Attachment 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

MEMORANDUM
FEBRUARY 13th, 2004

TO: Martin J. Virgilio, Director
Office of Nuclear Material Safety
and Safeguards

FROM: Alexander P. Murray, Senior Chemical Process Engineer
Special Projects Section
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards

Alex

SUBJECT: DIFFERING PROFESSIONAL VIEW ON CHEMICAL CONSEQUENCE LIMITS AT THE PROPOSED MIXED OXIDE (MOX) FUEL FABRICATION FACILITY
DOCKET NUMBER: 070-03098

Attached is the subject Differing Professional View (DPV). I am neither in favor of nor against the proposed facility - I am impartial. I am concerned about adequate assurances of safety. In summary, the DPV discusses chemical consequence limits (sometimes called chemical consequence levels of concern) for assessing the consequence category for potential radiochemical events at facilities regulated by the NRC under 10 CFR Part 70. Thus, these limits directly identify the need for safety controls, sometimes called PSSCs (Principal Structures, Systems, and Components) or IROFS (Items Relied Upon For Safety). The limits apply for acute (short-term) chemical exposures from radiochemical accidents, and, per the Standard Review Plan (SRP), should be conservative and include latency effects from these acute chemical exposures, such as cancer and reduced cardiopulmonary functions.

For chemical consequences from some potential events regulated by the NRC at the proposed MOX facility, both staff and the applicant have acknowledged that significant or even fatal consequences for some facility workers and members of the public might occur, with a "not unlikely" likelihood, and some additional radiation exposure. The affected area ("footprint of concern") and required controls are determined by the selected chemical consequence limits. The applicant has proposed mitigative strategies using limits based upon Temporary Emergency Exposure Limits (TEELs) from the U.S. Department of Energy. The prevailing management/staff position accepts the use of TEELs as design bases for the proposed MOX facility. It has been mentioned that this approach will likely be applied to all fuel cycle facilities regulated under Part 70.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

MEMORANDUM
FEBRUARY 13th, 2004

TO: Martin J. Virgilio, Director
Office of Nuclear Material Safety
and Safeguards

FROM: Alexander P. Murray, Senior Chemical Process Engineer
Special Projects Section
Special Projects and Inspection Branch
Division of Fuel Cycle Safety
and Safeguards

Alex

SUBJECT: AUTHORIZATION FOR PUBLIC RELEASE -
DIFFERING PROFESSIONAL VIEW ON CHEMICAL CONSEQUENCE LIMITS AT THE PROPOSED MIXED OXIDE (MOX) FUEL FABRICATION FACILITY
DOCKET NUMBER: 070-03098

I hereby request that the U.S. Nuclear Regulatory Commission make available to the public my Differing Professional View, dated February 13th, 2004, on the above subject, and that the agency make public my identity as the author.

As the Lead Chemical Safety Reviewer for MOX, I conclude that the use of TEELs for NRC regulatory purposes is too simple a position arrived at too expediently that, if allowed, would endorse the use of limits that do not provide for adequate assurances of safety. As discussed in more detail in the attached report, my concerns regarding the use of TEELs fall into four main areas:

1. Safety concerns from the NRC Staff's Revised Draft Safety Evaluation Report (RDSER) are not addressed, including inconsistencies with other limits and frequent changes over the three year duration of the Staff's review.
2. Normal NRC procedures for changing established NRC practice for multiple facilities, such as Staff interactions and rulemaking (e.g., public meetings), were not followed in management acceptance of the use of TEELs. Management requested the policy analysis from a single individual - no committees, task forces, and the usual NRC consensus process were involved. No table of values was prepared. The individual establishing the policy has a health physicist background and is not qualified to make policy on chemical toxicology and consequence limits.
3. TEELs are, by definition, temporary and do not incorporate safety margins that are usually included in other chemical exposure limits. This clearly contradicts established NRC practice that almost always incorporates margin in safety limits and design bases. TEELs also do not have a clear linkage to toxicological effects. TEELs were also established for the purposes of emergency preparedness (EP), such as for response personnel and evacuations, and may not be appropriate for design bases for safety controls.
4. Fundamental safety issues, such as consistent risk levels and adequate justification for accepting TEEL values which are frequently higher (sometimes multiple factors higher - see the attached table [Table A] and the attached report) than other consequence levels from other agencies. In short, where is the rationale and supporting information such that the use of values that are frequently higher than other values provides for adequate assurances of safety? In addition, on the MOX Construction Authorization Request (CAR), staff have been directed not to review consideration of latency effects even though the applicant has included a section on such effects in the revised CAR and the MOX Standard Review Plan mentions a review of latency effects.

In addition, the burden of adequate justification of the use of TEELs vis-a-vis the Staff's conclusions in the RDSER has not been placed on the applicant.

I request that:

(1) the NRC management/staff decision to accept the use of TEELs for the proposed MOX facility and all fuel cycle facilities regulated by the NRC under Part 70 be reversed
(2) Issue CS-05b on chemical consequence limits for the MOX application be reopened
(3) the applicant is requested to submit on the docket adequate justification for its use of values from TEELs (or other specific chemical consequence limits) vis-a-vis the Staff's conclusions in the RDSER

(4) a Task Force of 5 staff members with credentials and experience in chemical consequence assessment and exposure limits is formed to establish an NRC Staff position, based upon considerations of the available limits, the draft Staff chemical consequence limits derived for the MOX application, the MOX applicant's input, consistent risk levels, reasonable conservatism, and uncertainties (both in chemical effects and design/license application). Potential Task Force members include Lydia Roche, Don Stout, Rich Millstein, Walt Schwink, and myself.

(5) a rulemaking process is conducted that presents these proposed limits to the licensees and the public, with Federal Register Notices and Public Meetings, and, ultimately, that produces consistent guidance for licensees and applicants.

The attached report summarizes my DPV request (Section 1), applicable regulations and the standard review plan (Section 2), relevant chronological events (Section 3), and staff discussions (Section 4), and includes some relevant documentation as attachments.

I request that the DPV panel allows me the opportunity to clarify my views and provide additional information on this complex and important subject, as discussed in NRC Management Directive (MD) 10.159. Also, per MD 10.159, I propose Walt Schwink as a qualified individual who can serve on a review panel for this DPV. Finally, I will continue to monitor the emphasis on the schedule and the issue closure process.

Table A:
Comparison of Staff-Generated Values (In Bold) with TEEL Values
For Use as Chemical Limits for
Chemicals at the MFFF (Key chemicals are bolded)

Name	MFFF Emergency Exposure Limits (Staff value is bolded - TEEL-19 value is in parenthesis) (Underlined chemicals have one or more higher TEELs)			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Aluminum Nitrate (Lab) (as Al)	**2** [45]	**10** [75]	**500** [500]	mg/m^3
Argon (liquid)	**150** [2.1E5] (in gas spaces)	**700** [3.5E5] (in gas spaces)	**1,500** [5E5] (in gas spaces)	ppm
Argon-Hydrogen (gas)	0.1 (1% of LEL) [no TEEL]	1 (10% of LEL) [no TEEL]	1 (10% of LEL) [no TEEL]	volume %
Argone Methane (P10 Gas)	0.14 (2.5% of LFL) [no TEEL]	1.4 (25% of LFL) [no TEEL]	1.4 (25% of LFL) [no TEEL]	volume %
Azodicarbonamide	**9** [125]	**15** [200]	**250** [200]	mg/m^3
Chlorine	**1.5** [3]	**1.5** [7.5]	**1.5** [60]	mg/m^3
Chromic (III) Acid (Lab)	**0.5** [1.5]	**2.5** [5]	**25** [50]	mg/m^3
Dodecane/Diluent	**3.5** [1.25]	**20** [7.5]	**200** [125]	mg/m^3
Ferrous sulfate (Lab)	**1** [7.7]	**5** [12.5]	**350** [350]	mg/m^3
Fluorine (Lab)	**0.2** [0.775]	**7.5** [7.75]	**20** [31]	mg/m^3
Helium	**150** [2.1E5]	**700** [3.5E5]	**1,500** [5E5]	ppm
Hydrazine (carcinogen)	**0.04** [0.7]	**0.04** [6.6]	**0.04** [40]	mg/m^3
Hydrazine Hydrate (carcinogen)	***0.0025*** *[0.02 mg/m3]*	***0.02*** *[0.04 mg/m3]*	***0.02*** *[0.04 mg/m3]*	ppm

Name	MFFF Emergency Exposure Limits (Staff value is bolded - TEEL-19 value is in parenthesis) (Underlined chemicals have one or more higher TEELs)			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Hydrazine Monohydrate *(carcinogen)*	***0.0075*** *[0.0075]*	***0.06*** *[0.06]*	***50*** *[50]*	mg/m³
Hydrazine Nitrate (carcinogen?)	**3** [3]	**5** [5]	**5** [25]	mg/m³
Hydrofluoric Acid (Hydrogen fluoride)	**1.5** [1.5]	**15** [16.4]	**25** [41]	mg/m³
Hydrochloric Acid	**4** [4.5]	**7** [30]	**7** [224]	mg/m³
Hydrogen	**0.1** [4.1]	**1** [4.1]	**1** [4.1]	volume %
Hydrogen Peroxide	**1.4** [14]	**60** [71]	**105** [142]	mg/m³
Hydroxylamine Nitrate	**10** [15]	**26** [26]	**125** [150]	mg/m³
Iron (Lab)	**30** [30]	**50** [50]	**500** [500]	mg/m³
Isopropanol	**1,000** [1,000]	**1,000** [5,000]	**1,225** [5,000]	mg/m³
Manganese	**1** [3]	**3** [5]	**3** [500]	mg/m³
Manganese Nitrate	**1** [10]	**3** [15]	**3** [500]	mg/m³
Manganous Sulfate (Lab)	**1** [7.5]	**3** [12.5]	**3** [500]	mg/m³
Nitric Acid	**0.4** [3]	**10** [15]	**10** [200]	mg/m³
Nitric Oxide	**30** [30]	**30** [30]	**125** [125]	mg/m³
Nitrogen	N/A	N/A	N/A	mg/m³
Nitrogen Dioxide	**1** [7.5]	**2** [9.4]	**2** [35]	mg/m³
Nitrogen Tetroxide	**1** [15]	**2** [15]	**2** [75]	mg/m³

Name	MFFF Emergency Exposure Limits (Staff value is bolded - TEEL-19 value is in parenthesis) (Underlined chemicals have one or more higher TEELs)			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Oxalic Acid	**2** [2]	**2** [5]	**2** [500]	mg/m³
Oxygen	N/A	N/A	N/A	mg/m³
Potassium Permanganate (Lab)	**3** [7.5]	**5** [15]	**125** 125]	mg/m³
Silver Nitrate	**0.01** [0.045]	**0.05** [0.075]	**10** [15]	mg/m³
Silver Oxide (Lab)	**30** [30]	**50** [50]	**75** [50]	mg/m³
Sodium (Lab)	**2** [0.5]	**2** [5]	**10** [50]	mg/m³
Sodium Azide	**0.1** [0.29]	**0.1** [0.29]	**0.1** [12.5]	mg/m³
Sodium Carbonate (monohydrate TEEL values lower)	**30** [30]	**50** [50]	**500** [500]	mg/m³
Sodium Hydroxide	**0.5** [0.5]	**2** [5]	**2** [50]	mg/m³
Sodium Nitrite (Lab)	**0.125** [0.125]	**1** [1]	**60** [60]	mg/m³
Sulfuric Acid (Lab - carcinogen)	**2** [2]	**10** [10]	**15** [30]	mg/m³
Sulfamic Acid (Lab)	**40** [40]	**250** [250]	**500** [500]	mg/m³
Thenoyl TrifluoroAcetone (Lab)	3.5 [3.5]	25 [25]	125 [125]	mg/m³
Tributyl Phosphate	**6** [6]	**10** [10]	**300** [300]	mg/m³
Uranium Dioxide (carcinogen?) (Values as U)	**0.1** [0.6]	**0.6** [1]	**0.6** [10]	mg/m³
Uranyl Nitrate (carcinogen?) (Values as U)	**0.6** [0.6]	**0.6** [1]	**10** [10]	mg/m³

Name	MFFF Emergency Exposure Limits (Staff value is bolded - TEEL-19 value is in parenthesis) (Underlined chemicals have one or more higher TEELs)			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Xylene (Lab)	**600** [600]	**655** [750]	**655** [4,000]	mg/m^3
Zinc Stearate	**10** [30]	**50** [50]	**400** [150]	mg/m^3
Zirconium Nitrate (as Zr)	**5** [10]	**35** [10]	**50** [50]	mg/m^3

DIFFERING PROFESSIONAL VIEW ON CHEMICAL CONSEQUENCE LIMITS AT THE PROPOSED MIXED OXIDE (MOX) FUEL FABRICATION FACILITY DOCKET NUMBER: 070-03098

1. Summary:

Prevailing NMSS Staff/Management Position: This is presented in the transcripts of the 507th ACRS Meeting, November 6th 2003 Session, on page 159 et seq., and indicates the use of TEELs is an acceptable methodology and this would close Issue CS-05b. The basis is a management policy decision that is included as Attachment 1.

My Assessment As the Lead Chemical Safety Reviewer for MOX: The use of TEELs for NRC regulatory purposes is too simple a position arrived at too expediently that, if allowed, would endorse the use of limits that do not provide for adequate assurances of safety. The concerns regarding the use of TEELs fall into four main areas:

1. Safety concerns from the NRC Staff's Revised Draft Safety Evaluation Report (RDSER) are not addressed, including inconsistencies with other limits and frequent changes over the 3 year duration of the Staff's review. In addition, the burden of adequate justification of the use of TEELs vis-a-vis the Staff's conclusions in the RDSER has not been placed on the applicant.
2. Normal NRC procedures for changing established NRC practice, such as Staff interactions and rulemaking (e.g., public meetings), were not followed in management acceptance of the use of TEELs. Management requested the policy analysis from a single individual - no committees, task forces, and the usual NRC consensus process were involved. No table of values was provided. The individual establishing the policy has a health physicist background and is not qualified to make policy on chemical toxicology and consequence limits.
3. TEELs are, by definition, temporary and do not incorporate safety margins that are usually included in other chemical exposure limits. This clearly contradicts established NRC practice that almost always incorporates margin in safety limits and design bases. For example, the MOX Standard Review Plan mentions conservatism in the section on chemical limits and effects, and R.G. 1.78 identifies lower values and much shorter exposure times. TEELs also do not have a clear linkage to toxicological effects. TEELs were also established for the purposes of emergency preparedness (EP), such as for response personnel and evacuations, and may not be appropriate for design bases for safety controls.
4. Fundamental safety issues, such as consistent risk levels and adequate justification for accepting TEEL values which are frequently higher (sometimes multiple factors higher) than other consequence levels from other agencies. In short, where is the rationale and supporting information such that the use of values that are frequently higher than other values provides for adequate assurances of safety? In addition, on the MOX Construction Authorization Request (CAR), staff have been directed not to review consideration of latency

effects even though the applicant has included a section on such effects in the revised CAR and the MOX Standard Review Plan mentions a review of latency effects.

