UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

MEMORANDUM TO: Michele S. Kelton, Technical Information Assistant
Advisory Committee on Reactor Safeguards

FROM: Dana A. Powers, Chairman
ACRS Subcommittee on Reactor Fuels

SUBJECT: PROPOSED MINUTES OF THE ACRS SUBCOMMITTEE MEETING ON REACTOR FUELS - DECEMBER 15-16, 2004

I certify that, based on my review of the subject minutes, and to the best of my knowledge and belief, I have observed no substantive errors or omissions in the record of this proceeding subject to the comments noted below.

Comments:

Dana A. Powers

Dana A. Powers, Chairman

6 | May | 2005

Date

March 28, 2005

MEMORANDUM TO: Dana A. Powers
Chairman
Reactor Fuels Subcommittee
ACRS

FROM: Maggalean W. Weston
Senior Staff Engineer
ACRS

SUBJECT: WORKING COPY OF THE MINUTES OF THE ACRS SUBCOMMITTEE ON REACTOR FUELS, DECEMBER 15-16, 2004, ROCKVILLE, MD

A working copy of the minutes for the Reactor Fuels subcommittee meeting on the Mixed Oxide Fuel Fabrication Facility construction authorization request final safety evaluation report, held on December 15-16, 2004, is attached for your review. Please provide me with any comments that you might have.

Attachment:
As Stated

Issued: 3/28/05
Certified: 5/6/05

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
REACTOR FUELS SUBCOMMITTEE
MIXED OXIDE (MOX) FUEL FABRICATION FACILITY
ROOM T-2B3, 11545 ROCKVILLE PIKE, ROCKVILLE, MARYLAND
DECEMBER 15-16, 2004
MEETING MINUTES

INTRODUCTION

The ACRS subcommittee on Reactor Fuels held a meeting on December 15 and 16, 2004, with representatives of the NRC staff to discuss the draft final safety evaluation report (DFSER) for Mixed Oxide (MOX) Fuel Fabrication Facility construction authorization request (CAR) submitted by the Department of Energy (DOE) . The meeting was open to the public. Maggalean W. Weston was the cognizant ACRS staff engineer and designated federal official (DFO) for this meeting. The meeting was convened by the Reactor Fuels Subcommittee Chairman, Dr. Dana A. Powers, at 8:30 a.m. and adjourned at 5:54 p.m. on December 15, and at 8:30 a.m. and adjourned at 12: 30 on December 16, 2004.

Attendees

Attendees at the meeting included ACRS members and staff; members of the Advisory Committee on Nuclear Waste (ACNW); representatives of the NRC staff; and members of the public as follows:

ACRS-ACNW Members/Staff

D.A. Powers, Chairman
M.T. Ryan, ACNW Chairman
M.V. Bonaca, Member
A. G. Croff, ACNW Member
R.S. Denning, Member
F.P. Ford, Member
S.L. Rosen, Member
V.H. Ransom, Member
J.D. Sieber, Member
G.B. Wallis, Member
R.F. Weiner, ACNW Member
M.W. Weston, DFO

NRC Staff

David Brown, NMSS
Fred Burrows, NMSS
Ted Carter, NMSS
Mike Cash, OIG
Patrick Castleman, OCM
Tom Cox, NMSS
Diana Diaz, NMSS
Joseph Giitter, NMSS
Scott Gordon, NMSS
John Hull, OGC
Joel Klein, NMSS
Stu Magruder, NMSS
Alex Murray, NMSS
Bill Troskoski, NMSS
Rex Wescott, NMSS

Other Attendees

Ken Ashe, DCS
Gerald Senentz, DCS
Richard Sweigert, DCS
Herb Massie, DNFSB
Herb Feinworth, Gamma
Igor Feldblyum, ITD Services
Mosi Dunani, NNSA
Sam Glenn, NNSA
Jamie Johnson, NNSA
Damian Peko, NNSA
Garrett Smith, NNSA
Sergey Mostinskiy, Rostechnadzor
Andreg Kislov, Rostechnadzor

Other members of the public were also in attendance at this meeting. A list of those attendees who registered is attached to the Office Copy of these minutes.

Presentations and Discussion

The presentations to the subcommittee and the related discussions are summarized below. The presentation slides and handouts used during the meeting are attached to the Office Copy of the minutes.

Chairman's Comments

Dana Powers, Subcommittee Chairman, convened the meeting. He noted the presence of the Advisory Committee on Nuclear Waste who will serve as members of the subcommittee. He stated that the purpose of the meeting was to discuss the MOX Fuel Fabrication Facility (MOX FFF) construction authorization request draft final safety evaluation report (DFSER). The large volume of paper to be read was acknowledged as a challenge and appreciation expressed for the tremendous efforts made to read through it all. D. Powers indicated that he would like to craft a strategy of action in preparation for the full committee meeting currently scheduled for February. He also commented that the indication that there were open items in the FSER, when in fact there were none, posed a problem for him because it left members looking for issues related to those open items.

NRC Presentations

The NRC presentations were made by Joe Giitter, David Brown, Alex Murray, and William Troskoski. Chris Tripp who was scheduled to present was ill and did not attend. The technical presentation continued with the following topics:

Introduction

- Red Oil Explosions
- HAN Explosions
- Electrolyzer Fires
- Uranium Burnback
- Applicability of TEELS
- Control Habitability
- Flammable Gases

Subcommittee Comments

Introduction
Overview

J. Giitter provided some background information and discussed some of the changes to the construction authorization request (CAR) that had delayed their meeting with the ACRS since November 2003. The change involved reducing the site boundary to one of about 160 meters from the stack. He indicated that there were no open items and that the staff had concluded that the applicant has met the safety requirements necessary for the issuance of a construction authorization. The final SER is scheduled to be issued in February.

- D. Powers questioned why the FSER still had reference to open items, since it was stated that there were none. The response was that it had been inadvertently left in.

- G. Wallis questioned why there was no technical information with equations and criteria. The response was that this was too early in the process for that detail. This is just establishing the design bases.

- S. Rosen commented that this was an immense number of promises for the future. The response was that there were many commitments for the future license application that is expected in the spring.

- M. Bonaca stated that he had difficultly where preventative actions were presented as a means of providing defense and protection, but it was not clear whether these actions would be automatic or built into the process or whether they were tied to human action. And, would any means of action be acceptable. The response was that pretty detailed information on what the systems, structures, or components (SSCs) were that would prevent an accident. As the presentation progressed, it was felt that some of this would be better understood.

D. Brown gave a brief synopsis of the evolution of the facility. He talked about the cancellation of the immobilization plant where about eight and a half metric tons of plutonium was to be immobilized, not turned into MOX fuel. In April 2002, the decision was made to covert all 34 metric tons of plutonium to MOX fuel. This meant that there would now be two plutonium disposition facilities, the pit disassembly and conversion facility (PDCF) and the MOX fuel fabrication facility. The PDCF would receive weapon components, convert those components to plutonium dioxide, which would be feed material for the MOX facility. D. Brown said that the facility will be partially built by the time the license application review is completed. The staff is anticipating a two year review and construction is not scheduled to begin until late summer.

D. Brown stated that this was a two step process - the construction permit and then the license to possess and use licensed material. The applicant must provide a safety assessment of the design bases of principal structures, systems, and components, a description of the quality assurance program and an environmental report. The NRC has prepared an environmental impact statement based on the environmental report. The review and approval is of the principal SSCs and the values of the controlled parameters.

D. Brown talked about the changes made by DOE. The process cell exhaust system was made a principal SSC. DOE removed the uranium oxide dissolution system. They added another unit for dealing with the waste solvent from the PUREX cycle and modified the chemical inventory list which resulted in an update to the waste stream inventory.

At this point, the staff approves of the CAR and in February construction inspections will begin. Efforts are underway to set up a construction inspection program with the regional office. Even though this is a construction permit, for these purposes they will be treated as a licensee.

- D. Powers asked if the PDCF actually existed. The response was , no, the plan is that the initial feedstock for the MOX facility would be existing surplus plutonium dioxide and the PDCF would be built after the MOX facility to provide the remainder of the 34 metric tons.

- D. Powers commented then that it would be difficult at this stage to assess whether an event at the PDCF would affect activities at the MOX facility. The response was that the CAR does not identify events at the proposed PDCF. It is expected to be considered in the future integrated safety analysis (ISA) that will be provided next spring along with the license application.

- G. Wallis asked how many tons would go to McGuire and Catawba. The response was that each reactor would get a proportionate share.

- D. Powers asked is the facility has a finite lifetime. The response was that after fabrication of the 34 metric tons, the facility would be deactivated and decommissioned.

- D. Powers stated that it is important to understand the design lifetime of the facility. The response was that it is certainly a consideration, especially where aging effects on materials have to be considered.

- P. Ford asked when would the committee hear about the materials degradation issue which must impact the design bases. What are the materials degradation mechanisms and how do they impact the margins? The response was that when the materials degradation is an important part of the reliable function on the principal SSCs, then it would be looked at. Any further information will be provided in the ISA.

- J. Giitter commented that is important to note what we're looking at. Part 70 was developed as a one-step licensing process in mind and what is being done with the MOX facility is unique. The NRC is actually doing a two-step licensing process under a regulation that was intended to be used for a one-step process. At this point, the only thing the applicant has to provide us with are the design bases for the principal SSCs and the components that are really controls to insure that the facility will be designed against natural phenomena and accidents.

- P. Ford asked if there were lessons from the chemical industry that are bing considered here. The response was that there are several codes and standards which have been identified as design bases for addressing corrosion monitoring, maintenance, and placement programs. Top level selection of materials for components has been spelled out in construction permit. Specific details, such as time of surveillance, actual corrosion rates, the presence or absence of corrosion type probes, corrosimeters, etc., would be expected in the license application.

