uranium intake exceeds 200 mg.

Level IV: No likely fatalities but potential for significant and/or disabling health impacts requiring hospitalization/treatment. The basis is exceeding AEGL-1. For a 10 minute HF exposure, this is 1 ppm; for a 30 minute exposure, this is also 1 ppm; and for a 60 minute exposure, this is also 1 ppm. Uranium intake exceeds 30 mg.

Level V: Existing licensing/accident basis, no fatalities, minimal effects (< AEGL-1). Uranium intake is less than 30 mg.

The number of exposed individuals is based upon the specific threat scenario and site conditions. Reasonably conservative meteorological conditions and population densities for the specific site under evaluation will be assumed. Plume effects will consider population within a 90 degree arc (25% pie section) downwind from the facility, scenario location, and effect zones based upon the consequence levels and the distance from the release. If indicated by site considerations (e.g., a high percentage of wind direction variability), plume effects will be based upon the population in the worst case 90 degree arc. The framework will sum the potential fatality estimates from each zone for comparison to the consequence table.

Chemical events tend to be prompt (typically of 30-90 minute durations) and the analysis will only consider mitigation methods appropriate for the specific site, scenario, and release timeframe.

References:
www.epa.gov/oppt/aegl/process.htm

Stephen A. McGuire, "Chemical Toxicity of Uranium Hexafluoride Compared to Acute Effects of Radiation," NUREG-1391, February 1991.

D.R. Fisher et al, "Uranium Hexafluoride Public Risk," PNL-10065, August 1994.

TECHNICAL BASIS FOR ACUTE RADIATION PROMPT FATALITIES

WHOLE BODY RADIATION EXPOSURE

The staff has reviewed several technical sources of information and data to develop a technical basis for an average number of prompt fatalities from acute whole body radiation exposure. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000 Chernobyl accident summary report provides the number of emergency worker fatalities observed in various exposure ranges (see Table 1).[1] Other technical literature presents a range of doses associated with mortality (in percentages) of an exposed population. Table 2 compares the LD_{10}, LD_{50}, and LD_{90} doses reported in the Textbook of Military Medicine,[2] an Armed Forces Radiobiology Research Institute (AFRRI) reference,[3] and in NUREG/CR-4214.[4] These references apply to high dose rate, whole body, acute, exposures only.

Table 1. Chernobyl emergency worker fatalities observed in different exposure ranges.

Range of Dose (rads)	Number of workers exposed in this dose range	Number of fatalities[5]
80 - 210	41	0 (0%)
220 - 410	50	1 (2%)
420 - 640	22	7 (32%)
650 - 1600	21	20 (95%)

Table 2. Comparison of LD10, LD50, and LD90 values (dose in rads).

Lethal Dose (LD) at various percentages of population exposed	Military Reference - untreated	AFFRI without medical care	NUREG/CR-4214 with supportive care	AVERAGE
LD_{10}	290	300	330	310
LD_{50}	430	530	450	470
LD_{90}	570	800	550	640

From these references, which showed close agreement, the staff estimated a range of fatalities for the potentially exposed population during a postulated accident.

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[1] UNSCEAR, Volume II of the 2000 Report., ANNEX J, "Exposures and effects of the Chernobyl accident," Table 11, "Emergency workers with acute radiation sickness following the accident"

[2] "Textbook of Military Medicine: Medical Consequences of Nuclear Warfare," 1989, Figure 2-10, "Human mortality for high-dose-rate, low-LET radiation doses to bone marrow."

[3] "Medical Management of Radiological Casualties, 2nd Ed.," Armed Forces Radiobiology Research Institute, Bethesda, MD. April 2003, pp. 89 and 91. *Note*: Lethal Doses (LD) at 10%, 50%, and 90% probability are estimated to be without medical care.

[4] "Health Effects Models for Nuclear Power Plant Accident Consequence Analysis," NUREG/CR-4214, Rev. 2, Part I, ITRI-141, Published October 1993, Figure 3-1, "Risks of mortality from the hematopoietic syndrome for minimal, supportive, and mixed treatments: central estimates for exposure at a high dose rate."

[5] Percentage of treated patients in parenthesis

DETERMINATION OF EXPOSED POPULATION

Specific threat or site conditions determined the number of exposed individuals. A range of population densities will be assumed for off-site threats to simulate venues or locations where individuals could be exposed. For on-site threats, specific population estimates will be used, considering potential mitigating effects where applicable, e.g., evacuation and sheltering. Site-specific meteorological conditions will be assumed unless the threat relates to transportation, where nominal meteorology data will be assumed.

Rad* indicates the rad-equivalent which is calculated by multiplying the high linear energy transfer (LET) component of the absorbed dose by a relative biological effectiveness (RBE) factor. Specifically, when calculating the lung dose, the high LET component is multiplied by ten.

Ex 5
P1

Attachment 5

Application of the Decision Making Framework to a Postulated Security Event Scenario at a Research Reactor

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Ex #3
p2-a

Ex #3
p 3-c

Ex #3
p 4-a

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3.3

P5 Ex #3

3.4 [redacted]

Ex 3
p6-

Ex #3
p7-a

[redacted]

Ex #3 pg-a

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3.5

Ex 3 pg-a

[redacted]

[1] "Identification and Analysis of Factors Affecting Emergency Evacuations Volume I: Main Report," Draft Report dated July 25, 2004.

The value assigned to this factor is 3.

Ex #3 p10-a

4.0 [redacted]

Ex #3
p 11-a

[redacted]

[2] "Health Effects Models for Nuclear Power Plant Accident Consequence Analysis," J. S. Evans, S. Abrahamson, M. A. Bender, B. B. Boecker, E. S. Gilbert, B. R. Scott, October 1993, NUREG/CR-4214, Reve. 2, Part I, ITRI-141

Ex 3
p 12

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[3] "Medical Management of Radiological Casualties," Armed Forces Radiobiology Research Institute, April 2003, pages 90

Ex #3
p13-a

[redacted]

Ex #3
p 14 - 2

[redacted]

Ex #3
p15-a

[redacted]

Attachment 6

~~SAFEGUARDS INFORMATION~~

EX.3 p1-a

Application of the Decision Making Framework to a Postulated Security Event Scenario at a Fuel Cycle Facility

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Ex #3
p2-a

Ex 4
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Ex #3
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Ex # 3
p5-a

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Ex #3
p6-c

Ex #3
p7-a

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Ex # 3
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Ex #3
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