DPV Position:

(1) the NRC management/staff decision to accept the use of TEELs for the proposed MOX facility and all fuel cycle facilities regulated by the NRC under Part 70 be reversed
(2) Issue CS-05b on chemical consequence limits for the MOX application be reopened
(3) the applicant is requested to submit on the docket adequate justification for its use of values from TEELs (or other specific chemical consequence limits) vis-a-vis the Staff's conclusions in the RDSER
(4) a Task Force of 5 staff members with credentials and experience in chemical consequence assessment and exposure limits is formed to establish an NRC Staff position, based upon considerations of the available limits, the draft Staff chemical consequence limits derived for the MOX application, the MOX applicant's input, consistent risk levels, reasonable conservatism, and uncertainties (both in chemical effects and design/license application). Potential Task Force members include Lydia Roche, Don Stout, Rich Millstein, Walt Schwink, and myself
(5) a rulemaking process is conducted that presents these proposed limits to the licensees and the public, with Federal Register Notices and Public Meetings, and, ultimately, that produces consistent guidance for licensees and applicants. Such guidance could be in the form of a Branch Technical Position (from the Fuel Cycle Facilities Branch) or a separate guidance document (say, a NUREG document).

Significance: If the prevailing position is not reversed, TEEL values could be used as chemical consequence limits for the proposed MOX facility and all fuel cycle facilities. TEEL values tend to be significantly greater than values available from other agencies (see Table A, previously). Potential events may not be adequately characterized in terms of consequences and safety controls may not be appropriately identified to protect the workers, the public, and the environment. Thus, safety risks that affect the safe handling of licensed radiative materials may not be identified and approaches for adequate safety measures (i.e., to reach acceptable risk levels) may not be implemented. Significant injuries and/or fatalities could result to workers and the public from such potential events. There would also be significant financial liabilities from actual injuries and deaths, insurance payments, likely litigation, repairs, and lost operations. There could also be international repercussions due to the agreements involved in plutonium disposition. This would negatively impact the NRC strategic goals of maintaining safety, improving regulatory effectiveness, and increasing public confidence. The potential news impact of such an event would be extremely critical of the NRC and could result in increased Congressional oversight.

2. The NRC, Chemical Safety, and the Regulations:

2.1 The Regulations

The NRC is the lead regulatory agency at its licensee facilities. The NRC regulates three main categories of chemical safety at its licensees: hazardous chemical effects from radioactive materials (e.g., for MOX, the chemical toxicity of depleted uranium), hazardous chemical effects from chemicals produced from radioactive materials (e.g., for MOX, nitric acid fumes from nitrate solutions or nitrogen tetraoxide releases via the oxidation column), and chemical hazards that affect the safe handling of radioactive materials (this is sometimes referred to as facility conditions affecting the safe handling of licensed radioactive materials - an example would be a potential nitrogen tetraoxide release from storage cylinders that increases worker radiation exposure but has severe or even fatal consequences to the workers involved). In general, the NRC does not strictly regulate only chemical hazards.

For the proposed MOX facility, the principal governing regulation is 10 CFR Part 70 which also reiterates the chemical hazards regulated by the NRC: 70.61(b)(4), 70.61(c)(4), 70.62(c), and 70.64(a)(5) outline the three categories of chemical hazards the NRC currently regulates, simply put as:

Category 1: chemical hazards that are caused by the radioactive material,

Category 2: chemical hazards from chemicals released by radioactive materials, and

Category 3: chemical hazards that affect the safe handling of radioactive materials (essentially facility conditions in 70.64(a)(5)).

Chapter 8 of the MOX Standard Review Plan (SRP - NUREG-1718) also reiterates these three categories of chemical safety regulated by the NRC.

Parts 70.61(b)(4), 70.61(c)(4), and 70.65(b)(7) mention the requirement for appropriative quantitative standards (i.e., chemical consequence levels) for acute chemical exposures to licensed materials or hazardous materials. Appropriate chemical consequence levels are needed for high and intermediate consequence events, and for the two receptors of the worker and the individual located outside the controlled area; the latter is usually identified as having limits appropriate for a member of the public. This approach is usually interpreted by Staff and licensees/applicants to mean three chemical consequence levels - low, intermediate, and high. No chemical standards are identified for 70.64(a)(5), which includes the third category of chemical safety. However, in practice, the same limits are usually used.

Part 70.62(c) (iii) further elaborates that the ISA (Integrated Safety Analysis) should identify facility hazards that could affect the safety of licensed materials and thus present an increased radiological risk. Finally, the chemical protection baseline design criterion in 70.64(a)(5) specifies that the design "must provide for adequate protection against *chemical risks produced from licensed material, facility conditions which might affect the safety of licensed material,* and *hazardous chemicals produced from licensed material.*" Note that a specific dose level is not specified for either the chemical or radiological effect in facility hazards and facility conditions.

Part 70 also contains a general safety statement:

70.23(b): "The Commission will approve construction of the principal structures, systems, and components of a plutonium processing and fuel fabrication plant ... when the Commission has determined that the design bases of the principal structures, systems, and components, and the quality assurance program, provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents."

Note that this general statement has no restriction on potential chemical accidents; if such chemical accidents are possible, have high consequences, and present undue risk, then the applicant is required to provide reasonable assurance of protection against the consequences of such potential accidents.

In addition, the Atomic Energy Act (AEA) also contains general clauses "... to protect the health and safety of the public" (Section 2, paragraphs (d) and (e)). Section 161(b) states in part, "... to protect health or to minimize danger to life or property." Section 182(a) contains a similar statement.

Thus, the NRC regulates the three categories of chemical safety and chemical consequence limits are needed.

2.2 The MOX Standard Review Plan (SRP - NUREG-1718):

Chapter 8 of the SRP discusses chemical safety.

Section 8.4.3.2 mentions the list of hazardous chemicals is acceptable if it includes, among other items, associated exposure limits such as OSHA Permissible Exposure Limits (PELs), Emergency Response Planning Guidelines (ERPGs), etc.

Section 8.4.3.3 discusses acceptance criteria for chemical accident sequences; Paragraph C mentions a conservative estimate of potential consequences; Paragraph D mentions that the chemical consequence limits have a supporting rationale or basis, such as Acute Exposure Guideline Level (AEGL), ERPG, or other cited value, such as OSHA/NIOSH. TEELs are not mentioned but the applicant may propose an alternate standard accompanied by supporting information.

Section 8.4.3.4 discusses the acceptance criteria for chemical accident consequences. Paragraph A mentions the applicant should provide information supporting the conclusion that, among other items, the assumed data input leads to a <u>conservative</u> estimate of potential consequences (this implies reasonably conservative values for chemical consequence levels). Paragraph B mentions the consideration of latent effects from acute chemical exposures. Paragraph C mentions the consideration of uncertainty in comparing chemical hazards with the performance requirements of 10 CFR 70.61.

Section 8.5.1 mentions the safety assessment of the design basis (i.e., for a CAR - Construction Authorization Request, as part of a two-step licensing review) should consider the above, among other items, consistent with the level of the design. For a CAR review, the chemical consequence levels would be considered part of the design basis.

The acceptance criteria for the CAR stage are based upon a determination that the design bases of the principal structures, systems, and components, and the quality assurance program, provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents.

3. Overview of Chemical Consequence Documents and Events:

3.1 MOX Construction Application Request (CAR - DCS-NRC-000038):

The applicant submitted the CAR on February 21, 2001. The CAR approach has hazardous chemicals in three main areas and activities: the MOX fuel fabrication area of substantial construction (includes the main contaminated processing areas, with gloveboxes and cells), an immediately adjacent reagents building of simple construction, and chemical deliveries by vehicles. In addition, there is a separate gas storage area that could present an asphyxiation concern. No safety controls for chemical effects are identified apart from the air supply to the Emergency Control Room. The CAR indicates chemical effects to the public, site worker, and facility worker would be low, using the DOE TEEL consequence limits (pages 8-13 and 8-14). Atmosphere D class stability, a 4.5 m/sec wind speed, a rural terrain, and a leak from the largest container were assumed. In addition, the applicant stated on page 8-14 that principal structures, systems, and components (PSSCs) defined for radiological events may be applicable to process units where chemicals mix with radiological material. A design basis for chemical consequence limits was not identified. The applicant identified TEELs as the design basis in response to a request for additional information (RAI) from the NRC. This list in the RAI had some lower values than the list mentioned in the CAR. Non-MOX NRC Staff were queried as to the limits applied to existing facilities - TEELs were not used (see Attachment 2).

3.2 Argonne National Laboratory (ANL) Analyses on the Original Environmental Report - Late 2001:

ANL started evaluating chemical consequence effects from potential chemical releases in late 2001, starting with information supplied by the applicant's Environmental Report. ANL independently decided to use the ALOHA code for estimation of consequences after separately evaluating chemical release and evaporation rates. The ALOHA code is maintained and updated by NOAA and is funded by the EPA; the EPA routinely uses ALOHA for estimating consequences from chemical releases. ANL used F Class meteorology and a wind speed of 1.5 m/sec, as recommended by the EPA (40 CFR 68.22) for the minimum, worst case scenario. The results from using ALOHA showed significant chemical consequences beyond 100 meters for several chemicals, and estimates for nitrogen tetraoxide and hydrazine had the potential to exceed limits at the Savannah River Site (SRS) boundary some 5 miles away. Estimated concentrations for nitrogen tetraoxide indicate fatalities could result. ANL is a DOE National Laboratory and used the TEEL values for the chemical consequence limits. ANL deferred additional work on the chemical consequence modeling until later in 2002, pending receipt of a

Revised Environmental Report from the applicant that incorporated changes to the program made by the applicant (and DOE) in February 2002.

3.3 NRC Staff Analyses in the DSER - April 2002:

The staff had to address the apparent contradiction of the CAR analyses, which indicated no chemical concerns, and the preliminary ANL results, which indicated significant chemical consequences. The staff conducted several parametric analyses using the ALOHA code and obtained similar results to ANL; i.e., indicating the potential for significant chemical consequences. The results are summarized in Section 8 of the staff's Draft Safety Evaluation Report (DSER, NRC, April 2002) and in Table 1 here, along with the TEEL values used.

Table 1: Preliminary Analysis of Potential Chemical Impacts - Ambient Temperatures (using TEELs as guidelines; staff does not accept the use of TEELs)

Chemical	Exposure at 100 m, mg/m3	TEEL-1 mg/m3	TEEL-2 mg/m3	TEEL-3 mg/m3	Maximum Distance to TEEL Level, m		
					TEEL-1	TEEL-2	TEEL-3
N_2O_4	140,000	15	15	75	8,000	8,000	4,000
HNO_3	250	2.5	12.5	50	1,800	700	300
HAN	350	10	25	125	600	400	200
$N_2H_4.H_2O$	35	0.006	0.04	0.04	>10,000	5,000	5,000

TEEL = Temporary Emergency Exposure Level (from DOE)

Note that the values at 100 m exceed the values for TEEL-3s by a wide margin. Thus, significant, high consequence chemical effects would be anticipated and the workers would not be able to adequately evacuate. For at least two chemicals (nitrogen oxides [N2O4] and nitric acid [HNO3]), the exposure levels would be so high that fatalities would likely result in and around the facility. The staff does not accept the use of TEEL values for chemical consequence limits due to multiple TEEL changes in the past two years, NIOSH and EPA requirements and guidance for using lower values, and the NRC use of lower values for chemical consequence categorization for other fuel cycle facilities. The NRC would likely use values lower than Immediately Dangerous to Life and Health (IDLH) limits; for example, these might be in the 10-15 mg/m3 range for N2O4 and 8-10 mg/m3 range for nitric acid. The use of lower, more reasonable consequence levels of concern results in receptors at even greater distances being potentially impacted and in a larger area (footprint) of high consequence effects around the facility. The staff identified controls for chemical safety as part of open item CS-5.

3.4 Staff In-Office Review of Applicant Document - August 2002:

The staff reviewed documents during the August 2002 In-Office Review. In one of the documents, chemical consequences are analyzed. Table 2 summarizes the results for the site worker. The Table 2 results indicate high consequences which was acknowledged in the document. Table 3 shows the results as a function of distance. The applicant had concluded that nitrogen tetraoxide and hydrazine could exceed the numerical value of the TEEL-2 limit at the SRS boundary (about 5 miles - 8 km - away), the location originally assumed for the public receptor (NB - recent program changes in November 2003 have greatly changed the Controlled Area Boundary, and the public receptor is now approximately 100 meters from the point of release). This is essentially consistent with the prior analyses by ANL and the staff. Again, potential releases from nitrogen tetraoxide result in such high estimated concentrations that they would likely result in fatalities, regardless of the chemical consequence (e.g., TEEL) values used.

<u>Table 2: Applicant's Results for the Public (the 100 meter receptor)</u>

Compound	Release Rate, kg/hr	Concentration at 100 meters
N2H4*H2O, 35% 477 liters, 47.7 m2 pool	1.487	0.136 mg/m3 (TEEL-3 = 0.02)
HNO3 609 liters, 60.9 m2 pool	5.806	0.266 ppm (TEEL-3 = 20)
N2O4 908 liters, 90.8 m2 pool	2,442	280 mg/m3 (TEEL-3 = 36)
UO2, drum emptying 200 kg	0.120	0.014 mg/m3 (TEEL-3 = 10)
UO2, fire event 37,500 kg	2.25	0.258 mg/m3 (TEEL-3 = 10)

Table 3: Applicant's ALOHA Results as a Function of Distance for Several Chemicals

N2H4*H2O, 35%, 477 liters, TEEL-3 = 0.02 mg/m3 **(hydrazine hydrate)**

Distance, miles	ALOHA Value	Extrapolation Fit
0.0621 (100 meters)	8.67 mg/m3	7.718 mg/m3
0.1242	2.24	2.248
0.25	0.592	0.647
0.5	0.167	0.189
1	0.0517	0.055
1.5	0.0276	0.027
2	0.0182	0.016

[Staff notes that the power fit is trending below the ALOHA results for 1.5 and 2 mile distances and will likely underestimate the ALOHA prediction at the SRS boundary.]