- G. Wallis asked about the meaning of likely and unlikely. The response was that unlikely means during the life of the plant (the actual mission of the plant will be completed in 14 years)

- A. Croff asked how the operation and maintenance philosophy was factored into the design of the facility. The response was that the fundamental design philosophy is that the facility is highly automated. Maintenance and surveillance are also a part of that philosophy. Other detail will be provided with the license application.

- A. Croff commented that it seems the focus should be on considering everything that's of concern before the die is cast. The response was that the comment was noted.

- M. Ryan asked how do you assure yourself that the waste management plan will work and that other things have been done that will not have a backward impact on the facility. The response was that the waste management systems in the plant have to be considered as a part of the safety review for the effects of potential accidents and natural phenomena, but the regulations allow transfer of the waste back to DOE, at which point, NRC no longer has jurisdiction.

- M. Ryan commented that handoff to DOE is not as clear as it needs to be for NRC to feel comfortable in taking an action to move forward with regard to waste management. The response was that the review was done to assure that there was sufficient waste management capacity at the Savannah River Site (SRS).

- R. Weiner asked if a parallel matrix for chemical hazards as there is for radiological hazards since workers are at greater chemical risk than radiological risk. The response was yes, there is a matrix delineating the chemical risks.

- S. Rosen asked about the fire protection and criticality safety and the use of clean agents versus water for fire suppression since the clean agents suppress the fires, but do little to remove the heat which when exposed to oxygen can reignite. The response was that the staff would ask about some clarification of how these choices are made in the ISA.

- D. Powers asked about the consequences of accidents with the reduced boundary. He said you go from an alpha hazard with the fire to a gamma hazard, or an inhalation toxicology to an exposure one. The response was that this would be discussed during the criticality safety discussion

Red Oil Explosions

A. Murray, NMSS, discussed "red oil." "Red oil" is a collective term referring to the formation of nitrated organic compounds resulting from the two phases of the aqueous polishing solvent extraction. It can refer to the mixtures containing butyl nitrate or nitrated tetrapropylene hydrogenated dodecane. These are primarily liquid phase reactions. Gaseous phase reactions can contribute to the explosiveness of the event if the gaseous phase products are not removed. The "red oil" species can undergo exothermic reactions with relatively small quantities of the species, i.e., less than 100 gallons. The reactions tend to occur more violently around the interface between the organic phase and the aqueous phase. Control of "red oil" species and reactions are largely based on operational experience and empirical laboratory testing. Analysis using kinetic rate equations has not been done. The applicant has identified the "red oil" event as a high consequence event and selected a preventive strategy to render the event highly unlikely (preventing an explosion or rupture of vessels resulting from an uncontrolled reaction). The preventative actions are a combination of engineered controls and administrative controls consisting of 3 PSSCs and 5 safety functions. The 3 PSSCs are an offgas treatment system, a process safety control system, and chemical safety controls. The applicant has committed to define the reaction kinectics, determine the effects of impurities and establish operational limits and setpoints in the ISA.

- D. Powers commented on the diversity of nomenclature in the CAR and the DFSER.

- P. Ford asked if many of the events have had a human factor element to them. The response was that they were not sure about the human factor, but that they tend to involve unnoticed accumulation of organic material in tank vessels or evaporators, which involves human monitoring by chemical sampling analysis.

- S. Rosen asked if the ISA would contain a section on the first-time startup that the staff will review. The response was that it should.

HAN Explosions

W. Troskoski discussed HAN (hydroxylamine nitrate)and hydrazine. HAN and hydrazine are a part of a dilute nitric acid solution used to reduce extracted Pu (IV) to Pu (III). This transfers (strips) the Pu (III) into the aqueous phase. A similar nitric acid solution containing HAN and hydrazine recovers unstripped Pu in the plutonium barrier prior to sending the solvent back to the regeneration process. Hydrazine stabilizes the HAN and reduces some plutonium from IV to III. Hydrazine reacts very quickly with nitrous acid. HAN, a very reactive chemical, is evident in both the purification and solvent recovery systems. HAN is explosive under the right conditions and can undergo very rapid autocatalytic decomposition. There are large quantities of noncondensable gases involved in the HAN reaction. Therefore, pressure excursions are of concern. The applicant has identified this as a high consequence event and selected a preventative strategy to render this highly unlikely. The safety strategy focuses on prevention and is based on two different cases. In the first case where you have vessels with HAN and hydrazine and no MOX addition, you want to avoid decomposition reactions.

- P. Ford asked if the staff were satisfied after reviewing the data base that adequate margin existed. The response was that they have found substantial margin in each of the key parameters proposed for the design bases.

Electrolyzer Fires

A. Murray discussed the potential for titanium reactions or fires in the electrolyzer area. The purification or Purex process requires that you work with dissolved species. The feed material is plutonium dioxide and it has to be dissolved. The dissolution process is done by an electrolytic method which produces a very reactive silver plus two ion which in turn affects the dissolution. Because the silver is a very aggressive oxidant, it can be very corrosive. Titanium has been proposed because of its corrosive resistance to silver two. Titanium is a reactive metal and under normal conditions in the electrolyzer you have very large electrical currents. You also have the presence of oxygen in various forms which with an electrical fault could initiate a titanium reaction. The planned fire protection measures would probably not be effective on titanium fires. A titanium fire would be very difficult to predict and also to mitigate. Therefore, the applicant has identified it as a high consequence event. They have proposed both passive and active engineered controls.

- R. Denning asked if the staff preferred automatic controls to administrative controls to address this issue. The response was that they had expressed their preferences for engineering controls rather than administrative controls and the applicant had responded with a safety strategy based upon administrative controls. The staff found the proposal reasonable.

Uranium Burnback

A. Murray indicated that mixed oxide fuel contains a depleted uranium oxide component which has been observed to undergo what is called burnback, which is oxidation from the UO_2 to U_3O_8. The area where this is a hazard is where the uranium is a powder, but it has been ball-milled to a very fine particle size and as a result, has a fairly high surface area. When air has been allowed into the process, burnback can occur. Burnback can occur quite rapidly and produce some reasonable high temperatures of several degrees centigrade, maybe even up to the 600 degrees centigrade range quite quickly. It was stated that burnback is essentially a kinetically limited reaction.

- D. Powers asked if kinetically limited meant chemical kinetics at the surface. The response was that kinetically limited meant that uranium dioxide is unstable from a thermodynamics viewpoint under normal conditions.

Temporary Emergency Exposure Limits (TEELS)

A. Murray indicated that chemical limits were limits required for assessing consequences from NRC-regulated chemical events. The chemical limits are uses to determine PSSCs and design bases. There are significant variations between different limits and these variations affect the presence or absence of PSSCs. The limits are categorized as high, intermediate, and low consequence events. A high consequence event is usually life threatening or has life threatening effects. An intermediate event is with significant injuries, but with the ability to escape from the area. The low consequence event is characterized by offensive odors and/or stinging of the eyes.

Control Room Habitability

A. Murray stated that the facility will have multiple control rooms and control areas. There will be two emergency control rooms. The emergency control rooms are to maintain a habitable environment for operators and provide cooling to emergency electrical rooms

- S. Rosen asked if the emergency control rooms will be continuously manned. The response was that the applicant has what is called a distributed control strategy, where, if there were an event, the appropriate operators would go to the emergency control room in question and perform their functions.
- D. Powers asked who makes the decision that there is a general site emergency. The response was that this would be provided at the license application stage.

Flammable Gases

R. Wescott discussed flammable gases. The facility uses flammable gases and combustible liquids which can initiate fires and explosions. Flammable and combustible materials can result in deflagrations as concentrations get higher. Fires and explosions can breach confinement and release radiochemical materials.

accordance with these procedures, oral or written statements may be presented by members of the public. Electronic recordings will be permitted only during those portions of the meeting that are open to the public. Persons desiring to make oral statements should notify Mr. Howard J. Larson, (Telephone 301–415–6805), between 7:30 a.m. and 4 p.m. e.t., as far in advance as practicable so that appropriate arrangements can be made to schedule the necessary time during the meeting for such statements. Use of still, motion picture, and television cameras during this meeting will be limited to selected portions of the meeting as determined by the ACNW Chairman. Information regarding the time to be set aside for taking pictures may be obtained by contacting the ACNW office prior to the meeting. In view of the possibility that the schedule for ACNW meetings may be adjusted by the Chairman as necessary to facilitate the conduct of the meeting, persons planning to attend should notify Mr. Howard J. Larson as to their particular needs.

Further information regarding topics to be discussed, whether the meeting has been canceled or rescheduled, the Chairman's ruling on requests for the opportunity to present oral statements and the time allotted, therefore can be obtained by contacting Mr. Howard J. Larson.

ACNW meeting agenda, meeting transcripts, and letter reports are available through the NRC Public Document Room at *pdr@nrc.gov*, or by calling the PDR at 1–800–397–4209, or from the Publicly Available Records System (PARS) component of NRC's document system (ADAMS) which is accessible from the NRC Web site at *http://www.nrc.gov/reading-rm/adams.html* or *http://www.nrc.gov/reading-rm/doc-collections/* (ACRS & ACNW Mtg schedules/agendas).

Video Teleconferencing service is available for observing open sessions of ACNW meetings. Those wishing to use this service for observing ACNW meetings should contact Mr. Theron Brown, ACNW Audiovisual Technician (301–415–8066), between 7:30 a.m. and 3:45 p.m. e.t., at least 10 days before the meeting to ensure the availability of this service. Individuals or organizations requesting this service will be responsible for telephone line charges and for providing the equipment and facilities that they use to establish the video teleconferencing link. The availability of video teleconferencing services is not guaranteed.

The ACNW meeting dates for Calendar Year 2005 are provided below:

ACNW meeting No.	Meeting dates
	January 2005 (No meeting).
157	February 23–25, 2005.
158	March 15–17, 2005.
159	April 19–21, 2005.
160	May 17–19, 2005.
161	June 15–17, 2005.
162	July 19–21, 2005.
	August 2005 (No meeting).
163	September 20–22, 2005.
164	October 18–20, 2005.
	November 2005 (No meeting).
165	December 13–15, 2005.

Dated: December 1, 2004.

Andrew L. Bates,

Advisory Committee Management Officer.

[FR Doc. 04–26901 Filed 12–7–04; 8:45 am]

BILLING CODE 7590–01–P

NUCLEAR REGULATORY COMMISSION

Advisory Committee on Reactor Safeguards; Meeting of the Subcommittee on Reactor Fuels; Notice of Meeting

The ACRS Subcommittee on Reactor Fuels will hold a meeting on December 15–16, 2004, Room T–2B3, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance.

The agenda for the subject meeting shall be as follows:

Wednesday, December 15, 2004—8:30 a.m. until the conclusion of business.

Thursday, December 16, 2004—8:30 a.m. until 1 p.m.

The purpose of this meeting is to discuss the draft final safety evaluation report for the Mixed Oxide Fuel Fabrication Facility construction authorization request. The Subcommittee will hear presentations by and hold discussions with representatives of the NRC staff regarding this matter. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Members of the public desiring to provide oral statements and/or written comments should notify the Designated Federal Official, Ms. Maggalean W. Weston (telephone (301) 415–3151) five days prior to the meeting, if possible, so that appropriate arrangements can be made. Electronic recordings will be permitted.

Further information regarding this meeting can be obtained by contacting the Designated Federal Official between 8 a.m. and 5:30 p.m. (e.t.). Persons planning to attend this meeting are urged to contact the above named individual at least two working days prior to the meeting to be advised of any potential changes to the agenda.

Dated: December 1, 2004.

John H. Flack,

Acting Branch Chief, ACRS/ACNW.

[FR Doc. 04–26902 Filed 12–7–04; 8:45 am]

BILLING CODE 7590–01–P

OFFICE OF PERSONNEL MANAGEMENT

Submission for OMB Review; Comment Request for a Revised Information Collection: OPM Form 1644

AGENCY: Office of Personnel Management.

ACTION: Notice.

SUMMARY: In accordance with the Paperwork Reduction Act of 1995 (Public Law 104–13, May 22, 1995), this notice announces that the Office of Personnel Management (OPM) has submitted to the Office of Management and Budget (OMB) a request for a revised information collection. OPM Form 1644, Child Care Tuition Assistance Program for Federal Employees, is used to verify that child care providers are licensed and/or regulated by State and/or local authorities. Therefore, agencies need to verify that child care providers to whom they make disbursements in the form of child care subsidies meet the statutory requirement.

Approximately 2000 OPM 1644 forms will be processed annually. The OPM Form 1644 takes approximately 10 minutes to complete by each provider. The annual estimated burden is 333.3 hours.

For copies of this proposal, contact Mary Beth Smith-Toomey on (202) 606–8358, FAX (202) 418–3251 or e-mail to *mbtoomey@opm.gov*. Please include a mailing address with your request.

DATES: Comments on this proposal should be received within 30 calendar days from the date of this publication.

ADDRESSES: Send or deliver comments to—

Francis T. Cavanaugh, Acting Manager, Work Life Group, Employee and Family Support Center, Division of Strategic Human Resources Policy, Office of Personnel Management, 1900 E. Street, NW., Room 7315, Washington, DC 20415;

and

Joseph F. Lackey, OPM Desk Officer, Office of Information & Regulatory

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
REACTOR FUELS SUBCOMMITTEE
MIXED OXIDE FUEL FABRICATION FACILITY
ROOM T-2B3, 11545 ROCKVILLE PIKE, ROCKVILLE, MARYLAND

DECEMBER 15, 2004

- PROPOSED SCHEDULE -

	SUBJECT	PRESENTER	TIME
I.	Introductory Remarks Subcommittee Chair	Dana Powers, ACRS	8:30 - 8:45 a.m.
II.	Presentation Introduction	Joe Giitter, NMSS Dave Brown, NMSS	8:45 - 9:30 a.m.
III.	Technical Presentations		
	A. Red Oil Explosions	Alex Murray, NMSS	9:30 - 10:15 a.m.
		*****BREAK*****	10:15 - 10:30 a.m.
	B. HAN Explosions	Bill Troskoski, NMSS	10:30 - 11:15 a.m.
	C. Electrolyzer Fires	Alex Murray, NMSS	11:15 - 12:00 a.m.
		*****LUNCH*****	12:00 - 1:00 p.m.
IV.	Technical Presentations (Continued)		
	D. Uranium Burnback	Alex Murray, NMSS	1:00 - 1:45 p.m.
	E. Applicability of TEELS	Alex Murray, NMSS	1:45 - 2:15 p.m.
	F. Control Room Habitability	Alex Murray, NMSS	2:15 - 3:00 p.m.
		*****BREAK*****	3:00 - 3:15 p.m.
	G. Flammable Gases	Rex Wescott, NMSS	3:15 - 4:00 p.m.
V.	Summary/Questions	All	4:00 - 4:30 p.m.
VI.	DPV/DPO Discussion	Alex Murray, NMSS	4:30 - 5:15 p.m.
VII.	Subcommittee Discussion	Dana Powers, ACRS	5:15 - 5:30 p.m.

Note: Presentation time should not exceed 50% of the total time allocated for a specific item. Number of copies of presentation materials to be provided to the ACRS - 40.

ACRS CONTACT: Maggalean W. Weston, mww@nrc.gov or (301) 415-3151.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
REACTOR FUELS SUBCOMMITTEE
MIXED OXIDE FUEL FABRICATION FACILITY
ROOM T-2B3, 11545 ROCKVILLE PIKE, ROCKVILLE, MARYLAND

DECEMBER 16, 2004

- PROPOSED SCHEDULE -

SUBJECT	PRESENTER	TIME
I. Introductory Remarks Subcommittee Chair	Dana Powers, ACRS	8:30 - 8:45 a.m.
II. Technical Presentations (Continued)		
H. Upper Subcritical Limit for MOX Powders	Chris Tripp, NMSS	8:45 - 9:30 a.m.
III. Subcommittee Discussion	Dana Powers, ACRS	9:30 -10:00 a.m.
	*****BREAK*****	10:00 -10:30 a.m.
IV. Subcommittee Discussion (Continued)		10:30 - 12:00 noon

Note: Presentation time should not exceed 50% of the total time allocated for a specific item. Number of copies of presentation materials to be provided to the ACRS - 40.

ACRS CONTACT: Maggalean W. Weston, mww@nrc.gov or (301) 415-3151.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE MEETING REACTOR FUELS (MOX FFF)

December 15, 2004

PLEASE SIGN IN BELOW
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NAME	ORGANIZATION
Ken Ashe	DCS
RICHARD SWEIGART	DCS
GERALD SENENTZ	DCS alltoo DOE
Mosi Dayani	NNSA National Nuclear Security Administration (China)
Sam Glenn	NNSA
Herb Massie	DNFSB Defense Nuclear Facility Safety Board Both DOE & NNSA oversight
HERB FEINROTH	Gamma
Garrett Smith	NNSA
Damian Peko	NNSA
Sergey Mostinskiy	ROSTECHNADZOR
Andrey Kislov	ROSTECHNADZOR
Igor Feldblyum	ITD Services Inc.
Jamie Johnson	NNSA

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE MEETING ON REACTOR FUELS (MOX FFF)

December 15, 2004

NRC STAFF PLEASE SIGN IN BELOW
PLEASE PRINT

NAME	NRC ORGANIZATION
William Troskoski ✓	NMSS/FCSS
David Brown ✓	NMSS/FCSS
Scott Gordon ✓	NMSS/FCSS
Joel Klein ✓	NMSS/FCSS
Joseph Giitter ✓	NMSS/FCSS
STU MAGRUDER ✓	NMSS/FCSS
ALEX MURRAY ✓	NMSS/FCSS
Tom Cox ✓	NMSS/FCSS
John Hull ✓	OGC
FRED BURROWS ✓	NMSS/FCSS
Mike Cash ✓	OIG
PATRICK CASTLEMAN ✓	OCM/NJD
DIANA DIAZ ✓	NMSS/FCSS
TED CARTER ✓	NMSS/FCSS
Rex Wescott ✓	NMSS/FCSS

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE MEETING REACTOR FUELS (MOX FFF)