HNO3, 13.6 N, 609 liters, TEEL-3 = 20 ppm **(nitric acid)**

Distance, miles	ALOHA Value	Extrapolation Fit
0.0621 (100 meters)	26.9 ppm	23.947 ppm
0.1242	6.95	6.972
0.25	1.83	2.007
0.5	0.517	0.584
1	0.16	0.170
1.5	0.0856	0.083
2	0.06	0.05

[Staff notes that the power fit is trending below the ALOHA results for 1.5 and 2 mile distances and will likely underestimate the ALOHA prediction at the SRS boundary.]

N2O4, 100%, 908 liters, TEEL-3 = 36 mg/m3 **(nitrogen tetraoxide or tetroxide)**

Distance, miles	ALOHA Value	Extrapolation Fit
0.0621 (100 meters)	29,100 mg/m3	25,944.5 mg/m3
0.1242	7,520	7,552.5
0.25	1,990	2,173.6
0.5	560	632.7
1	173	184.2
1.5	92.7	89.5
2	60.9	53.6

[Staff notes that the power fit is trending below the ALOHA results for 1.5 and 2 mile distances and will likely underestimate the ALOHA prediction at the SRS boundary.]

Note that the TEEL values used by the applicant for hydrazine and nitrogen tetraoxide differ by a factor of two from those used by ANL (shown in Table 1).

3.5 Argonne National Laboratory (ANL) Analyses on the Revised Environmental Report:

ANL resumed work on chemical consequence analysis with the receipt of the Revised Environmental Report from the applicant. Again, they have independently accepted and used the ALOHA code for analyses and have concluded there is the potential for significant chemical consequences to the site worker from several chemicals and to the public from at least one chemical (hydrazine). Their results are essentially the same as in their previous activities (see Section 3.2, previously). ANL again used TEEL values for the limits.

3.6 Revised Construction Application Request (RCAR) - October 2002:

Sections 5.5.2.10 and 8.4 of the RCAR summarizes the chemical accident consequences.

The applicant has assessed a "not unlikely" likelihood for chemical releases. The analysis is stated to follow the guidance found in NUREG/CR-6410. The calculations for the site worker are based upon an F stability class using 95% meteorology from 10 years of historic data, and arrived at an air speed of 2.2 m/sec (i.e., different again from the CAR and previous analyses). The chi/q is calculated by the ARCON96 code applied at 100 meters; this value is 6.1E-4 sec/m3 (page 5.4-16). The calculations for the public are based upon a distance of 5 miles (8 km) using the MACCS2 code; the calculated chi/q is 3.7E-6 sec/m3 (page 5.4-15). The use of ALOHA for the 5 mile receptor is also mentioned for chemica releases.

The applicant has identified a uranium dioxide release from a fire event as requiring controls under Part 70; this event is regulated by the NRC because the chemical hazards arise from a radioactive material. This is representative of the first category of chemical safety regulated by the NRC. The applicant proposed controls to provide adequate assurances of safety.

The applicant has identified two events involving hazardous chemicals produced from radioactive materials. One involves a chlorine release and the other involves a release of nitrogen tetraoxide via the oxidation column. These are representative of the second category of chemical safety regulated by the NRC. The applicant has proposed mitigating engineered controls to provide adequate assurances of safety; for nitrogen tetraoxide, these controls limit the release rate to under 44 kg/hr so that TEEL-2 limits (15 mg/m3) are not exceeded for the 100 meter receptor. Note that the public receptor is now located at the 100 meter distance, so a lower limit will likely apply.

The applicant has stated that the only safety functions to meet the 70.61 performance requirements for operators are in the Emergency Control Room (ECR). Consequently, the ECR air conditioning system is designated as a safety control to maintain habitable conditions during an event, such as a release of hazardous chemicals. No other controls are identified for chemical safety or for meeting 70.62 and 70.64(a)(5) requirements for chemical safety. The applicant has not identified any other safety effects from a chemical release. The applicant has identified ten administrative controls with some twenty-seven safety functions for radiological safety that occur outside of the control room.

TEELs are identified as the design basis for chemical consequence limits. Values in the RCAR are different from values in the original CAR and the RAI response. Values for nitric acid and hydrazine have changed considerably and increased, and result in some accident scenarios no longer requiring safety controls. .

3.7 Public Meetings with the Applicant - December 2002 to June 2003:

The NRC held public meetings with the applicant in this timeframe. The applicant commented that they used of TEELs because they were endorsed by DOE and they represented the most relevant limits for the proposed MOX facility. Such statements do not provide the adequate assurance of safety mentioned in the acceptance criteria in the MOX standard review plan nor do they necessarily meet the regulations. Applicant/Staff discussions did note the changes in the TEEL values and the differences between TEELs and other chemical consequence limits for similar purposes, and the potential impacts on the identification of safety controls and the footprint affected by NRC-regulated chemical events.

3.3 NRC Staff Analyses in the Revised DSER [RDSER] - April 2003:

This is summarized from Section 8 of the Revised DSER (RDSER).

The applicant has based the chemical consequence limits for accident categories on Temporary Emergency Exposure Limits (TEELs) Revision 18 - see Tables 4 and 5. TEELs were adopted by the U.S. Department of Energy (DOE), Subcommittee on Consequence Assessment and Protective Action (SCAPA) (Reference 8.3.38.). The SCAPA-approved methodology was used to obtain hierarchy-derived TEELs (see revised CAR Section 8.3.4).

The TEEL hierarchy/toxicity methodology has been used by DOE/SCAPA to develop community exposure limits for over 1,200 chemicals to date. The following are the TEEL definitions:

- TEEL-0 - The threshold concentration below which most people will experience no appreciable risk of health effects.
- TEEL-1 - Low Consequence Level - The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
- TEEL-2 - Intermediate Consequence Level - The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

- TEEL-3 - High Consequence Level - The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

The staff review indicates the list of TEELs is not a regulatory based and revised document. SCAPA was established by the Emergency Management Advisory Committee (EMAC) of DOE to assist the Director of Emergency Management. SCAPA provides DOE with technical recommendations in emergency preparedness. TEELs are one of the products of SCAPA and are intended for use by DOE and DOE contractors as guidance only when a peer reviewed exposure limit does not exist (emphasis added).

The staff has found that the TEEL limits change, for example:

- The original CAR identifies a nitric acid TEEL-3 of 20 ppm (50 mg/m3). The RAI 113 response has 50 mg/m3 (20 ppm - the same). The 2002 revised SCAPA in the revised CAR has 78 ppm (200 mg/m3).

- The original CAR identifies a hydrazine hydrate TEEL-3 of 10 ppm. The RAI 113 response has 0.02 ppm. The revised SCAPA list has 30 ppm as hydrazine and 0.04 mg/m3 as hydrazine hydrate (0.006 ppm, based upon a heptahydrate molecular weight of 158). The applicant is using 50 mg/m3 (about 40 ppm) in the revised CAR.

- The original CAR identifies a nitrogen tetraoxide (also known as tetroxide or peroxide) TEEL-3 of 30 ppm. The RAI 113 response has 20 ppm. The latest list from SCAPA has 20 ppm and this is used by the applicant in the revised CAR.

Thus, in the space of about 2 years, these TEEL-3s have varied by 50% or more. NRC regulations and guidance do not mention TEELs. As discussed below, the NRC does not find the applicant's proposed use of TEELs or the values in Table 4 acceptable.

Table 4: Chemical Consequence Limits Proposed By the Applicant for the MFFF (mg/m3)

Name	Low Consequence Level (TEEL-1 Value)	Intermediate Consequence Level (TEEL-2 Value)	High Consequence Level (TEEL-3 Value)
Aluminum Nitrate	15	15	500
Azodicarbonamide	125	500	500
Chlorine	3	7.5	60
Chromic (III) Acid	1	2.5	25
Diluent (C10-C13 Isoalkanes)	5	35	200
Ferrous sulfate (Lab)	7.5	12.5	350
Fluorine (Lab)	0.75	7.5	30
Hydrazine Monohydrate	0.0075	0.06	50
Hydrazine Nitrate	3	5	5
Hyrofluoric Acid	1.5	15	40
Hydrochloric Acid	4	30	200
Hydrogen Peroxide	12.5	60	125
Hydroxylamine Nitrate	15	26	125
Iron	30	50	500
Isopropanol	1000	1000	5000
Manganese Nitrate	10	15	500
Manganous Sulfate	7.5	12.5	500
Nitric Acid	2.5	15	200
Nitric Oxide	30	30	125
Nitrogen Dioxide	7.5	7.5	35
Nitrogen Tetroxide	15	15	75
Oxalic Acid	2	5	500
Potassium Permanganate	7.5	15	125
Silver Nitrate	0.03	0.05	10
Silver Oxide	30	50	75
Sodium	0.5	5	50

Name	Low Consequence Level (TEEL-1 Value)	Intermediate Consequence Level (TEEL-2 Value)	High Consequence Level (TEEL-3 Value)
Sodium Carbonate	30	50	500
Sodium Hydroxide	0.5	5	50
Sodium Nitrite	0.125	1	60
Sulfuric Acid	2	10	30
Sulfamic Acid	40	250	500
Thenoyl TrifluoroAcetone	3.5	25	125
Tributyl Phosphate	6	10	300
Uranium Dioxide	0.6	1	10
Uranyl Nitrate	1	1	10
Xylene	600	750	4000
Zinc Stearate	30	50	400
Zirconium Nitrate	35	35	50

Table 5: Applicant's Use of Chemical Limits for Qualitative Chemical Consequence Categories

Consequence Category	Worker	Public
High	Concentration ≥ TEEL-3	Concentration ≥ TEEL-2
Intermediate	TEEL-3 > Concentration ≥ TEEL-2	TEEL-2 > Concentration ≥ TEEL-1
Low	TEEL-2 > Concentration	TEEL-1 > Concentration

The NRC does not promulgate its own chemical consequence limits but relies on values from other agencies and organizations that have a clear toxicological and regulatory basis. The staff notes that there are multiple limits available for assessing the impacts from potential chemical releases. In the SRP, Chapter 8 mentions both ERPGs and AEGLs as potential acute chemical exposure limits.

The Emergency Response Planning Guidelines (ERPGs) were developed by the ERPG committee of the American Industrial Hygiene Association (AIHA), an industry organization. The ERPGs were developed as planning guidelines to anticipate adverse health effects from the exposure to toxic chemicals. The ERPGs are three-tiered guidelines based upon 1-hour exposures. The verbal definition of each ERPG tier is comparable to the same TEEL tier. ERPG values only exist for about 100 chemicals. The ERPGs are emergency response guidelines and a planning tool, and do not contain safety factors that are usually incorporated into exposure guidelines. ERPGs are not a standard for the protection of the public. The staff review found that the ERPGs have essentially identical numerical values as the comparable TEELs and present the same concerns.

The EPA is developing Acute Exposure Guideline Levels (AEGLs) as a government standard for emergency response, in a public process involving some 28 organizations, including the National Academy of Sciences. These AEGLs are defined as follows:

- AEGL-1 (Low Consequence Level) is the airborne concentration (expressed as ppm or mg/m3) of a substance at or above which it is predicted that the general population, including "susceptible" but excluding "hypersusceptible" individuals, could experience notable discomfort. Airborne concentrations below AEGL-1 represent exposure levels that could produce mild odor, taste, or other sensory irritations.

- AEGL-2 (Intermediate Consequence Level) is the airborne concentration (expressed as ppm or mg/m3) of a substance at or above which it is predicted that the general population, including "susceptible" but excluding "hypersusceptible" individuals, could experience irreversible or other serious, long-lasting effects or impaired ability to escape. Airborne levels below AEGL-2 but above AEGL-1 represent exposure levels which may cause notable discomfort.

- AEGL-3 (High Consequence Level) is the airborne concentration (expressed as ppm or mg/m3) of a substance at or above which it is predicted that the general population, including "susceptible" but excluding "hypersusceptible" individuals, could experience life-threatening effects or death. Airborne levels below AEGL-3 but at or above AEGL-2 represent exposure levels that may cause irreversible or other serious, long-lasting effects or impaired ability to escape.

The staff notes that the verbal definition of AEGL-2 overlaps TEEL-3 and the verbal definition of AEGL-1 overlaps TEEL-2. Per the definition, an exposure exceeding the AEGL-2 level may cause an impaired ability to escape.

Currently, AEGLs have been established for only four chemicals. Interim AEGLs are available for additional chemicals, including chlorine, hydrazine, nitric acid, and nitrogen dioxide. Table 6 provides interim AEGL values for one hour exposures to these chemicals. Values are available for exposures of 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours; generally the longer the exposure, the lower the chemical concentration for each AEGL. For nitric acid, note that the proposed AEGL-3 value is lower than the TEEL-3 value and the AEGL-2 is lower than the TEEL-2 value. AEGLs are not threshold limits but are similar to a gradient with probability considerations as to the percentage affected.

Table 6: Interim AEGL Values for Several Chemicals at the MFFF

Summary of Proposed AEGL Values, in ppm [mg/m3], 1 hour exposure basis				
Classification	chlorine	hydrazine	nitric acid	nitrogen dioxide
AEGL-1	0.5 [1.5]	0.1[0.13]	0.5 [1.5]	0.5 [0.9]
AEGL-2	2 [6]	13 [17]	4 [12]	12 [23]
AEGL-3	20 [60]	35 [46]	22 [66]	20 [38]

The staff review has also identified NRC guidance that uses IDLH values for chemicals in control room habitability evaluations. IDLH (Immediately Dangerous to Life and Health) values have been developed for many chemicals by NIOSH (National Institute for Occupational Safety and Health) and are published in many places. NIOSH defines IDLH as a condition that poses a threat to exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. The purpose behind IDLH is to establish a limit for the contaminated environment that the worker can escape from in the event of failure of the respiratory protection equipment; in essence, only highly reliable respiratory protection should be used in contaminated environments with concentrations above the IDLH. IDLH includes consideration of severe eye and respiratory irritation and other deleterious effects (e.g., disorientation or incoordination) that could prevent escape. As a safety margin, the IDLH values are based on the consequences of a nominal, 30 minute exposure, although the worker was expected to exit the are immediately upon loss of respiratory protection. The NRC guidance is based upon a maximum exposure to chemicals for two minutes at an IDLH value as providing adequate safety margin. IDLH values exist for several hundred chemicals. IDLH values are generally applied to worker populations. For members of the public, 10% of the IDLH is sometimes used to accommodate the wider range of population groups, ages, and sensitivities encountered. Table 7 provides a summary of IDLH values for several chemicals of concern at the proposed MFFF. The staff notes that N2O4 is the dimer of NO2 and the two exist in equilibrium. This exacerbates releases and the NO2 is responsible for the reddish color observed during N2O4 spills.