December 16 2004

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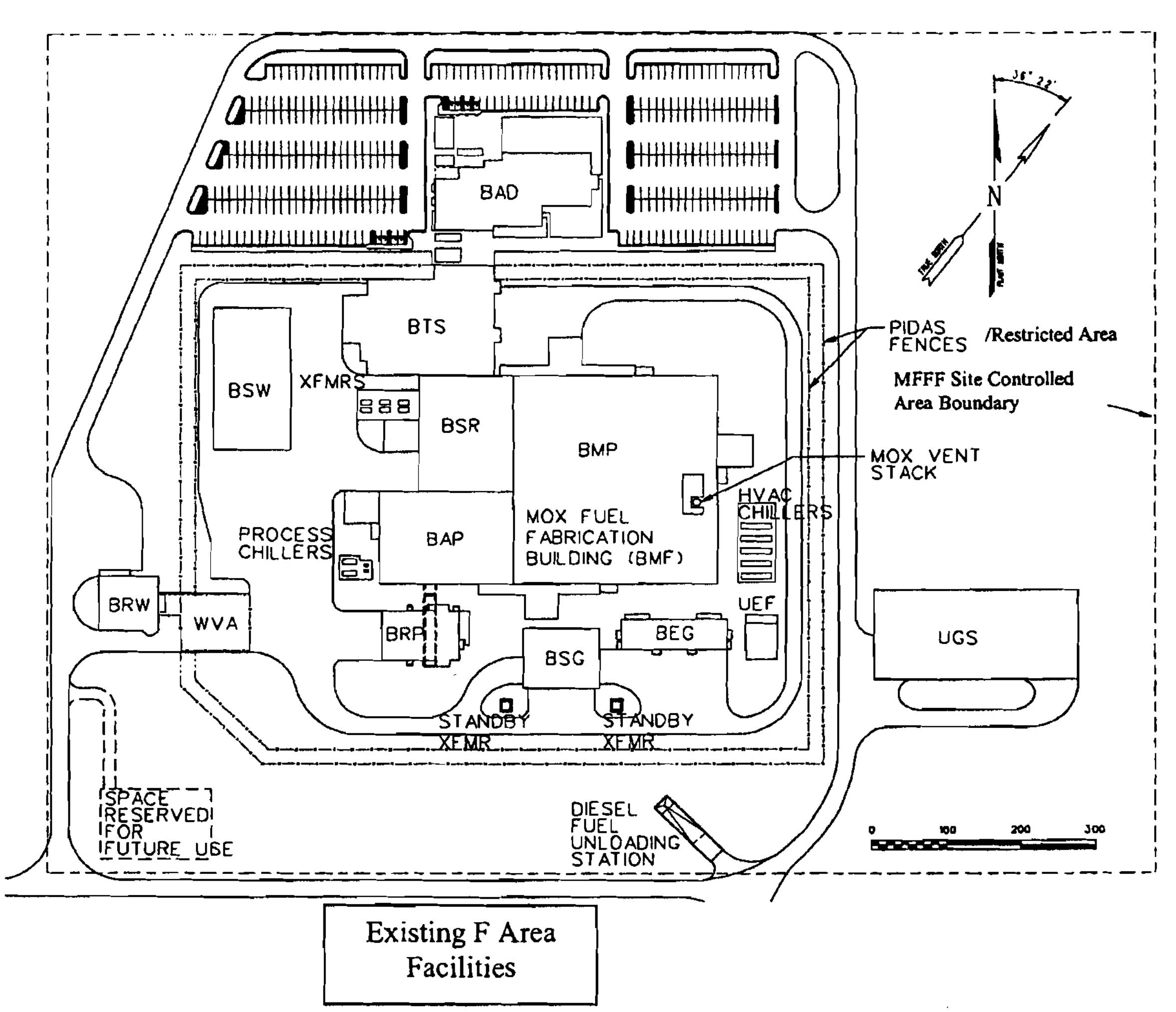
NAME	ORGANIZATION
J.R. Clark	Gamma Engineering
Ken Ashe	DCS
Bob F	DCS
Sam G.	NNSA

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE MEETING ON REACTOR FUELS (MOX FFF)

December 16 2004

NRC STAFF PLEASE SIGN IN BELOW
PLEASE PRINT

NAME	NRC ORGANIZATION
Joel Klein	NRC/NMSS/FCSS
CRAIG HRABAL	NRC/NMSS/FCSS/TSG
Melanie Galloway	NRC/NMSS/FCSS/TSG
Kim E Hammer	NRC/NMSS/FCSS/TSG
Rex Wescott	NRC/NMSS/FCSS/SPB
STU MAGRUDER	NRC/NMSS/FCSS/SPB
Tom Cox	NRC/NMSS/FCSS/SPB
Garrett Smith	DOE/NNSA
Dave Brown	NRC/NMSS/FCSS/SPB



BUILDING LEGEND

MOX FUEL FABRICATION BUILDING (BMF)

BMP- MOX Processing Area
BAP- Aqueous Polishing Area
BSR- Shipping and Receiving Area

SUPPORT BUILDINGS

BTS- Technical Support Building
BAD- Administration Building
BSW- Secured Warehouse Building
BRW- Receiving Warehouse Building
WVA- Vehicle Access Portal
UEF- Emergency Fuel Storage Vault

BRP- Reagents Processing Building
UGS- Gas Storage Area
BEG-Emergency Generator Building
BSG- Standby Generator Building
BRW- Receiving Warehouse Building

Figure 1.1-2. MFFF Site Layout

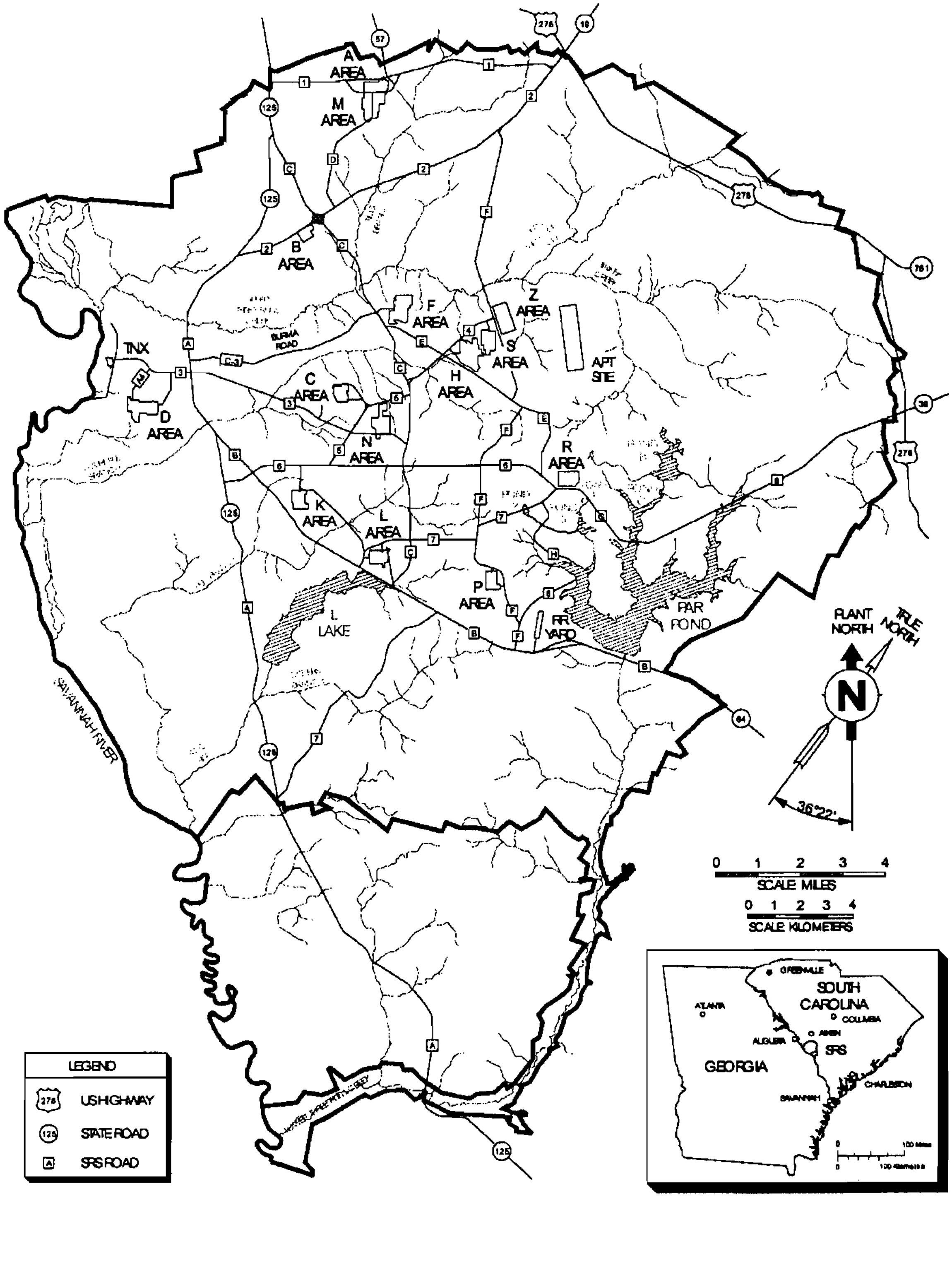


Figure 1.1-1. Location of Savannah River Site and F Area

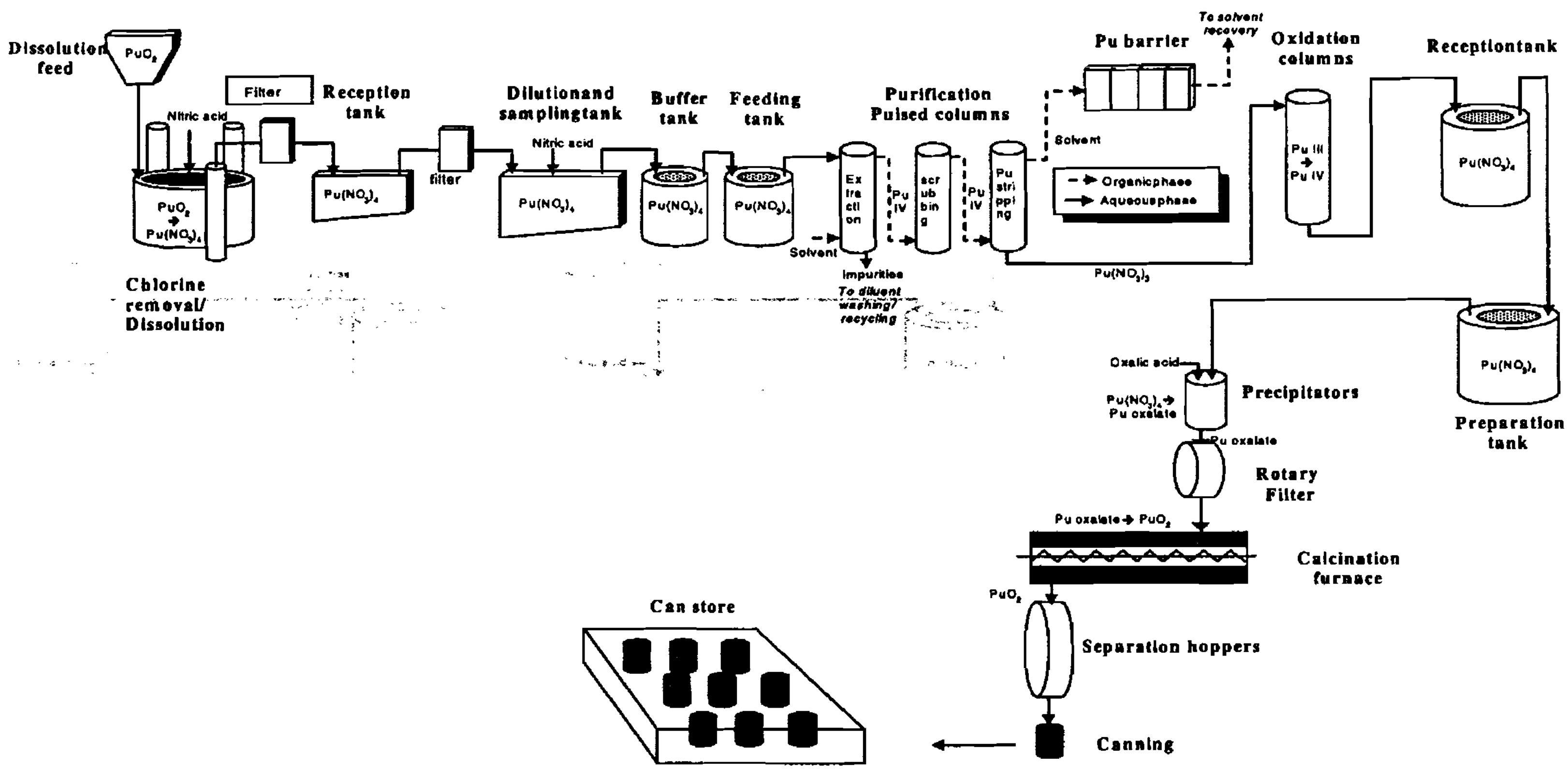


Figure 1.1-4. Aqueous Polishing Process

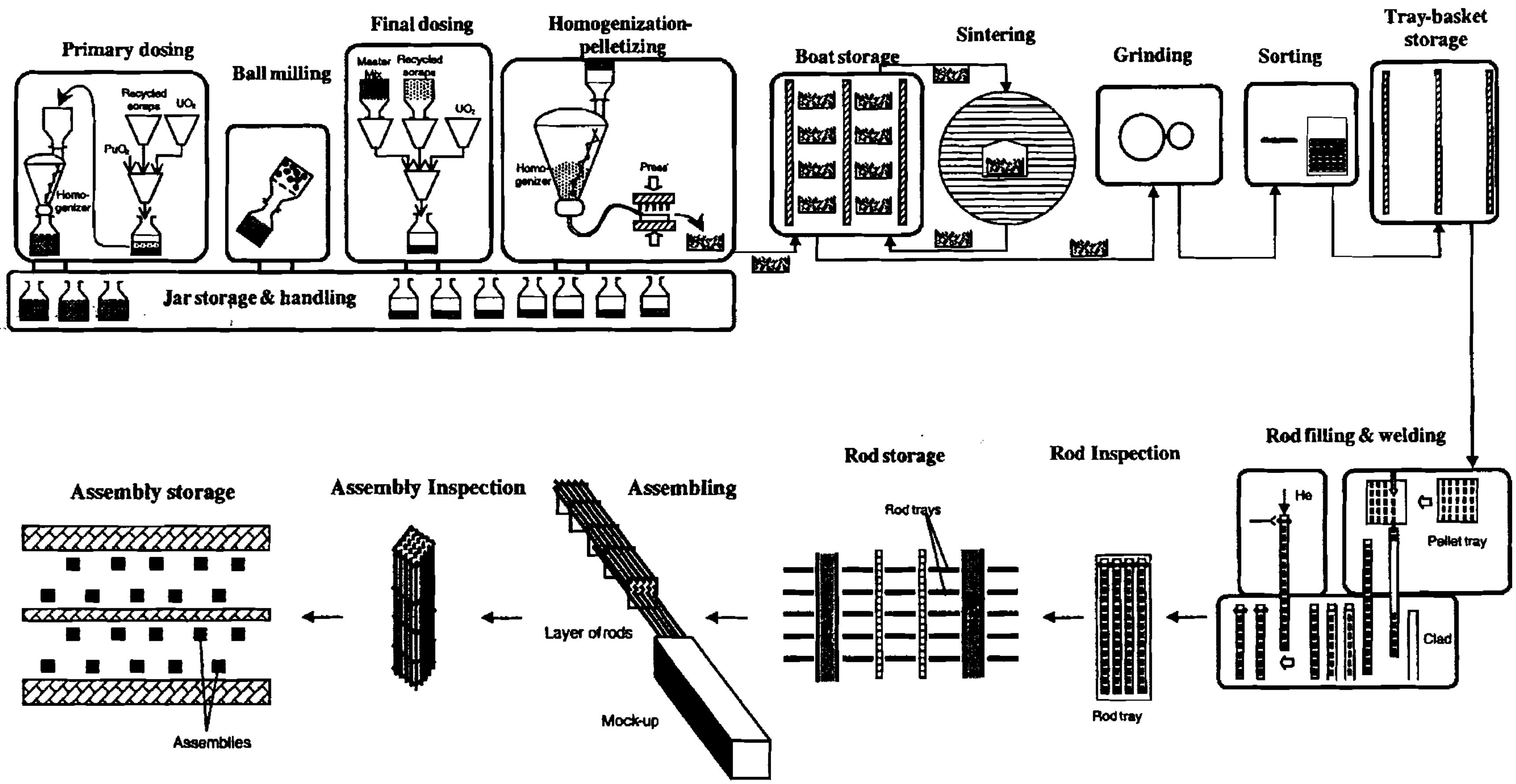
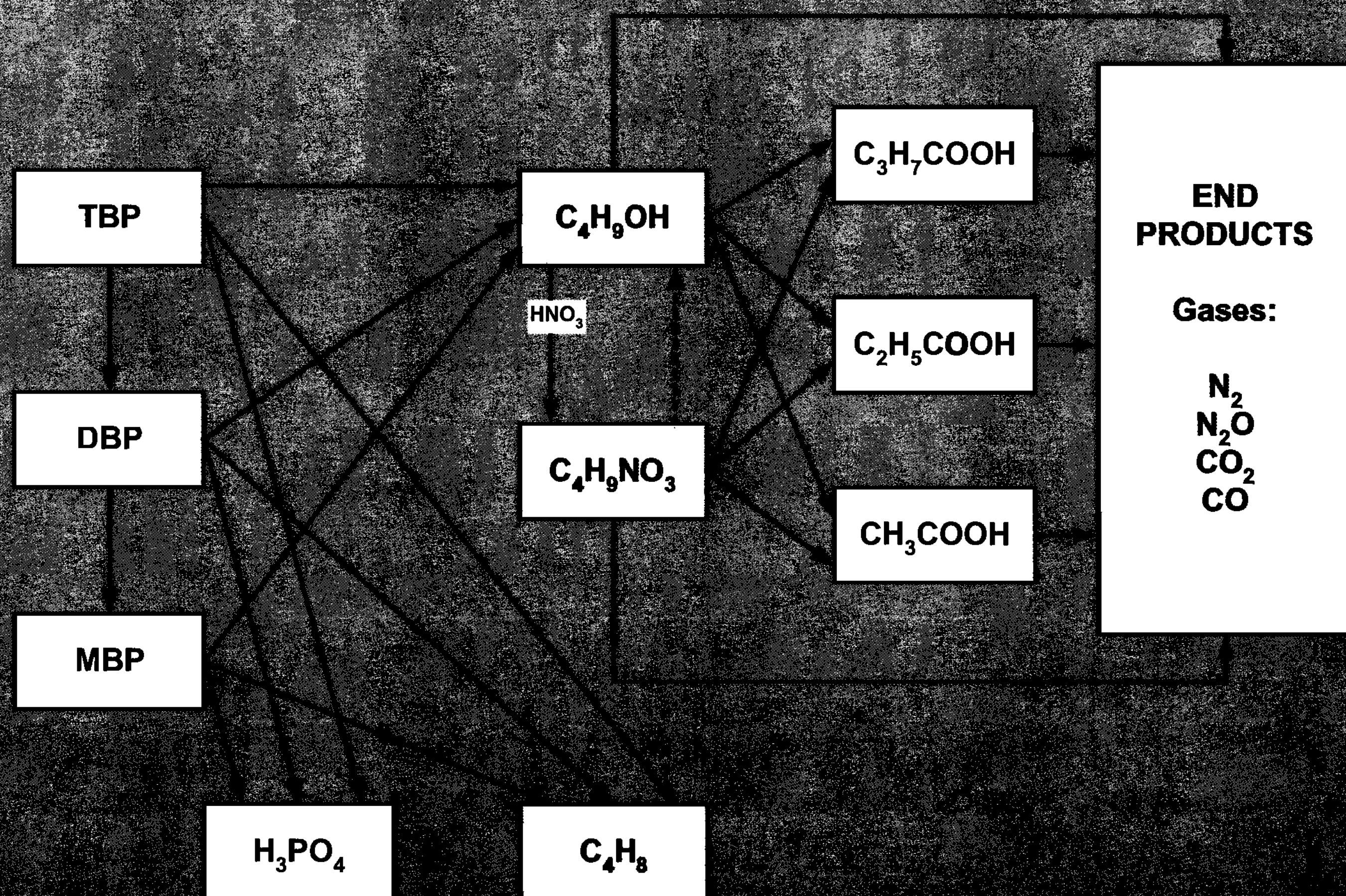