The staff review found other limits mentioned in the chemical literature.

The U.S. military has published short-term, chemical exposure guidelines for deployed military personnel. These include temporary exposure (or acute, represented by a 1-hr time period) and short-term exposure (or sub-acute, represented by1-14 day values) military air guidelines

(MAGs). The MAGs are a compilation of published 1-hour values from Emergency Response Planning Guidelines (ERPGs), AEGLs, and TEELs. Other values were

Table 7: Summary of IDLH, ST, and Toxic Endpoint Limits

Summary of Values, in ppm [mg/m3]				
Compound	IDLH (i.e., for the worker)	10% of IDLH (i.e., for the public)	NIOSH ST	EPA Toxic Endpoint
Chlorine (1 ppm = 2.95 mg/m3)	10 [30]	1 [3]	0.5 [1.45] (NIOSH, 15 minutes)	3 [8.7]
Hydrazine (1 ppm = 1.33 mg/m3)	50 [66.5] Carcinogen	5.0 [6.7]	0.03 [0.04] (2 hour basis)	8.3 [11]
Nitric Acid (1 ppm = 2.62 mg/m3)	25 [66]	2.5 [6.6]	4 [10]	10 [26]
Nitrogen Dioxide/N2O4 (1 ppm = 1.91 mg/m3)	20 [38]	2 [3.8]	1 [1.8]	(Not Listed)
Uranium (insoluble compounds) (1 ppm = 10 mg/m3)	1 [10]	0.1 [1]	0.06 [0.6]	(Not Listed)

used where appropriate and consistent with the application and effect levels, such as Emergency Exposure Guideline Levels (EEGLs - a significant effects level), Short-term Public Emergency Guidance Levels (SPEGLs - a minimal effects level), Ceiling Limit values (also a minimal effect level), and Immediately Dangerous to Life and Health (IDLH - a severe effect level). In summary, they are based upon a review of the applicability of short-term exposure values. The MAGs are also based upon the assumption that a deployed military population consists of healthy and fit individuals with no predisposing health factors, and aged 18-55; in short, a subset of the population. The levels are defined as:

- MAG-1 is the airborne concentration corresponding to a minimal health effect level
- MAG-2 is the airborne concentration corresponding to a significant health effect level
- MAG-3 is the airborne concentration corresponding to a severe health effect level

As explained in the MAG documentation, concentrations below the minimal effects level (MAG-1) may be considered safe or of negligible severity for most individuals from inhalation exposures to a specific chemical. Individuals exposed to concentrations between the minimal and significant effects levels (between MAG-1 and MAG-2) may be considered to be in a marginal severity category and would experience mild irritation or temporary health effects. Individuals exposed to concentrations between the significant and severe effects levels (between MAG-2 and MAG-3) may be considered to be in a critical severity category but should not experience or develop irreversible health effects or symptoms that would impair their ability to take protective action. Individuals exposed to air concentrations exceeding the severe effects level (greater than MAG-3) would be considered to be of catastrophic severity where irreversible or life-threatening health effects may occur. Thus, the verbal definitions of MAG-3 and MAG-2 approximately correspond to TEEL-3 and TEEL-2, respectively.

These MAG limits are tabulated for many chemicals and Table 8 lists several of interest to the MFFF. The staff review notes that the MAG-3 value for nitric acid is less than the IDLH value and significantly below the TEEL-3 value proposed by the applicant.

Table 8: MAG Values for Selected Chemicals

Summary of MAG Values, in ppm [mg/m3]				
Compound	MAG-1	MAG-2	MAG-3	1-14 Day MAGs
Chlorine	1 [2.9]	3 [8.7]	20 [58]	0.1 [0.29]
Hydrazine	0.3 [0.4]	0.8 [1.0]	10 [13]	0.01 [0.013]
Nitric Acid	0.5 [1.3]	4 [10]	13 [34]	2 [5.2]
Nitrogen Dioxide	(-)	15 [28]	20 [38]	3 [5.6]

Note: MAGs do not currently have values for uranium.

NIOSH has also identified short term exposure limits (STELs or STs) for some chemicals. ST values are usually based upon a 30 minute, time weighted exposure that should not be exceeded at any time during a workday. Thus, ST values can represent repetitive short term exposures. ST values exist for some chemicals of interest at the MFFF.

The EPA has defined toxic endpoints as part of its risk management program. Selected values for chemicals of interest have already been shown in Table 6.

In summary, the staff notes that the applicant has not identified a design basis for chemical consequence levels. In addition, the levels mentioned by the applicant appear to change frequently, are not based upon a peer reviewed process, are not clearly tied to toxicological information, and have high numerical values as compared to other standards. Thus, they do not provide regulatory stability, and adequate margin and conservatism for assessing chemical risks and identifying PSSCs to meet the performance requirements of 10 CFR 70.61. The staff finds the levels proposed by the applicant do not provide reasonable assurance of chemical safety at the proposed facility for routine operations, off-normal conditions, and potential accidents.

The staff also concludes that no single source of chemical hazard limits may contain all of the chemicals likely to be encountered at the proposed facility and address all potential release situations (e.g., worker and public, and high, intermediate, and low consequences); adequate margin and conservatism is likely to involve the selection of the lowest value from AEGL-2s, MAG-3s, ERPG-3s, IDLHs, STELs, and TEEL-3s for workers, and the selection of the lowest value from EPA Toxic Endpoint, AEGL-1s, MAG-2s, ERPG-2's, STEL/PEL, and TEEL-2s for the public. These concerns about consequence levels are identified as part of open item CS-5b; the applicant should provide chemical consequence levels that provide regulatory stability, have a clear toxicological basis, and provide adequate margin and conservatism.

4. Staff Discussions:

The staff have been discussing this issue with the applicant for approximately 30 months now. As noted in the Staff's RDSER, the TEEL values for some chemicals have fluctuated significantly in that timeframe. Even if the numerical values were selected as a design basis, the staff would neither have confidence nor an adequate technical safety basis that the selected values would provide for adequate assurance of safety and meet the requirements of the regulations or the acceptance criteria of the SRP. Inconsistencies within the TEEL list proposed by the applicant (e.g., nitric acid and NOx, the differences between the TEEL 1,2,3 values for specific chemicals) and with other limits and trends (AEGLs, MAGs, STs etc. - generally lower exposure limits) have not been adequately explained. The applicant has frequently responded that TEELs are used by DOE - such a statement does not provide for adequate assurances of safety. The policy statement in Attachment 1 does not adequately address adequate assurances of safety and even notes that TEELs are not peer-reviewed and rely upon U.S. Department of Energy personnel. Thus, I conclude:

1. Safety concerns from the NRC Staff's Revised Draft Safety Evaluation Report (RDSER) are not addressed and an adequate technical safety basis has not been provided for the use of TEELs. In addition, the burden of adequate justification of the use of TEELs vis-a-vis the Staff's conclusions in the RDSER has not been placed on the applicant.

MOX chemical reviewers were asked by management to review the available chemical consequence limits from multiple sources and develop an algorithm for assembling a reasonable list of values that could meet the SRP acceptance criteria (e.g., as discussed earlier in Section 2 of this report - technical basis, conservatism, and inclusion of latent effects. The SRP does not mention TEELs. As the Lead Chemical Safety Reviewer, I started by contacting other members of the NRC staff involved in the licensing of existing fuel cycle facilities - some of the E-mail contacts are included in Attachment 2. None of the respondents mentioned the use of TEELs for existing facilities. From this information and the continuing review of the chemical exposure area, the MOX chemical safety reviewers generated a Staff algorithm and list of values, which are presented in Attachment 3. Note that the algorithm starts with the TEEL values. Where values from other sources exist for a specific chemical, those other values are substituted for the TEEL values if they are less than the TEEL value for the indicated consequence level and application circumstance, or have a better toxicological rationale. I emphasize that these are not the lowest values available (as implied by Attachment 1), but are usually lower than the corresponding TEEL values (see Table A in the cover letter).

Subsequently, management involved with MOX were not pleased with the Staff algorithm and values, including reaching a consensus within the schedule and potentially different chemical consequence values from those used by DOE (e.g., at the Savannah River Site, the location of the proposed facility). MOX Program Management requested a management policy review of the applicant's proposal to use TEELs in their safety assessment. This policy review was conducted by a single SLS advisor; as noted previously, the resultant policy is in Attachment 1. This policy endorsed the use of TEELs. There was limited interaction with the technical review staff and no consideration of actual practice at fuel cycle facilities. The policy does not indicate any reconciliation of comments. The policy acceptance of TEELs would contradict the MOX SRP (i.e., clear technical basis, conservatism, and latent effects) and other NRC guidance, such as Regulatory Guide 1.78 which endorses a maximum exposure time of two minutes if IDLH values are exceeded (TEELs are not mentioned and TEELs are for a nominal one hour exposure). This is not discussed in the policy. The policy confuses dispersion model effects with exposure limits from definitive measurements in tests and case studies (i.e., no dispersion effect). The policy does not provide a clear technical safety basis as to why higher chemical concentration levels would be acceptable, provide commensurate levels of safety given the deterministic nature of chemical effects, and provide adequate margin and conservatism. No consensus or rulemaking process was used. There were no public meetings on the subject (i.e., due to major changes in guidance [e.g., SRP] and practice that result from using TEELs). Attachment 4 contains the short biography of the SLS policy advisor from a recent NRC announcement - this individual has a health physics background and is not qualified to make policy on chemical toxicology and consequence limits. Thus, I conclude:

2. Normal NRC procedures for changing established NRC practice, such as Staff interactions and rulemaking (e.g., public meetings), were not followed in management acceptance of the use of TEELs. Management requested the policy analysis from a single individual - no committees, task forces, and the usual NRC consensus process were involved. The individual establishing the policy has a health physicist background and is not qualified to make policy on chemical toxicology and consequence limits.

DOE guidance on the use of TEELs and ERPGs is included in Attachment 5. This emphasizes the temporary nature of TEELs and, if there is a better value, use it. It also establishes the link between TEELs and ERPGs, the presence of uncertainties, and the absence of safety margins From this and the RDSER, I conclude:

3. TEELs are, by definition, temporary and do not incorporate safety margins that are usually included in other chemical exposure limits. This clearly contradicts established NRC practice that almost always incorporates margin in safety limits and design bases. TEELs may have large uncertainties which may not be accounted for (e.g., no margins). TEELs also do not have a clear linkage to toxicological effects. TEELs were also established for the purposes of emergency preparedness (EP), such as for response personnel and evacuations, and may not be appropriate for design bases for safety controls.

Overall, I have to conclude:

4. Fundamental safety issues, such as consistent risk levels and adequate justification for accepting TEEL values which are frequently higher (sometimes multiple factors higher - see the table attached to the cover letter [Table A]) than other consequence levels from other agencies. In short, where is the rationale and supporting information such that the use of values that are frequently higher than other values provides for adequate assurances of safety? In addition, on the MOX Construction Authorization Request (CAR), staff have been directed not to review consideration of latency effects even though the applicant has included a section on such effects in the revised CAR and the MOX Standard Review Plan mentions a review of latency effects.

Finally, I note that, after a recent meeting (February 12th, 2004) with a licensee to discuss a license amendment, an NRC Program Manager informed a Chemical Safety Reviewer that TEELs were accepted by NRC management and, thus, no questions should be asked of the licensee regarding the use of TEELs for chemical consequence criteria. Thus, it appears this policy is being applied to other fuel cycle facilities even though the previously identified concerns have not been addressed or reconciled.

ATTACHMENT 1:

MANAGEMENT POLICY PAPER ON THE USE OF TEELs FOR CHEMICAL CONSEQUENCE LIMITS IN NRC LICENSED FUEL CYCLE FACILITIES

From: Brian Smith
To: Alex Murray; Andrew Persinko; David Brown; John Lubinski; Norma Garcia Santos; W Troskoski
Date: 10/8/03 8:27AM
Subject: Fwd: Chemical Consequence Criteria

Attached is Don Cool's final response to our request concerning the use of TEELs.

CC: Joseph Giitter; Joseph Holonich; Robert Pierson

From: Donald Cool
To: Smith, Brian
Date: 10/6/03 1:10PM
Subject: Chemical Consequence Criteria

Brian:

Attached is the results of my review of the chemical consequence criteria for the MOX facility. This review was conducted in response to the memo from Andrew Persinko to Donald Cool, June 23, 2003, with attachments, and reflects many interactions between myself and members of FCSS.

Donald A. Cool

CC: Gillen, Daniel

Policy Review for Chemical Consequence Criteria

Background:

The Division of Fuel Cycle Safety and Safeguards (FCSS) requested an independent policy review of selection of chemical consequence criteria for use in the designation of high, intermediate, and low consequence events at the Mixed Oxide Fabrication Facility (MOX). This review was conducted to provide an independent perspective of the background material developed by the FCSS chemical safety staff, and the relative merits of positions which FCSS could take in the review of the application for construction. Background materials included the Standard Review Plan for Fuel Cycle Facilities, draft Safety Evaluation Report, and various references related to development of industry standards.[1] The question posed by FCSS is the appropriate values to be used in designating high and intermediate consequence concentrations. A tremendous amount of work has gone into the analysis and identification of concerns, and the efforts are to be commended.

The question of acceptable methods for designating chemical consequence criteria is addressed in NUREG-1520, Fuel Cycle Facility Standard Review Plan, Chapter 6, Chemical Process Safety. The standard review plan for the MOX facility indicates that Emergency Response Planning Guidelines (ERPG) values and Acute Exposure Guidance Levels (AEGL) are recognized acceptable values for consideration. Temporary Emergency Exposure Limits (TEEL) are not identified in the SRP. However, there are some chemicals that will be used in the MOX facility for which neither an ERPG or AEGL is available. Hence the question of appropriate values.

Applicants are to demonstrate that they meet the criteria of § 70.61 for Performance Requirements. For chemical safety, applicants are to designate and limit the risk of credible high consequence events and intermediate consequence events as defined in §70.61(b) and §70.61(c), respectively.