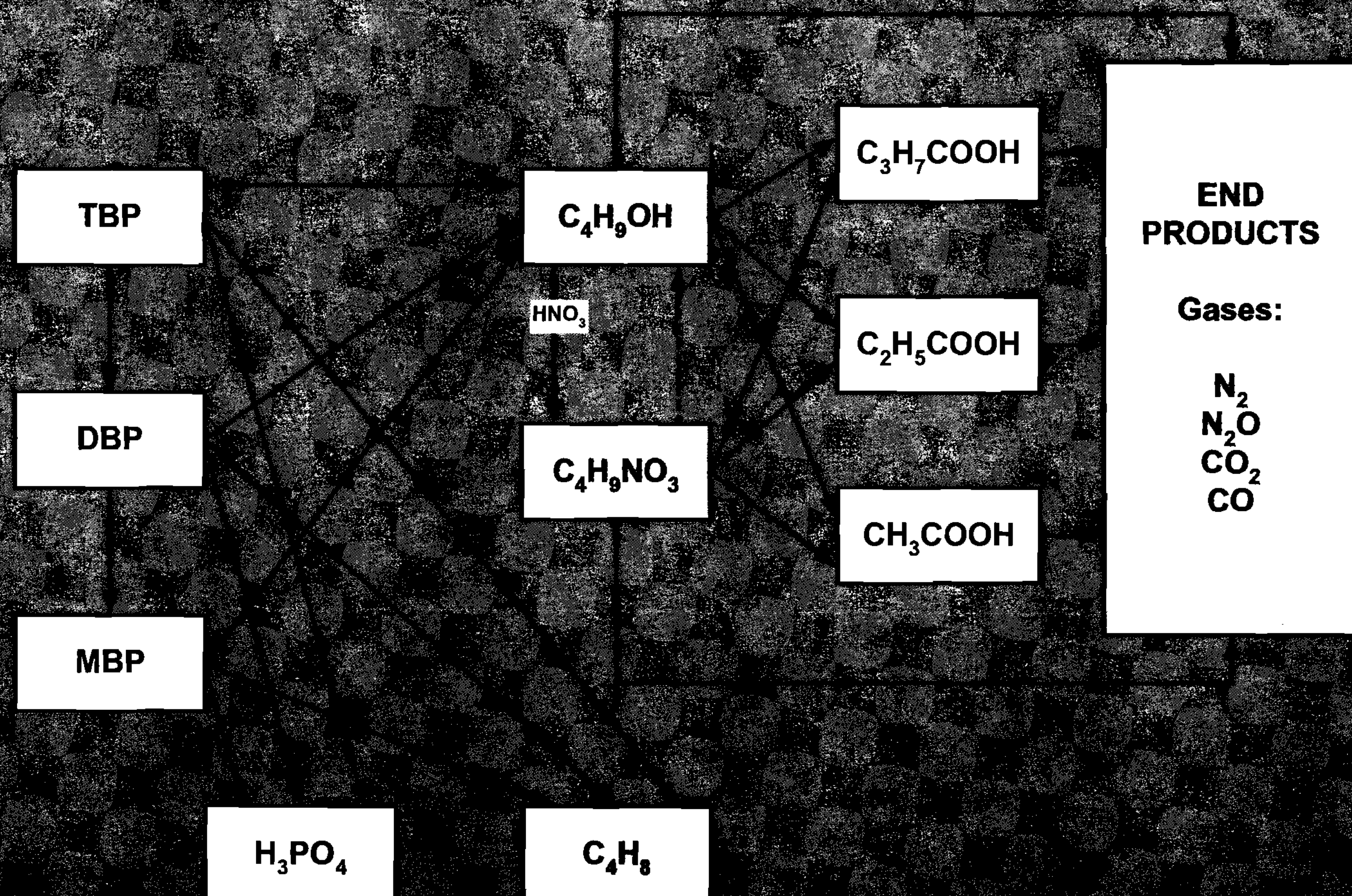
Figure 1.1-5. MOX Fuel Fabrication Process

CS-01: Red Oil
Sample Pathways and Intermediates



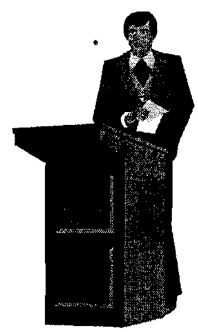
CS-01: Red Oil

Sample Pathways and Intermediates



Safety Concerns and Differing Viewpoints and Opinions on MOX

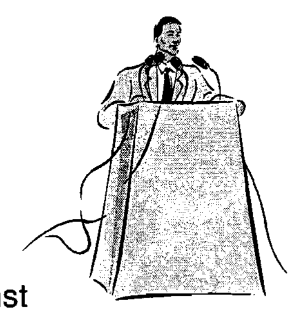
Alex Murray
Lead Chemical Safety Reviewer
NMSS/FCSS/SPB/MOFLS



Overview

Provide feedback on:

- **Safety Review Process**
- **Previously Open Items**
- **DPVs/DPOs**



Note:

I am impartial – neither for nor against the proposed facility.

I am concerned some safety issues remain and need to be addressed now and not at the License Application stage.

Safety Review Process

Two Step Licensing:

- **Step 1:**
  - Construction Permit
  - Present
- **Step 2:**
  - Licensing – possession and use
  - Future (next year)
- Concern is the balance between the two and how much can be deferred and revisited later in the licensing stage, particularly for commitments

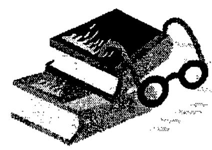
Safety Regulations

- Part 70.23(b): NRC approved when it has determined the DBs of the PSSCs, and QA plan, provide reasonable assurance of protection
- Part 70.61: Compliance with Performance requirements
- 70.64(a): Address the Baseline Design Criteria

Commitments are not mentioned

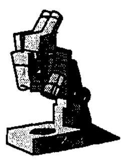
Safety Guidance

<u>**SRP:**</u>



- **Chapter 8 for chemical safety**
- **Arranged for two-part licensing review**
- **Commitments may be acceptable**

<u>**On MOX, accepted PSSCs and DBs that:**</u>



- **In general, have less information than SRP mentions**
- **Are not RAGAGEP**
- **Rely on future efforts and experiments to define current PSSCs and DBs**

RAGAGEP = Reasonable And Generally Accepted Good Engineering Practice

Diverse Viewpoints

Part of NRC strategic plan – safety and effectiveness goals

- **Staff/management discussions**
- **Nonconcurrences**
- **Differing Professional Views and Opinions [DPVs and DPOs]**

Some Observations

- A voting - not a consensus - process
- Nonconcurrences written – but not accessible by the public
- DPV/DPO only practical route to upper management and public
- Prevailing staff/management and MOX management often involved in DPV/DPO process – objectivity and independence unclear
- Unclear if staff have adequately followed QA and documentation needs
- A number of workshops are being conducted to address some of these issues

Public Comment

"The NRC needs to act as a regulator and conduct thorough safety reviews [of the MOX facility]"

(public comment during August 2002 public meeting on MOX, North Augusta, South Carolina)

Comments on Previous Open Items

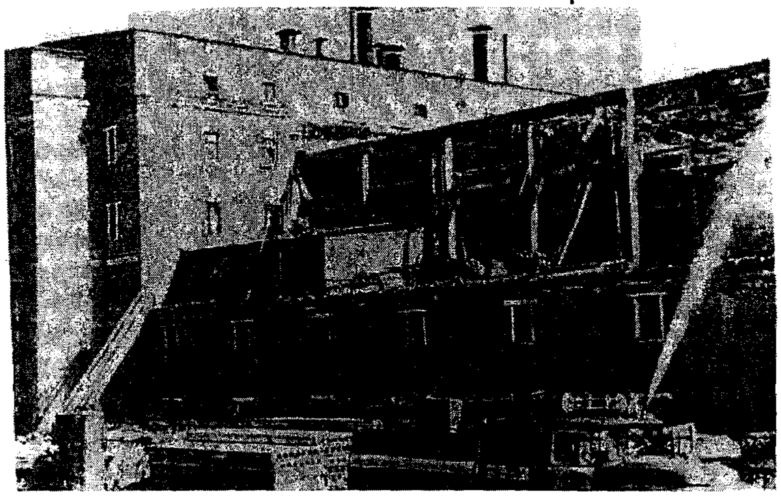
FSER Issues discussed earlier today and at November 2003 ACRS meeting

- CS-01: Red Oil
- CS-02: HAN/Hydrazine
- AP-03: Electrolyzer /Titanium Fire
- MP-01: Uranium Burnback
- CS-05b: Chemical Limits/TEELs
- CS-10: Control Room Habitability
- CS-09, AP-02, AP-08, and AP-09: Flammability

CS-01: Red Oil

- Nitrated TBP/organic compound mixtures
- Potential for significant damage and release of materials
- Open Systems:
  - Limited information provided by applicant
  - Acceptable because clearly based on test data
- Closed Systems:
  - Limited information provided by applicant
  - Clearly contradicts DOE/DNFSB RAGAGEP
  - In range identified as "unsafe"

Why I am concerned - Tomsk Red Oil Explosion



Essentially a runaway reaction!
Documented?
Yes.
1994

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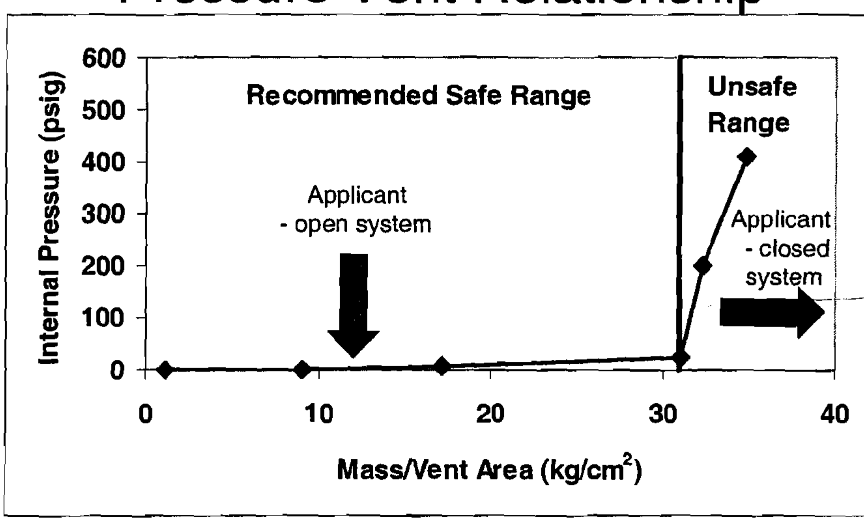
CS-01: Red Oil

Pressure Vent Relationship



not capable of venting a reaction

closed system out here

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My Conclusions:

GW- How can you tell who's right

- Approach for closed systems does not provide adequate assurances of safety:
  - Corresponds to 1 control parameter (T)
  - Common mode failure – heat transfer and vent
  - Inadequate margin
  - Uncertainties not adequately considered
  - High aspect ratio design will likely result in higher pressures and temperatures, and phase separation
  - No assurance quench system and 125 C limit will prevent red oil reactions
- No assurance approach can meet Part 70 requirements for a Construction Permit

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My Recommendation

Mario would this have implications for construction

AM. Yes, vent size would be different.

V.R. Vent size is relatively for closely open.

Yes, vent size

- Impose DOE/DNFSB RAGAGEP as permit condition
- Give applicant the opportunity to provide assurances about their strategy in the license application

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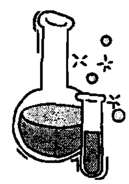
Vent occurs to outside the an off gas system

DOE thinks accident is $< 10^{-6}$ probability

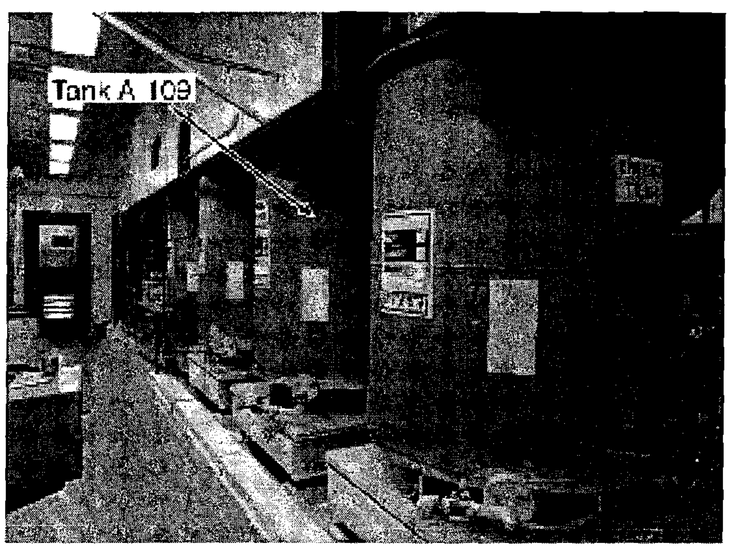
CS-02: HAN/Hydrazine

- Potential for rapid pressurization
- Two cases:
  - Case 1 – without NO_X
  - Case 2 – with NO_X addition
- Case 1 modeled as a system of PDEs to identify regions of stability and margin.



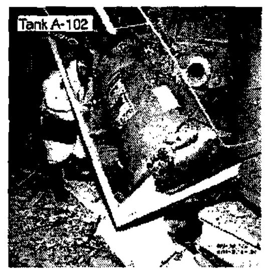
PRF Room Prior to Accident

1997



about 2530 gal HAN

Why I am concerned - PRF Accident Scene



flow of reagent how much energy goes into system

My Conclusions

- Case 1: no NO_X
  - Have only checked the mathematics
  - NRC model/software guidance for making a safety decision not followed
  - Contradictory design bases with hydrazoic acid
- Case 2: with NO_X
  - Applicant removed flow control
  - Cited standards accommodate flow design not flow control
- No assurance of meeting Part 70 criteria for construction permit

Recommendation

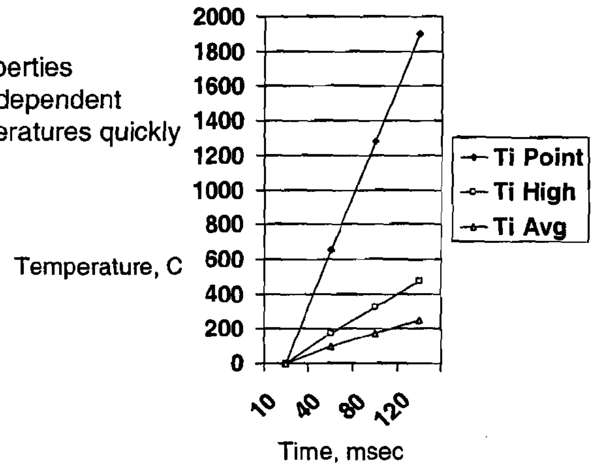
- Case 1: no NO_X
  - Have applicant commit to schedule to resolve DB conflict early after CAR/permit
- Case 2: with NO_X
  - Propose applicant's original flow control as permit condition
  - Give applicant the opportunity to provide assurances about their strategy in the license application

AP-03: Electrolyzer/ Titanium Issues

- Potential for titanium interactions and fires
- Applicant's strategy using RAGAGEPs
- Active and passive engineered controls (AECs and PECs)
- Active control terminates power, which removes the initiator for the event
- Find the approach of AECs and PECs meets Part 70 requirements

AP-03: Electrolyzer/Titanium Issues – Rapid Heating Possible

Assumed constant properties
Geometry and system dependent
Potential for high temperatures quickly



MP-01: UO_2 Burnback

- UO_2 Burnback reactions can damage HEPA filters directly or indirectly (igniting fibers/dust on the filters)
- Strong function of particle size
- Use of applicant UO_2 values produces higher loadings than staff calculations
  - Exceed threshold for one HEPA unit
  - 50-80% of threshold if distributed over C4 HEPAs
  - Contribution from other material on HEPAs not included

Burnback

- One or more features need to be identified as PSSCs and credited for safety
- Recommendation:
  - Propose permit condition that elevates intermediate HEPA filters to PSSCs for this event

CS-05b: Chemical Limits

Four Issues:

- Chemical releases – discussed as DPV/DPO later
- Modeling:
  - Dispersion Modeling – discussed as DPV/DPO
  - Phenomenological Modeling – addressed in FSER
- Chemical Limits – this discussion

Chemical Limit Concerns

- Findings from RDSER not addressed:
  - TEELs not independent, peer/public reviewed
  - TEELs not endorsed by a regulator
  - Certain TEEL values have increased substantially during review of the CAR
- Procedural Issues:
  - Policy decision – qualified staff not involved
  - Prior staff evaluations of limits not considered
  - Public not involved
  - Other regulators not consulted

December 2004 Presentation to ACRS Subcommitte 25

Nitric acid 1 mi 1 m 68

Hydrazine by factor of 10

toxicology / Health physicists reviewed

Chemical Limit Concerns (cont.)

- Safety Issues not addressed:
  - Why are significantly higher values acceptable?
  - Why are values that frequently change acceptable?
  - What is appropriate for determining PSSCs and DBs?
- Recommendation: NRC needs a task force of qualified staff to address chemical limits

December 2004 Presentation to ACRS Subcommitte 26

CS-10: Habitability

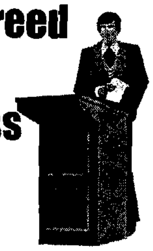
- Safety function of ECR HVAC is to maintain habitability
- Applicant's limits do not correspond to habitability
- Proposed permit condition applies habitability limits

Flammability Issues

- Applicant proposed NFPA 69 as design basis
- Applicant identified PSSCs for various areas
- Some PSSCs may not function as interlocks for NFPA 69 exception
- Staff has accepted NFPA 69 and expressed need for clear calculational basis for any exception with interlocks, for the license application

DPVs/DPOs

- 5 DPVs filed
- MD 10.159 DPV/DPO process changed in May 2004
- 2 DPVs went through full process
- 2 Management appointed panels agreed essentially 100% with the DPVs
- Actions and response did not address safety issues
- Both pursued as DPOs



DPV/DPO Process Changed

- Process has DPO and DPO Appeal, no DPV
- Authority delegated to NMSS for DPOs on MOX
- NMSS has signature authority for MOX
- Consolidation of MOX issues mentioned

DPV/DPO on Chemical Consequences

- DPV expressed concerns about chemical releases regulated by NRC
- Applicant has stated:
  - Not unlikely event
  - Radiation dose received (10s of mrem to 5-10 rem)
  - Not regulated because below 70.61
- Event has the potential for multiple fatalities, perhaps all operators outside the ECRs

NRC Assessment

nitrogen tetraoxide

- Management/staff
  - 1,500 mg/m^3 at 100 meters for N_2O_4 (in EIS)
  - "Immediately lethal"
- My assessment:
  - Estimated concentrations could be higher
  - Facility design exacerbates hazard
  - Safe havens not PSSCs
  - Unlikely operators could reach safe havens or exits

Titan 2 Silos
1970
2 people killed
a crew

N_2O_4 Release Example

DPV Panel Findings

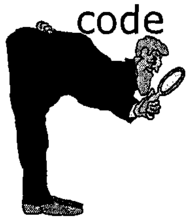
- DPV Panel agreed essentially 100%
  - Recommended the issue be re-opened or a new open issue established
  - Also recommended more guidance and review of safety evaluation process
- NRC Office/Division not in alignment with Panel report and decided:
  - Enough information on the docket, no need for the open item
  - Some guidance provided
- Review of safety evaluation process resulted in a chilling effect