The applicant has proposed the use of the TEEL[2] values for low, intermediate, and high consequence concentrations of chemicals. The TEEL values would be used to designate systems and components for which additional protection and controls are needed. This methodology is used by the Department of Energy for chemical hazard criteria, particularly in situations where other criteria, such as ERPG or AEGL values are not available. The applicant has proposed that the risk must be reduced if the chemical concentration from a intermediate consequence event exceeds the TEEL 2 level. Thus, TEEL 2 is the lower boundary for action. TEEL 3, in a corresponding way, forms the lower boundary for high consequence events, and would require further actions, above those proposed for TEEL 2 levels, to reduce the risk.

FCSS, in the draft Safety Evaluation Report, Revision 1, dated April 30, 2003, reached the following position:

> "The values proposed by the applicant are temporary limits are not from a regulatory based and revised document, not based on a peer-review process, and have high numerical values as compared to other standards. Thus, they do not provide adequate margin and conservatism for assessing chemical risks and identifying PSSCs to meet the performance requirements of 10 CFR 70.61. Therefore, the NRC does not find the

applicants proposed values in Table 8-11 acceptable. These concerns about consequence levels are identifies as part of Open Item CS-5b."

FCSS has indicated that the primary concern is the applicant's proposal for the high consequence level. There is a greater degree of agreement with the values at the intermediate and low consequence level. Staff has suggested a possible algorithm for selecting among different values, including AEGL's, ERPG's, TEEL's and other indices in order to specify the concentrations for high and intermediate consequence. This algorithm would effectively select the minimum concentration value from among a variety of possible sources, some of which are based on acute effects, and some of which also include consideration of long-term carcinogenic effects.

Review and Observations:

The original intention of the TEEL was to provide temporary guidance until ERPG or AEGL values can be developed. However, there are a number of chemicals for which a TEEL value, ERPG value, and an AEGL (or interim AEGL value) exists. Review indicates that when both values exist, the TEEL value and the ERPG value are identical. During the FCSS review process since the initial MOX application, several additional ERPG values have been put in place, and the TEEL value has be adjusted to match the ERPG value. For several of the chemicals of interest in the MOX application, this has resulted in larger concentration values for one or more of the consequence levels. The TEEL values have undergone several revisions since the beginning of the review period. Although not "peer reviewed" in the consensus standard definition of the term, the review and revision of TEEL values is a structured formulaic derivation process involving a large group of experts drawn from across the DOE complex.

In general, it would appear that the ERPG/TEEL values tend to be higher values when multiple guidance documents exist. This could be due to a more recent reflection of available data, since the ERPG/TEEL values are subject to more periodic revisions. It may also be the result of differences in the underlying methodology and approach used to derive the values. The actual rationale for specific changes is not available. As with any situation, there is a body of scientific evidence that is subject to data availability, interpretation, uncertainty, and debate. The establishment of values for acute exposure effects from chemicals is no exception. This results in a range of values, some of which may have more conservatism and margin built into their derivation.

To understand the potential for a substantial safety concern if the TEEL methodology is used, a comparison has been made with the concentrations considered to be immediately dangerous to life and health (IDLH). In every case reviewed, the IDLH is greater than the TEEL 2 value. Thus events would be identified as at least of intermediate consequence at concentrations less than that considered to be IDLH. In some cases IDLH values are less than the TEEL 3 values, while in other cases they are greater than the TEEL 3 level. In the two cases where IDLH is lower than TEEL3, chlorine is a factor of 2 different, and nitric acid is a factor of between 3 and 4 different. Thus it would appear that the only value of potential concern would be the TEEL3 value for nitric acid.

Nitric acid is unique in that the difference between TEEL 2 and TEEL 3 is more than an order of magnitude, an unusually large difference. The ERPG was established for nitric acid in 2001, and the TEEL 3 value was correspondingly adjusted in revision 18 of the TEELs. The ERPG sheet for nitric acid[3] cites several animal and human studies to support a 78 ppm TEEL 3 value, including LC_{50} animal data and human data from accidental silage gas poisoning. The IDLH value for nitric acid was revised from 100 ppm to 25 ppm in 1997. According to the data sheet for nitric acid IDLH[4]:

> "The revised IDLH for nitric acid is 25 ppm based on acute toxicity data in humans [Gekkan 1980] and animals [Diggle and Gage 1954]. This may be a conservative value due to the lack of relevant acute inhalation toxicity data for workers."

There do not appear to be any recent references or studies that were used to support the reduction of the IDLH. Thus, the differences between the IDLH value and the ERPG value may be seen as a measure of conservatism used in the derivation.

Conclusions:

In a risk informed and performance based regulatory approach, it is not necessarily appropriate to derive a process whereby all of the values are the most conservative of the possible range of outcomes available. Likewise, it may not be appropriate to select values which are the least conservative. The standard review plan indicates that ERPG values are one of the recognized acceptable values for consideration. Thus it would be reasonable to accept these values as a consistent methodological system for specifying high consequence and intermediate consequence levels. Given the derivation approach used for TEELs, it also appears reasonable to accept TEELs when ERPG values do not exist.

NRC would be on generally less firm ground to pick and choose between different sets of numbers on the basis of desired conservatism or margin. Selection of values from different methodologies would appear to result in an inconsistent basis for regulatory action, and one which would not promote regulatory stability or clear understanding and communication. The FCSS proposal for an algorithm to select each chemical based upon the most conservative values available would constitute creation of a government specific standard when industry standards exist, and would be subject to the same criticisms of not having a regulatory basis and not being based on a peer-review process. Unless there is a safety concern, the preferred approach would be for a consistent methodology. This review has not identified a safety concern, given the degree of variance between values, and the stated conservative nature of the key chemical in question. Further, no rationale has been presented for invalidating the previously published staff determination that ERPG values were an acceptable approach.

From a policy perspective, the use of the TEEL values, as proposed by the applicant, would appear to be a reasonable and consistent approach which provides for adequate protection of worker and public health and safety. This methodology will result in consistent designation of systems and components at levels for workers below that considered to be immediately dangerous to health and safety. While it is true that lower numbers could be advocated, this would not appear to be necessary to protect health and safety, and would lead to incoherence in the basis for staff decisions. The use of the TEEL values is therefore recommended. The alternative of specifying the IDLH as the high consequence definition for nitric acid, based on the difference between TEEL3 and IDLH, is not considered necessary to protect safety because of the stated conservative nature of the IDLH value.

It would be appropriate for the version and date of the TEEL values to be specified as part of the application, given the frequency with which chemical consequence criteria are revised. The applicant may wish to request a change to the application to reflect the revisions that have taken place since the original application.

References:

1. Memo from Andrew Persinko to Donald Cool, June 23, 2003, with attachments.
2. Derivation of Temporary Emergency Exposure Limits (TEEL). Journal of Applied Toxicology, 20. 11-20 (2000).
3. Emergency Response Planning Guidelines for Nitric Acid, 2001, AIHA Press.
4. www.cdc.gov/niosh/idlh/7697372.html

ATTACHMENT 2:

E-MAILS ON CHEMICAL CONSEQUENCE LIMITS USED IN NRC STAFF REVIEWS OF EXISTING FUEL CYCLE FACILITIES

From: Alex Murray
To: Donald Stout; Mary Adams; W Troskoski
Date: Thu, Sep 12, 2002 3:28 PM
Subject: Chemical Exposure Limits

Hi there,

As you probably know, I am working on the chem safety review for MOX. The applicant hasn't provided limits as design bases yet, but seems to be leaning towards the DOE TEELs, with TEEL-3 limits for workers and SRS workers, and TEEL-2 limits for the public. These limits are used to catgorize safety equipment at the facility.

DOE/SCAPA is in the middle of updating the TEELs again and the values look like they are going to change. It may be difficult for the NRC to accept TEEL values if they keep changing and they come from DOE, the contracting agency for MOX (the self-regulation argument again).

What should be used? Short term exposure limits (STELs - 15 minutes or so)? Immediately dangerous to life and health (IDLH)? AEGLs (Is there a website listing somewhere?)? Are TEELs still OK? Help!!!!!

Any insights would be greatly appreciated,

Alex.

From: Don E Stout <klaatuyou@juno.com>
To: <axm2@nrc.gov>
Date: Fri, Sep 13, 2002 2:47 PM
Subject: The Level of Concern Page

Alex:
This web link discusses choosing a level of concern for ALOHA.

http://response.restoration.noaa.gov/cameo/locs/LOCpage.html

Don

From: Donald Stout
To: Alex Murray
Date: Mon, Sep 16, 2002 1:28 PM
Subject: Re: Chemical Exposure Limits

Alex:
EPA actually proposes that facilities use AEGL values first, then follow other acceptable action levels for chemicals not on the AEGL list. I'll check on 40 Part 68 info.

Don

>>> Alex Murray 09/16/02 10:14AM >>>
Don,

Thanx - right now, the applicant is proposing TEEL-3s for workers and TEEL-2s for the public for high consequence events (render highly unlikely), and TEEL-2s for workers and TEEL-1s for the public for intermediate events (render unlikely). These are not identified as design bases and the applicant is arguing these are not regulated by the NRC because no radioactive materials are involved and radiological safety is not impacted. However, the applicant has estimated concentrations of the 3 main toxic vapors as (100 meters): N_2O_4 29,100 mg/m3 ([TEEL-3] = 36), nitric acid 26.9 ppm (20 ppm limit), and hydrazine = 8.67 mg/m3 (old limit = 0.02 mg/m3). NRC and ANL estimates are higher. These all exceed TEEL-3s and could result in fatalities (N_2O_4 in particular).

Do you have a more specific citation for the 40 CFR 68/RMP reference for ERPG-2? Are there any values for ERPGs publically avaulable? If so, where? Heeellllllllpppppppppppppppppl

Confused in Chemistry Land (Alex).

>>> Donald Stout 09/15/02 10:23PM >>>
Alex:

What a mess!! What does the staff do? Thoughts?

PUNT!

Maybe the web link (provided in an earlier e-mail to you) with the discussions on ERPG, AEGL, IDLH, TLV and IDLH will help in selecting suitable and consistent concern levels for accident consequences. Licensees shouldn't be upset at what we allow them to choose from because EPA required that plants under 40 CFR Part 68 - RMP use ERPG- 2 values in their consequence analyses.

Travel on,

Don

>>> Alex Murray 09/13/02 09:46AM >>>
Don,

Thanx - you understand the dilemma the staff is facing with MOX!!!!!

Do you know where I can find a listing of ERPGs and AEGLs for comparison? (The AIHA site is for members only.)

Should STELs be used if they are lower?

What to use if the chemical is a carcinogen or mutagen at levels below IDLH?

What do we currently use with fuel cycle licensees - approach or actual values? (We must have something for nitric acid.)

Does the NRC have any guidance for differentiating values for the public as compared to the workers?

Does the level of concern correspond to the appropriate value for identifying safety "stuff?"

The three main compounds of concern and some of the values I have are:

Nitrogen tetraoxide: TEEL-3 = 20 ppm; PEL = STEL = 1 ppm (1.8 mg/m3 - NO2 basis) [OSHA has a 5 ppm value for continuous exposure]; maximum for respirator use = 20 ppm; IDLH = 20 ppm;
<u>Note: TEEL-3 equals the IDLH, which is not reasonable. A level of concern = 10% of IDLH would be 2 ppm. This would be above the STEL.</u>

Hydrazine: TEEL-3 = 0.02 ppm; revised working groupt TEEL-3 = 30 ppm (!); PEL = 0.03 ppm, 2 hour basis; escape or SCBA (!), IDLH = [50 ppm] {but a carcinogen at lower levels}
<u>Note: Old TEEL-3 appears to be based upon the PEL because of consideration as a carcinogen. "Working" TEEL-3 appears to be</u>
<u>based on IDLH without consideration as a carcinogen. A level of concern at 10% of IDLH would be 5 ppm but this doesn't seem to consider carcinogen effect.</u>

Nitric acid: TEEL-3 = 50 mg/m3 (about 20 ppm); revised, working group TEEL-3 = 78 ppm (about 200 mg/m3); PEL = 2 ppm (5 mg/m3); STEL = 4 ppm [10 mg/m3]; maximium for respirator use = 25 ppm (about 80 mg/m3); IDLH = 25 ppm (about 70 mg/m3)
<u>Note: "working" TEEL-3 is a four-fold increase over the old value and above IDLH. STEL is 20% of TEEL-3. A level of concern at 10% of IDLH would be 2.5 ppm and below the STEL.</u>

What a mess!! What does the staff do? Thoughts?

Hapless Beaker in Chemistry-land. (Alex).

>>> Donald Stout 09/12/02 05:45PM >>>
Alex:

I agree that using TEEL's is not a good idea and they are a moving target. The Region I EPA person I spoke with during the ALOHA class said that he uses 10 % of the IDLH for a level of concern value. Most of the time this is a very conservative number. If an ERPG or AEGL or Ceiling Limit value does not exist I believe we should consider the 10% of IDLH. A licensee may not agree but they could provide us with the data or rationale for using their own value. We have to take a position in order for the debate to begin. IDLH values are products of NIOSH who are the official toxicologists for OSHA. Watch this space.

<u>One for all and all for one.</u>
We have met the enemy.

Don

>>> Alex Murray 09/12/02 03:28PM >>>
Hi there,

As you probably know, I am working on the chem safety review for MOX. The applicant hasn't provided limits as design bases yet, but seems to be leaning towards the DOE TEELs, with TEEL-3 limits for workers and SRS workers, and TEEL-2 limits for the public. These limits are used to catgorize safety equipment at the facility.

DOE/SCAPA is in the middle of updating the TEELs again and the values look like they are going to change. It may be difficult for the NRC to accept TEEL values if they keep changing and they come from

DOE, the contracting agency for MOX (the self-regulation argument again).

What should be used? Short term exposure limits (STELs - 15 minutes or so)? Immediately dangerous to life and health (IDLH)? AEGLs (is there a website listing somewhere?)? Are TEELs still OK? Help!!!!!

Any insights would be greatly appreciated,

Alex.

From: Lidia Roche
To: Alex Murray; Donald Stout; Mary Adams; W Troskoski
Date: Fri, Oct 18, 2002 11:28 AM
Subject: Re: Chemical Consequence Levels

Don: excellent suggestion. The AEGLS and ERPG's were collected from public data. NIOSH , which is the agency collecting the real data for the AEGLS, told us they would be willing to expand it and do it for the chemicals used in our facilities that were not covered in their limits yet. TenEyck did not think it necessary to give them $100K for the purpose. But if today's environment is different and needed, another alternative is to approach them. I know I have he contacts somewhere. It is the Research body, and separate from, OSHA.

Lidia

>>> Donald Stout 10/18/02 10:11AM >>>
Alex:
I would propose that we use a quasi-tiered approach. My first choice would be to use "level of concerns" or "toxic endpoint" values that are listed in 40 CFR Part 68 - Appendix A. These values are what EPA requires for facilities under the RMP program.

For all other cases, the reviewer will have to use his knowledge and exercise discretion when an ERPG or IDLH is not available or e.g., when latent effects are more significant than acute effects.

This is my approach and it does not conflict with 70.61 performance requirements.

Finally, if we have conflicting values, I ALWAYS use the conservative value.

Thank you for the opportunity to comment.

Don Stout

>>> Alex Murray 10/10/02 03:11PM >>>
All,

The question keeps arising about appropriate limits or levels for chemical consequences from off-normal situations at NRC licensees. What levels (types - TEELs - or specifics - for nitric acid) does the NRC currently apply to its fuel cycle (and other) licensees, and what would we do in the future, such as with the licensing of a new facility like MOX?

Please advise - and thanx in advance,

Alex.

From: Lidia Roche
To: Alex Murray; Donald Stout; Mary Adams; W Troskoski
Date: Fri, Oct 18, 2002 2:05 PM
Subject: Re: Chemical Consequence Levels

RESEND: Also, I suggest to consult SAX: Dangerous properties of Industrial Materials, because although it stipulates the limits for e.g., workers exposure, it gives, by comparison, a sense of how dangerous the substance is. In addition, TOXLINE AND RTECS (Registry of Toxic Effects of Chemical Substances) may provide useful information that may serve as the basis for a regulatory position. (Chem Line and the Toxicology Data Bank may also be helpful.

In addition, when speaking of latent effects, most think of cancer and exposure to radioactivity, but chemicals may also cause cancer, e.g., nicotine and its products, insecticides, strong acids, particularly with repeated or high dose exposures, etc. EPA has a list of carcinogens. SAX mentions this type of toxicity as well.

Thank you.
>>>>>>>>>>>>>>>>>>>

Don: excellent suggestion. The AEGLS and ERPG's were collected from public data. NIOSH , which is the agency collecting "real" data for the AEGLS, told us they would be willing to expand it and do it for the chemicals used in our facilities that were not covered in their limits yet. TenEyck did not think it necessary to give them $100K for the purpose. But if today's environment is different and needed, another alternative is to approach them. I know I have he contacts somewhere. It is the Research body, and separate from, OSHA.

Lidia

>>> Donald Stout 10/18/02 10:11AM >>>
Alex:
I would propose that we use a quasi-tiered approach. My first choice would be to use "level of concerns" or "toxic endpoint" values that are listed in 40 CFR Part 68 - Appendix A. These values are what EPA requires for facilities under the RMP program.

For all other cases, the reviewer will have to use his knowledge and exercise discretion when an ERPG or IDLH is not available or e.g., when latent effects are more significant than acute effects.

This is my approach and it does not conflict with 70.61 performance requirements.

Finally, if we have conflicting values, I ALWAYS use the conservative value.

Thank you for the opportunity to comment.

Don Stout

>>> Alex Murray 10/10/02 03:11PM >>>
All,

The question keeps arising about appropriate limits or levels for chemical consequences from off-normal situations at NRC licensees. What levels (types - TEELs - or specifics - for nitric acid) does the NRC currently apply to its fuel cycle (and other) licensees, and what would we do in the future, such as with the licensing of a new facility like MOX?

Please advise - and thanx in advance,

Alex.

From: W Troskoski
To: Alex Murray
Date: Fri, May 23, 2003 9:09 AM
Subject: Chemical consequences

Alex,

Speaking with Walt Schwink in the hall this morning, for the GDPs he used EPA numbers for offsite and OSHA numbers for onsite workers. When considering what we would accept for the MOX facility, why not try to mirror that general strategy?

Bill

From: Alex Murray
To: W Troskoski
Date: Fri, May 23, 2003 9:19 AM
Subject: Re: Chemical consequences

Bill,

In general, that is what we are doing. The TEELs and MAGs are based upon analyses of EPA, NIOSH/OSHA, and ERPG values. AEGLs are an ongoing, EPA refinement process. As we discussed, we are refining it further based upon NIOSH/OSHA to eliminate inconsistencies. The devil is in the details!! Oh - this is funnnn!

Hop-along.

>>> W Troskoski 05/23/03 09:09AM >>>
Alex,

Speaking with Walt Schwink in the hall this morning, for the GDPs he used EPA numbers for offsite and OSHA numbers for onsite workers. When considering what we would accept for the MOX facility, why not try to mirror that general strategy?

Bill

From: Alex Murray
To: David Brown; W.Troskoski
Date: Mon, Jun 9, 2003 6:01 PM
Subject: Action: E-mail on Chemical Limits

Action,

The E-mail I tried to send from Florida - got 911 instead!! Please add this to the Don Cool Package,

Alex.

—ooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooc

Hi Bill,

They shut the E-mail system down last Friday for maintenance while I was in Groupwise and I have had some trouble getting in ever since.

Please find attached the methodology and the list of chemical consequence levels we were discussing last week. Per the discussions with Walt and the GDP approach, the list generally uses NIOSH/OSHA and EPA values. In general:

- all unchanged values are from the TEEL-17m list proposed by the applicant in the RAI responses (Fall 2001).

- the values are generally lower than the TEEL-18 values proposed by the applicant.

- the range of values between the low, intermediate, and high consequence values is flatter than with the TEEL list.

- dodecane and solvent values need to be checked further.

- HAN values need to be checked again.

- hydrazine compounds should be more consistent - the only difference should be based upon molecular weight corrections. No values should exceed the NIOSH ceiling value of 0.04 mg/m3 for hydrazine.

- I did not have time to find values for flammables. Per the pocketbook, the high consequence value should not exceed 10% of the lower explosive limit (LEL). For hydrogen, the LEL is about 9%, and this high consequence limit would then be 1%.

This list of values is likely to be acceptable to the staff and lets use it in discussions with DCS on chemical consequence limits.

Alex.

Algorithm:

1. Start with values from TEEL Revision 17m (TEEL-17m) list. Use values from TEEL Revisions 18/19 (TEEL-18/19) if a value from TEEL-17m is not available.
   Basis: Staff review of the TEEL-17m list concluded that many chemicals were included and it represented a reasonable starting point for adjustments. Risk level generally around 1E-4/yr for healthy workers.

2. Adjust downward if the corresponding MAG is lower; no change otherwise.
   Basis: MAGs are based upon a similar review of similar sets of data as the TEELs. Therefore, there should be general consistency and, where there are differences, the use of the lower value provides assurance of reasonable conservatism and margin.

3. Adjust downward if the corresponding one-hour AEGL or interim AEGL is lower; no change otherwise.
   Basis: This provides a fresh review and use of some new data. Selection of lowest value accounts for general population (as compared to healthy worker 18-55 years old) provides assurance of reasonable conservatism and margin.

4. Adjust value (values) downward if the corresponding IDLH value is lower; no change otherwise. This is likely to only impact a few high consequence values.
   Basis: This provides a review per regulatory analysis of the situation and accepted practices. Selection of lowest value accounts for general population (as compared to healthy worker 18-55 years old) provides assurance of reasonable conservatism and margin.

5. Use NIOSH/OSHA values to adjust only if the following apply:
   - If an ST/STEL (short term exposure limit) is identified for a chemical by NIOSH/OSHA for time periods exceeding one hour, and it is below the intermediate consequence value, adjust the intermediate consequence value downward to match; no change otherwise.
   - If an ST/STEL (short term exposure limit) is identified for a chemical by NIOSH/OSHA for time periods less than one hour, and it is below the intermediate consequence value, adjust the intermediate consequence value downward to match; no change otherwise.
   - If a C (ceiling limit - not to be exceeded anytime) is identified for a chemical by NIOSH/OSHA

   Basis: This provides a review per regulatory analysis of the situation and accepted practices. Selection of lowest value accounts for general population (as compared to healthy worker 18-55 years old) provides assurance of reasonable conservatism and margin.
   - If a low consequence value exceeds a TWA by OSHA or NIOSH, adjust it downwards to match. Otherwise, no change.

   Basis: This corresponds to exposure of untrained public to normal worker risk. No time averaging of value used in this table.

6. Adjust NO_2 and N_2O_4 to the same mass concentration value that is the lowest of the two.
<u>Basis:</u> The two chemicals are in equilibrium and coexist.

C = Ceiling limit
IDLH = Immediately Dangerous to Life or Health
ST = Short Term exposure limit
TWA - Time Weighted Average

Table 8-11, TEEL Values Used as Chemical Limits for Chemicals at the MFFF (Key chemicals are bolded)

Name	MFFF Emergency Exposure Limits			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Aluminum Nitrate (Lab) (as Al)	2 (TWA - NIOSH) (TEEL-17m is 6)	10	500	mg/m³
Argon (liquid)	N/A	N/A	N/A	mg/m³
Argon-Hydrogen (gas)	N/A	N/A	N/A	mg/m³
Argone Methane (P10 Gas)	N/A	N/A	N/A	mg/m³
Azodicarbonamide	9	15	250	mg/m³
Chlorine	1.5 (AEGL and NIOSH C)	1.5 (C - NIOSH) (6 is AEGL)	1.5 (C - NIOSH) (29 is IDLH)	mg/m³
Chromic (III) Acid (Lab)	0.5 (TWA - NIOSH) (TEEL-17m is 0.75)	2.5	25 (TEEL 17m and IDLH)	mg/m³
Dodecane/Diluent	3.5	20	200 (TEEL 18)	mg/m³
Ferrous sulfate (Lab)	1 (TWA - NIOSH) (TEEL-17m is 3)	5	350	mg/m³
Fluorine (Lab)	0.2 (TWA - NIOSH) (TEEL-17m is 0.75)	7.5	20 (AEGL)	mg/m³
Helium	N/A	N/A	N/A	mg/m³
Hydrazine (carcinogen)	0.04 (C - NIOSH, 2 hr) (0.4 is MAG)	0.04 (C - NIOSH, 2 hr) (1 is MAG)	13 (MAG)	mg/m³
Hydrazine Hydrate (carcinogen)	0.0025	0.02	0.02	ppm
Hydrazine Monohydrate (carcinogen)	0.0075 (TEEL-18)	0.06 (TEEL-18)	50 (TEEL-18)	mg/m³
Hydrazine Nitrate (carcinogen?)	3	5	5	mg/m³
Hyrofluoric Acid (Hydrogen fluoride)	1.5	15	25 (IDLH)	mg/m³
Hydrochloric Acid	4	7 (C - NIOSH) (TEEL-17m is 30)	7 (C - NIOSH) (75 is IDLH)	mg/m³

Hydrogen	N/A	N/A	N/A	mg/m^3
Hydrogen Peroxide	1.4 (TWA - NIOSH) (TEEL-17m is 12.5)	60	105 (IDLH)	mg/m^3
Hydroxylamine Nitrate	10	26	125	mg/m^3
Iron (Lab)	30	50	500	mg/m^3
Isopropanol	1,000 (TWA - NIOSH and TEEL-17m)	1,000	1,225 (NIOSH ST) (10% of LEL is 5,000)	mg/m^3
Manganese	1 (TWA - NIOSH) (TEEL-17m is 3)	3 (ST - NIOSH)	3 (ST - NIOSH)	mg/m^3
Manganese Nitrate	1 (TWA - NIOSH) (TEEL-17m is 3)	3 (ST - NIOSH)	3 (ST - NIOSH)	mg/m^3
Manganous Sulfate (Lab)	1 (TWA - NIOSH) (TEEL-17m is 3)	3 (ST - NIOSH)	3 (ST - NIOSH)	mg/m^3
Nitric Acid	0.4 (MAG, AEGL)	10 (MAG, AEGL) (ST)	10 (ST) (MAG is 34)	mg/m^3
Nitric Oxide	30 (TEEL-17m and OSHA TWA)	30 (TEEL-17m and OSHA TWA)	125 (same as IDLH)	mg/m^3
Nitrogen	N/A	N/A	N/A	mg/m^3
Nitrogen Dioxide	1 (AEGL)	2 (ST - NIOSH) (MAG is 15) (C - OSHA is 9)	2 (ST - NIOSH) (C - OSHA is 9) 38 (MAG, AEGL)	mg/m^3
Nitrogen Tetroxide	1 (AEGL) (TEEL-17m is 19)	2 (ST - NIOSH) (MAG is 15) (C - OSHA is 9) (TEEL-17m is 19)	2 (ST - NIOSH) (C - OSHA is 9) 38 (MAG, AEGL) (TEEL-17m is 75)	mg/m^3
Oxalic Acid	2	2 (ST - NIOSH)	2 (ST - NIOSH) (IDLH is 500)	mg/m^3
Oxygen	N/A	N/A	N/A	mg/m^3
Potassium Permanganate (Lab)	3	5	125	mg/m^3
Silver Nitrate	0.01 (NIOSH - OSHA)	0.05	10 (TEEL-17m and IDLH; as Ag)	mg/m^3
Silver Oxide (Lab)	30	50	75	mg/m^3
Sodium (Lab)	2	2	10	mg/m^3
Sodium Azide	0.1 (C - NIOSH, as HN3, skin)	0.1 (C - NIOSH, as HN3, skin)	0.1 (C - NIOSH, as HN3, skin)	mg/m^3

Sodium Carbonate	30	50	500	mg/m^3
Sodium Hydroxide	0.5	2 (C - NIOSH)	2 (C - NIOSH) (IDLH is 10) (TEEL-17m is 50)	mg/m^3
Sodium Nitrite (Lab)	0.125	1	60	mg/m^3
Sulfuric Acid (Lab - carcinogen) (TEEL-17m and MAGs)	2	10	15 (IDLH) (TEEL-17m is 30)	mg/m^3
Sulfamic Acid (Lab)	40	250	500	mg/m^3
Thenoyl TrifluoroAcetone (Lab)	3.5	25	125	mg/m^3
Tributyl Phosphate	6	10	300 (IDLH is 330)	mg/m^3
Uranium Dioxide (carcinogen?) (Values as U)	0.1	0.6 (ST - NIOSH) (TEEL-17m is 1)	0.6 (ST - NIOSH) (10 is IDLH, TEEL-17m)	mg/m^3
Uranyl Nitrate (carcinogen?) (Values as U)	0.6	0.6	10	mg/m^3
Xylene (Lab)	600	655 (ST - NIOSH) (TEEL-17m is 750)	655 (ST - NIOSH) (TEEL-17m is 4000)	mg/m^3
Zinc Stearate	10 (TWA - NISOH) (TEEL-17m is 30)	50	400	mg/m^3
Zirconium Nitrate (as Zr)	5 (TEEL-18 is 35)	35 (TEEL-18)	50 (TEEL-18 and IDLH)	mg/m^3

Table 8-12, Applicant's Use of Chemical Limits for Qualitative Chemical Consequence Categories

Consequence Category	Worker	Public
High	Concentration ≥ High	Concentration ≥ Intermediate
Intermediate	High > Concentration ≥ Intermediate	Intermediate> Concentration ≥ Low
Low	Intermediate > Concentration	Low > Concentration

From: David Brown
To: Brian Smith
Date: Thu, Jul 3, 2003 9:21 AM
Subject: FYI: Completing the FEIS w/o Chem. Safety resolution

Brian,

FYI - I am again in the uncomfortable position of completing a MFFF EIS without consensus re: chem. safety open items. As a result, I've decided to:

1) Use ERPGs/TEELs, with additional justification provided in the FEIS for using TEELs where ERPGs aren't available (Open Item CS-5b)

2) On the recommendation of ANL, NRC will use ERPGs for hydrazine (which are available) to assess the environmental impact of accidents involving hydrazine monohydrate. Note: ERPGs for hydrazine are higher than TEELs for hydrazine monohydrate, but ANL feels the ERPG represents a higher quality toxicological database. (Open Item CS-5b)

Except for CS-5b, there are no other SER open items that could impact the FEIS schedule.

CC: Alex Murray; Andrew Persinko; Tim Harris; W Troskoski

From: Alex Murray
To: Alex Murray
Date: 1/28/04 4:38PM
Subject: MOX ALERT - TEEL and LFL MOX Open Items Meeting

Memo to File:

This meeting occurred on Friday, December 19, 2003, and lasted from 2:30 to about 3:45 p.m.. Myself, Bob Pierson, Joe Holonich, and Joe Giitter were present. Bob mentioned that there were several open issues that he wanted to discuss with me. Bob referred to the memos on the open issues - the "do not cite or quote" memos. He and the managers had already met and discussed the prevailing staff positions on TEELs and flammability with several staff members (names were not given). The meeting was very collegial although I thought to myself few members of the NRC staff would subject themselves to this sort of scrutiny for a licensing review. I also had the impression that the managers had made up their minds to accept the prevailing staff/management positions - it was a forgone conclusion -Joe Giitter in particular pushed hard for acceptance of the prevailing positions. Some specific points are noted below.

TEELs were initially discussed. I explained the regulatory requirement for chemical consequence levels for categorizing high and intermediate chemical events, and, subsequently, PSSCs and IROFS. I explained that TEELs were not conservative and tended to be higher than comparable values such as AEGLs, interim AEGLs, MAGs, STs, and ceiling values. I also explained that they changed frequently, and, while the applicant would be commiting to specific values, frequent significant changes does not give assurance that the values translate into an acceptable level of safety/risk. I gave specific examples, such as nitric acid, NOx, and hydrazine. Fundamentally, I said the staff needs an explanation as to why higher values that have changed frequently provide for adequate assurances of safety (i.e., adequate identification of safety controls - PSSCs and IROFS) and were acceptable. I noted this has been asked of DCS but no response (beyond citing the TEEL methodology) has been received. I also stated that other staff members agree with me but have not come forth.

Joe Giitter could not understand the issue and said there was a wide range of estimates from dispersion models - factors of 2-10 were mentioned - and that these would mask any differences in TEELs or other values. He drew Gaussian curves on the board. I noted that was a modeling issue and not relevant, as the tests to determine the chemical consequence levels (e.g., AEGLs) were based upon measured exposures. Joe Giiter also said that the staff's proposed limits used the lowest values available - I explained that the staff's proposed limits did not use the lowest values available but tended to use the lowest acute exposure values for 30-60 minute exposures - the staff compared "apples to apples."

Bob Pierson asked if this was in the noise of risk - say 1E-5 to 1E-6. I said no - generally, chemical effects are deterministic and TEELs are like ERPGs and have no margin. Bob asked what it would take to come up with an acceptable set of values for chemical consequences. I replied that several NRC people on a task force, say myself, Lydia Roche, Don Stout, Rich Milstein etc., working part-time for 3-6 months could come up with a reasonable set of limits. Bob thought that was a long time with a lot of resources. I stated it seemed reasonable given the likely need for a public meeting.

Flammability was the other issue discussed. I explained that this was a question about the strategy of turning heaters off being effective in a cell environment (i.e., likely to be warm anyway). I also noted that the %LFL disparities between some of the vessels and thought we needed discussion with the applicant for them to explain their strategy better and explain why ventilation was not needed for the 60% LFL cases. One of the managers agreed with me that the applicant's approach would not likely work, but we could accept it now, state in the SER that the NRC did not think the applicant's strategy could work, and require them to demonstrate this at the ISA stage. I said we have done this in some situations, but this one seemed to be too much of a stretch. [I thought but did not say this raises the obvious question - if we currently don't think the strategy can work, why is it acceptable?]

ATTACHMENT 3:

NRC STAFF GENERATED ALGORITHM AND TABLE OF VALUES FOR CHEMICAL CONSEQUENCE LIMITS AT THE PROPOSED MOX FACILITY

Algorithm:

1. Start with values from TEEL Revision 17m (TEEL-17m) list. Use values from TEEL Revisions 18/19 (TEEL-18/19) if a value from TEEL-17m is not available.
   Basis: Staff review of the TEEL-17m list concluded that many chemicals were included and it represented a reasonable starting point for adjustments. Risk level generally around 1E-4/yr for healthy workers.

2. Adjust downward if the corresponding MAG is lower; no change otherwise.
   Basis: MAGs are based upon a similar review of similar sets of data as the TEELs. Therefore, there should be general consistency and, where there are differences, the use of the lower value provides assurance of reasonable conservatism and margin.

3. Adjust downward if the corresponding one-hour AEGL or interim AEGL is lower; no change otherwise.
   Basis: This provides a fresh review and use of some new data. Selection of lowest value accounts for general population (as compared to healthy worker 18-55 years old) provides assurance of reasonable conservatism and margin.

4. Adjust value (values) downward if the corresponding IDLH value is lower; no change otherwise. This is likely to only impact a few high consequence values.
   Basis: This provides a review per regulatory analysis of the situation and accepted practices. Selection of lowest value accounts for general population (as compared to healthy worker 18-55 years old) provides assurance of reasonable conservatism and margin.

5. Use NIOSH/OSHA values to adjust only if the following apply:
   - If an ST/STEL (short term exposure limit) is identified for a chemical by NIOSH/OSHA for time periods exceeding one hour, and it is below the intermediate consequence value, adjust the intermediate consequence value downward to match; no change otherwise.
   - If an ST/STEL (short term exposure limit) is identified for a chemical by NIOSH/OSHA for time periods less than one hour, and it is below the intermediate consequence and high consequence values, adjust the intermediate and high consequence values downward to match; no change otherwise.
   - If a C (ceiling limit - not to be exceeded anytime) is identified for a chemical by NIOSH/OSHA and it is below any value(s), adjust those values to match it.

   Basis: This provides a review per regulatory analysis of the situation and accepted practices. Selection of lowest value accounts for general workforce and population effects (as compared to healthy worker 18-55 years old without sensitivities), and provides assurance of reasonable conservatism and margin.
   - If a low consequence value exceeds a TWA by OSHA or NIOSH, adjust it downwards to match. Otherwise, no change.

   Basis: This corresponds to exposure of untrained public to normal worker risk. No time averaging of value used in this table.

6. Adjust NO_2 and N_2O_4 to the same mass concentration value that is the lowest of the two.
<u>Basis:</u> The two chemicals are in equilibrium and coexist.

7. The values for hydrazine compounds should be consistent. Most lists of chemical exposure limits only show hydrazine and do not differentiate between the hydrates. Since the hazardous part is the same, the only difference should be based upon molecular weight corrections. No values should exceed the NIOSH ceiling value of 0.04 mg/m3 for hydrazine after adjusting for molecular weight differences.

8. For flammable materials that do not have identified limits, use the NIOSH/pocketbook guidance: the high consequence value should not exceed 10% of the lower explosive limit (LEL). Use this value for the intermediate consequence level as well. For the low consequence value, use 10% of this value per the guidance from NIOSH and the EPA. If the LEL does not exist, use 25% of the LFL for the high and intermediate consequence limits, and 2.5% of the LFL for the low consequence limit. For hydrogen, the LEL is about 9%, and the high and intermediate consequence limits would then be 1%, and the low consequence level would be 0.1%.
<u>Basis:</u> the NIOSH/pocketbook guidance: the high consequence value should not exceed 10% of the lower explosive limit (LEL). The intermediate level is based upon current practice.

9. Base the limits for asphyxiants on oxygen displacement as follows:
High consequence level: 50% of dangerous level of oxygen depletion (16% oxygen or less). This corresponds to 1,500 ppm.
Intermediate consequence level: use oxygen deficient atmosphere limit (19.5% of oxygen). This corresponds to 700 ppm.
Low consequence level: 10% of high consequence level
<u>Basis:</u> air atmosphere and respirator guidelines, and EPA IDLH/public limit ratio. This corresponds to 150 ppm.
(The normal atmosphere is 20.946% oxygen).

10. Dodecane, solvent, and HAN values need to be checked further.

C = Ceiling limit
IDLH = Immediately Dangerous to Life or Health
ST = Short Term exposure limit
TWA - Time Weighted Average

Staff Generated Values For Use as Chemical Limits for Chemicals at the MFFF (Key chemicals are bolded)

Name	MFFF Emergency Exposure Limits			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Aluminum Nitrate (Lab) (as Al)	2 (TWA - NIOSH) (TEEL-17m is 6)	10	500	mg/m^3
Argon (liquid)	150 (in gas spaces)	700 (in gas spaces)	1,500 (in gas spaces)	ppm
Argon-Hydrogen (gas)	0.1 (1% of LEL)	1 (10% of LEL)	1 (10% of LEL)	volume %
Argone Methane (P10 Gas)	0.14 (2.5% of LFL)	1.4 (25% of LFL)	1.4 (25% of LFL)	volume %
Azodicarbonamide	9	15	250	mg/m^3
Chlorine	1.5 (AEGL and NIOSH C)	1.5 (C - NIOSH) (6 is AEGL)	1.5 (C - NIOSH) (29 is IDLH)	mg/m^3
Chromic (III) Acid (Lab)	0.5 (TWA - NIOSH) (TEEL-17m is 0.75)	2.5	25 (TEEL 17m and IDLH)	mg/m^3
Dodecane/Diluent	3.5	20	200 (TEEL 18)	mg/m^3
Ferrous sulfate (Lab)	1 (TWA - NIOSH) (TEEL-17m is 3)	5	350	mg/m^3
Fluorine (Lab)	0.2 (TWA - NIOSH) (TEEL-17m is 0.75)	7.5	20 (AEGL)	mg/m^3
Helium	150	700	1,500	ppm
Hydrazine (carcinogen)	0.04 (C - NIOSH, 2 hr) (0.4 is MAG)	0.04 (C - NIOSH, 2 hr) (1 is MAG)	0.04 (C - NIOSH, 2 hr) (13 is MAG)	mg/m^3

Name	MFFF Emergency Exposure Limits			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Hydrazine Hydrate *(carcinogen)*	*0.0025*	*0.02*	*0.02*	ppm
Hydrazine Monohydrate *(carcinogen)*	*0.0075 (TEEL-18)*	*0.06 (TEEL-18)*	*50 (TEEL-18)*	mg/m^3
Hydrazine Nitrate (carcinogen?)	3	5	5	mg/m^3
Hyrofluoric Acid (Hydrogen fluoride)	1.5	15	25 (IDLH)	mg/m^3
Hydrochloric Acid	4	7 (C - NIOSH) (TEEL-17m is 30)	7 (C - NIOSH) (75 is IDLH)	mg/m^3
Hydrogen	0.1 (1% of LEL)	1 (10% of LEL)	1 (10% of LEL)	volume %
Hydrogen Peroxide	1.4 (TWA - NIOSH) (TEEL-17m is 12.5)	60	105 (IDLH)	mg/m^3
Hydroxylamine Nitrate	10	26	125	mg/m^3
Iron (Lab)	30	50	500	mg/m^3
Isopropanol	1,000 (TWA - NIOSH and TEEL-17m)	1,000	1,225 (NIOSH ST) (10% of LEL is 5,000)	mg/m^3
Manganese	1 (TWA - NIOSH) (TEEL-17m is 3)	3 (ST - NIOSH)	3 (ST - NIOSH)	mg/m^3
Manganese Nitrate	1 (TWA - NIOSH) (TEEL-17m is 3)	3 (ST - NIOSH)	3 (ST - NIOSH)	mg/m^3
Manganous Sulfate (Lab)	1 (TWA - NIOSH) (TEEL-17m is 3)	3 (ST - NIOSH)	3 (ST - NIOSH)	mg/m^3

Name	MFFF Emergency Exposure Limits			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Nitric Acid	0.4 (MAG, AEGL)	10 (MAG, AEGL) (ST)	10 (ST) (MAG is 34)	mg/m^3
Nitric Oxide	30 (TEEL-17m and OSHA TWA)	30 (TEEL-17m and OSHA TWA)	125 (same as IDLH)	mg/m^3
Nitrogen	N/A	N/A	N/A	mg/m^3
Nitrogen Dioxide	1 (AEGL)	2 (ST - NIOSH) (MAG is 15) (C - OSHA is 9)	2 (ST - NIOSH) (C - OSHA is 9) 38 (MAG, AEGL)	mg/m^3
Nitrogen Tetroxide	1 (AEGL) (TEEL-17m is 19)	2 (ST - NIOSH) (MAG is 15) (C - OSHA is 9) (TEEL-17m is 19)	2 (ST - NIOSH) (C - OSHA is 9) 38 (MAG, AEGL) (TEEL-17m is 75)	mg/m^3
Oxalic Acid	2	2 (ST - NIOSH)	2 (ST - NIOSH) (IDLH is 500)	mg/m^3
Oxygen	N/A	N/A	N/A	mg/m^3
Potassium Permanganate (Lab)	3	5	125	mg/m^3
Silver Nitrate	0.01 (NIOSH - OSHA)	0.05	10 (TEEL-17m and IDLH; as Ag)	mg/m^3
Silver Oxide (Lab)	30	50	75	mg/m^3
Sodium (Lab)	2	2	10	mg/m^3
Sodium Azide	0.1 (C - NIOSH, as HN3, skin)	0.1 (C - NIOSH, as HN3, skin)	0.1 (C - NIOSH, as HN3, skin)	mg/m^3
Sodium Carbonate	30	50	500	mg/m^3
Sodium Hydroxide	0.5	2 (C - NIOSH)	2 (C - NIOSH) (IDLH is 10) (TEEL-17m is 50)	mg/m^3
Sodium Nitrite (Lab)	0.125	1	60	mg/m^3
Sulfuric Acid (Lab - carcinogen) (TEEL-17m and MAGs)	2	10	15 (IDLH) (TEEL-17m is 30)	mg/m^3
Sulfamic Acid (Lab)	40	250	500	mg/m^3

Name	MFFF Emergency Exposure Limits			
	Low Consequence	Intermediate Consequence	High Consequence	Units
Thenoyl TrifluoroAcetone (Lab)	3.5	25	125	mg/m^3
Tributyl Phosphate	6	10	300 (IDLH is 330)	mg/m^3
Uranium Dioxide (carcinogen?) (Values as U)	0.1	0.6 (ST - NIOSH) (TEEL-17m is 1)	0.6 (ST - NIOSH) (10 is IDLH, TEEL-17m)	mg/m^3
Uranyl Nitrate (carcinogen?) (Values as U)	0.6	0.6	10	mg/m^3
Xylene (Lab)	600	655 (ST - NIOSH) (TEEL-17m is 750)	655 (ST - NIOSH) (TEEL-17m is 4000)	mg/m^3
Zinc Stearate	10 (TWA - NISOH) (TEEL-17m is 30)	50	400	mg/m^3
Zirconium Nitrate (as Zr)	5 (TEEL-18 is 35)	35 (TEEL-18)	50 (TEEL-18 and IDLH)	mg/m^3

Table 8-12, Applicant's Use of Chemical Limits for Qualitative Chemical Consequence Categories

Consequence Category	Worker	Public
High	Concentration ≥ Intermediate	Concentration ≥ Intermediate
Intermediate	Concentration ≥ Intermediate	Intermediate> Concentration ≥ Low
Low	Intermediate > Concentration	Low > Concentration

Changed per discussions with applicant in April - June, 2003.

ATTACHMENT 4:

SHORT BIOGRAPHY OF MANAGEMENT SLS ADVISOR MAKING POLICY DECISION ON ACCEPTABILITY OF TEELs AS CHEMICAL CONSEQUENCE CRITERIA (i.e. CHEMICAL LEVELS OF CONCERN)

UNITED STATES
NUCLEAR REGULATORY COMMISSION

Announcement No. 010

Date: February 21, 2003

To: All NRC Employees

SUBJECT: MANAGEMENT ASSIGNMENTS WITHIN THE OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

As managers and staff, we need to focus on what we can do to continuously improve ourselves, the Office of Nuclear Material Safety and Safeguards (NMSS), and the NRC. A successful organization stays successful if it strives for continuous improvement and develops and maintains a competent, versatile, innovative, and resourceful team of staff and managers. This is certainly true in today's environment at the NRC.

One way for managers and staff to improve individually and for NMSS to develop into a stronger organization, is for individuals to move periodically to different positions within the organization. This movement provides an opportunity to embrace a new challenge and expand knowledge and skills. By taking on new assignments, we learn by first-hand experience the challenges our colleagues are facing, and have an opportunity to work with different people and further promote teamwork in NMSS. The organization benefits as unique talents and diverse views are utilized to address different technical and policy issues.

It is with these concepts in mind, the following NMSS management changes are being made and will become effective over the February-March time frame. The timing of the changes will vary in an effort to provide for the continuity of certain ongoing activities.

Charles L. Miller will become the Director, Division of Industrial and Medical Nuclear Safety, NMSS. Dr. Miller joined the NRC in 1980 as a Nuclear Engineer in the Office of

Nuclear Reactor Regulation (NRR). Since that time, he has held a number of positions in NRR including Project Manager; Technical Assistant; Section Leader; Project Director, Standardization Project Directorate; Project Director, Project Directorate I-2; Chief, Emergency Preparedness and Radiation Protection Branch, and Deputy Director, Incident Response Operations. From 1987-1988, he served as Technical Assistant to former Commissioner Bernthal. In 2001, he was appointed to his most recent position of Deputy Director, Licensing and Inspection Directorate in the Spent Fuel Project Office, NMSS. Dr. Miller received a B.S. degree in Chemical Engineering from the Widener University, and an M.S. and a Ph.D. in Chemical Engineering from the University of Maryland.

Patricia A. Holahan will become the Deputy Director of the Division of Industrial and Medical Nuclear Safety, NMSS. Dr. Holahan joined the NRC in 1991 as a Health Physicist in the Medical and Academic Use Safety Branch, Division of Industrial and Medical Nuclear Safety, NMSS. Since that time, she has held a number of positions in NMSS including Chief of the Regional Coordination and Events Section and Rulemaking and Guidance Section B, both in the Division of Industrial and Medical Nuclear Safety, NMSS. In 2000, she was appointed to her most recent position of Chief, Rulemaking and Guidance Branch, Division of Industrial and Medical Nuclear Safety, NMSS. Dr. Holahan received B.Sc. and M.Sc. degrees in Biophysics from the University of Western Ontario in Ontario, Canada, and a Ph.D. in Radiation Biology from Colorado State University.

Donald A. Cool will become the Senior Level Advisor for Health Physics policy issues, a newly created position in the agency reporting to the Director and Deputy Director, NMSS. Dr. Cool joined the NRC in 1982 as a Health Physicist in the Fuel Cycle Safety Branch, NMSS. Since that time, he has held a number of progressively more responsible positions including Section Leader, Programmatic Safety Section, NMSS, and Chief, Radiation Protection and Health Effects Branch, Office of Nuclear Regulatory Research. In 1995, Dr. Cool was appointed to his most recent position of Director, Division of Industrial and Medical Nuclear Safety, NMSS. Dr. Cool received a B.S. degree in Biology from Houghton College, and an M.S. and a Ph.D. in Radiation Biology from the University of Rochester.

Susan M. Frant will become the Chief, Fuel Cycle Facility Branch, Division of Fuel Cycle Safety and Safeguards, NMSS. Dr. Frant joined the NRC in 1982 as a Regional Impact Analyst in NRR. Since that time, she has held a number of positions including Chief, Procedures and Training Section, NRR; Senior Regional Coordinator, Office of the Executive Director for Operations; Deputy Director of the Radiation Safety and Safeguards and the Nuclear Material Safety Divisions in Region I; Chief, Transportation

Safety and Inspection Branch in the Spent Fuel Project Office (SFPO) in NMSS, and Deputy Director, Licensing and Inspection Directorate, SFPO. In 2001, she was appointed to her most recent position of Deputy Director, IMNS/NMSS. Dr. Frant received a B.A. degree in History from Beaver College, an M.S. degree in Psychology from Queens College, and an Ed.D. in Educational Psychology from the University of Southern California.

Gary S. Janosko will become the Acting Chief of the Rulemaking and Guidance Branch in the Division of Industrial and Medical Nuclear Safety, NMSS. Mr. Janosko began his career as an Accountant and Auditor for the U.S. Department of Energy and Martin Marietta Corporation. He joined the NRC in 1991 as an Audit Manager in the Office of the Inspector General. In 1998, Mr. Janosko became the Chief, Resource Management Branch, Program Management, Policy Development and Analysis Staff, NMSS, and in 1999 became Deputy Director of that organization. In 1999, Mr. Janosko was selected to participate in the Senior Executive Service Candidate Development Program. In 2001, he was appointed to his most recent position of Chief, Uranium Recovery Section, Division of Fuel Cycle Safety and Safeguards, NMSS. Mr. Janosko received a B.S. degree in Accounting from Indiana University of Pennsylvania and an MBA from Averett College, and is a Certified Public Accountant.

Larry W. Camper will become the Deputy Director of the Licensing and Inspection Directorate in the Spent Fuel Project Office, NMSS. Mr. Camper first joined the NRC in 1978 as a Health Physicist/License Reviewer but returned to the private sector two years later. In 1989, Mr. Camper returned to the NRC as Project Manager within the Division of Waste Management. In 1990, Mr. Camper became the Section Leader for the Medical and Academic Section, and in 1995 he was promoted to Chief of the Medical, Academic and Commercial Use Safety Branch, Division of Industrial and Medical Nuclear Safety. In 1999, he was appointed to his most recent position of Chief, Decommissioning Branch, Division of Waste Management, NMSS. Mr. Camper received a B.S. degree in Radiological Science, an MBA from George Washington University, and an M.S. degree in Biological Science (Radiological Health) from Pacific Western University/Oak Ridge Associated Universities.

Daniel M. Gillen will become the Chief of the Decommissioning Branch, Division of Waste Management, NMSS. Mr. Gillen began his career as a Geotechnical Engineer for a consulting firm conducting earthwork design, testing, and inspection. He joined the NRC in 1976, when he was selected as a Geotechnical Engineer (Intern) in NRR. In 1979, Mr. Gillen was selected for the position of Project Manager, Division of Waste Management, NMSS. Since 1979, Mr. Gillen has held positions of increasing responsibility as Senior

Project Manager, Chief of the Uranium Recovery Section, Assistant Chief, Uranium Recovery Branch, Division of Waste Management, NMSS, and Deputy Director, Program Management, Policy Development and Analysis Staff, NMSS. In 2002, he was appointed to his most recent position of Chief, Fuel Cycle Facilities Branch, Division of Fuel Cycle Safety and Safeguards, NMSS. Mr. Gillen received a B.S. degree in Civil Engineering from Manhattan College in New York City, and an M.S. degree in Geotechnical Engineering from the University of Notre Dame.

Please join me and Margaret Federline in congratulating these individuals on their new assignments.

/RA/
Martin J. Virgilio, Director
Office of Nuclear Material Safety
and Safeguards

ATTACHMENT 5:

SOME DOE GUIDANCE ON TEEL AND ERPG USAGE)

TEELs

DOE TEMPORARY EMERGENCY EXPOSURE LIMITS

Adobe Acrobat Reader is required to download these documents (click on the box to get it - FREE).

TEELs are Temporary Emergency Exposure Limits developed by DOE SCAPA. Federal regulations and internal DOE guidance require the use of ERPGs (and particularly ERPG-2) for emergency planning. Recognizing that ERPGs exist for a limited number of chemicals, DOE SCAPA developed TEELs so that DOE facilities could do complete hazard analysis and consequence assessments, even for chemicals lacking ERPGs.

TEEL Definitions are available at the one page TEEL Definitions.

To see how ERPGs and TEELs are used in DOE Emergency Planning look at the two page article and flow chart "No ERPG? Use a TEEL!" (DOE Emergency Manager, Oct. 1998).

TEELs are developed according to guidance first published in "Alternative Guideline Limits for Chemicals Without ERPGs," Craig, D.K., Davis J.S., DeVore, R. , Hansen, D.J., Petrocchi, A.J., Powell, T.J., American Industrial Hygiene Association Journal, 56:919-925 (1995). Hard copies of this article are available from Douglas K. Craig.

SCAPA TEEL development methodology: "Methodology for Deriving Temporary Emergency Exposure Limits (TEELs)."

TEELs are Temporary Emergency Exposure Limits. TEELs are not equivalent to ERPGs but are approximations to ERPGs. TEELs should be used only until an ERPG is developed for a chemical.

SCAPA TEELs list at: http://tis-hq.eh.doe.gov/web/chem_safety/teel.html

---

For further information on TEELs, contact:

Douglas K. Craig PhD
Westinghouse Safety Management Solutions, Inc.
1993 South Centennial Avenue
Aiken, SC 29801
(803) 502-9640
(803) 502-3084 (FAX)
doug.craig@wxsms.com

This page updated 08/13/01

Emergency Response Planning Guidelines

The Emergency Response Planning Guideline (ERPG) values are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects as described in the definitions for ERPG-1, ERPG-2, and ERPG-3 as a consequence of exposure to the specific substance.

- The *ERPG-1* is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.

- The *ERPG-2* is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

- The *ERPG-3* is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

It is recognized by the committee (and should be remembered by all who make use of these values) that human responses do not occur at precise exposure levels but can extend over a wide range of concentrations. The values derived for ERPGs should not be expected to protect everyone but should be applicable to most individuals in the general population. In all populations there are hypersensitive individuals who will show adverse responses at exposure concentrations far below levels where most individuals normally would respond. Furthermore, since these values have been derived as planning and emergency response guidelines, not exposure guidelines, they do not contain the safety factors normally incorporated into exposure guidelines. Instead, they are estimates, by the committee, of the thresholds above which there would be unacceptable likelihood of observing the defined effects. The estimates are based on the available data that are summarized in the documentation. In some cases where the data are limited, the uncertainty of these estimates is large. Users of the ERPG values are encouraged strongly to review carefully the documentation before applying these values.

In developing these ERPGs, human experience has been emphasized to the extent data are available. Since this type of information, however, is rarely available, and when available is only for low level exposures, animal exposure data most frequently forms the basis for these values. The most pertinent information is derived from acute inhalation toxicity studies that have included clinical observations and histopathology. The focus is on the highest levels not showing the effects described by the definitions of the ERPG levels. Next, data from repeat inhalation exposure studies with clinical observations and histopathology are considered. Following these in importance are the basic, typically acute studies where mortality is the major focus. When inhalation toxicity data are either unavailable or limited, data from studies involving other routes of exposure will be considered. More value is given to the more rigorously conducted studies, and data from short-term studies are considered to be more useful in estimating possible effects from a single 1-hr exposure. Finally, if mechanistic or dose-response data are available, these are applied, on a case by case basis, as appears appropriate.

It is recognized that there is a range of times that one might consider for these guidelines; however, it was the committee's decision to focus its efforts on only one time period. This decision was based on the availability to toxicology information and a reasonable estimate for an exposure scenario. Users who may choose to extrapolate these values to other time periods are cautioned to review the documentation fully since such extrapolations tend to hold only over very limited time frames, it at all.

Additional ERPG References: (under construction)

Kelly, DP and Cavender, FL, "Emergency Response," in Encyclopedia of Toxicology,

Volume 1, P. Wexler, ed., San Diego: Academic Press (1988). pp. 527-531

Click here for further information about the AIHA Emergency Response Planning (ERP) Committee and ERPGs.

To obtain ERPGs, contact:
American Industrial Hygiene Association
Support Services
(703) 849-8888
(703) 207-3561 (FAX)
E-Mail:InfoNet@AIHA.org

Last Update: 8/1/98 by Beth Lettieri (BLettieri@BNL.Gov)