Draft DPO Report

- No further action needed as safety issue is addressed
- Applicant has made blanket commitments without exception to:
  - Codes and standards with habitability requirements
  - 70.64 BDC for chemical safety – habitability implied as part of BDC
- Therefore, applicant is required to maintain habitability in all structures at the proposed facility

Summary of DPV/DPO on Chemical Modeling (I)

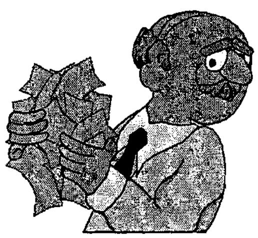
- Multiple codes available for dispersion and consequence estimation
- Applicant initially selected ARCON96, MACCS2, and ALOHA codes
- Applicant subsequently used only ARCON96 code



ARCON96 (coincidentally) produces lowest consequence results

Summary of DPV/DPO on Chemical Modeling (II)

- Applicant provided input meteorology info
- No verification and validation info provided
- No QA/qualification info provided



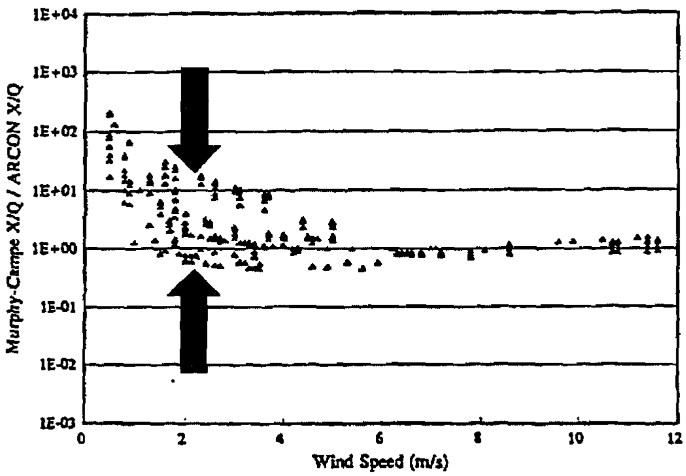
Fundamentally, no data On docket to support Site specific safety code Use at SRS MOX site

Summary of DPV/DPO on Chemical Modeling (III)

Authored DPV/DPO because:

- Matter closed – no reconsideration by local mgmt
- Safety significant:
  - potentially underestimate consequences by 1-2 orders of magnitude
  - Safety controls may be unidentified
- Submitted December 2002

Model/Data Comparisons (I)

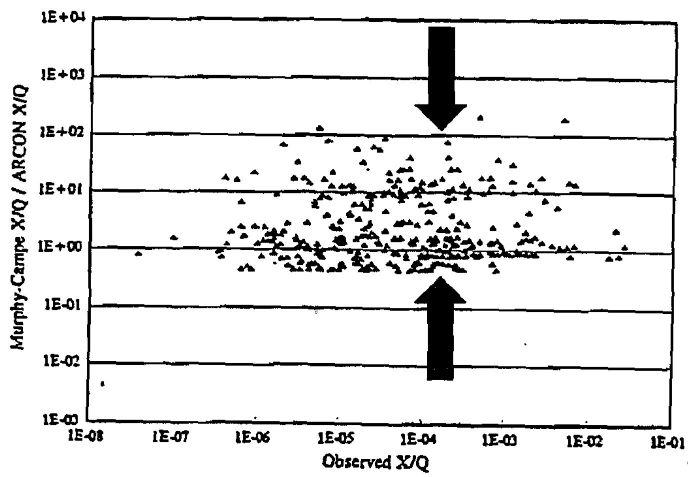


- Applicant Using SRS Wind speed Of 2.2 m/sec
- Which value to use?

Figure 27 Murphy-Campe / ARCON concentration ratios by wind speed
(based upon data from 7 reactor sites in NUREG/CR-6331 on ARCON96)

39

Model/Data Comparisons (II)



Applicant Using Circa 3E-4

Which value to use?

Figure 28 Murphy-Campe / ARCON concentration ratios by observed concentration
(based upon data from 7 reactor sites in NUREG/CR-6331 on ARCON96)

40

Subcommitte

DPV Panel Findings

Essentially agreed with DPV:

- Panel noted generic use of ARCON96 OK
  - **but** site specific application for MOX not verified/validated against site test data
- NRC guidance on software not followed
- Staff guidance on code selection and user needs

Office/Division Responses

On DPV/DPO Appeal, not in alignment with DPV Panel Report:

- Docketed information available
- MDs and NUREG/BR-0167 (Software QA Guidance) not useful
- Sufficient staff guidance available
- RES user-need memo for development/application of scientific codes

DPO Appeal

Three Main Points:

- Information cited is not V&V erified alidated
- No adequate QA on applicant's code
- Safety issues remain

Received DPO Report Monday (12/13), from a quick review:

- DPO appeal denied
- Implies V&V for site-specific application not needed

DPV on Waste Management Concerns

- Safety issues refer to premature closure of Open Items AP-05 and AP-06. Applicant should:
  - Confirm MFFF wastes are treated to meet SRS WACs and will be accepted
  - Identify PSSCs and DBs for the waste unit, such as an inventory limit DB and shutdown requirement
- Clearly within NRC regulatory authority

Waste DPV

NRC:

- Delayed the DPV for about a year
- Denied the DPV – waste is under DOE jurisdiction

Subsequently:

- NTEU filed a grievance on the process
- I requested the ACRS/ACNW review the DPV and the safety issues

DPVs on Chemical Limits and Flammability

NRC:

- Delayed the DPV for about 10 months
- Asked for resubmission

Subsequently:

- NTEU filed a grievance on the process

Summary

- Process and specific safety concerns
- Potential for more DPOs
- We – NRC, applicant, and DOE - need to do a good job and address these issues

FSER Open Item Resolution Since November 2003: NCS Review Area

Christopher S. Tripp
Criticality Safety Reviewer
NMSS/FCSS/TSG

NCS-04: MOX Validation

- Prior to last ACRS meeting:
- Previously closed for areas of applicability:
  - AOA(1): Pu-nitrate solutions
  - AOA(2): MOX pellets, rods, assemblies
  - AOA(5): Miscellaneous Pu-compounds
- Still open:
  - AOA(3): PuO_2 powders
  - AOA(4): MOX powders

NCS-04: MOX Validation

- Current Status: Closed
  - AOA(3): Approved
  - AOA(4): Approved with permit condition:
    - Additional 1% margin in k_{eff}
    - Reduced parametric range
      - Narrowed range in H/X
      - Narrowed range in EALF
      - Limited to <60cm DU reflector
  - Permit condition required due to reduced number of benchmarks for MOX powders

K_{eff} Margin

- Benchmarks for AOA(4) non-normal
- Committed to follow NUREG/CR-6698
- Nonparametric Method:
  - Uses lowest calculated k_{eff} & nonparametric margin (NPM)
  - NPM depends only on total number of benchmarks
- Method applied to AOA(3) & AOA(4)

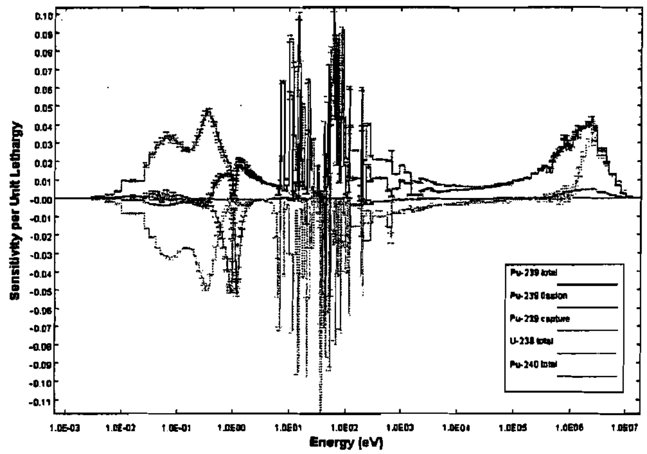
Application of NPM

- AOA(3):
  - 25 PuO_2 & 24 Pu-metal benchmarks
  - PuO_2 benchmarks found acceptable based on:
    - Similar materials, geometry, energy spectra
  - Pu-metal benchmarks found acceptable based on:
    - Differ from oxide only by density & chemical form
    - Staff calculations showed k_{eff} insensitive to density
    - Effect of oxygen on k_{eff} negligible
    - Confirmed by ORNL S/U code (TSUNAMI)
  - 49 applicable benchmarks → 0% NPM

Application of NPM

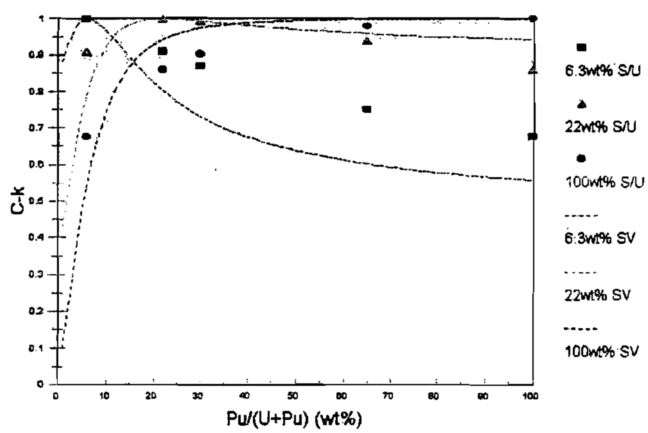
- AOA(4):
  - 42 MOX & 17 PuO_2 benchmarks
  - 38 MOX benchmarks found acceptable
  - 4 MOX benchmarks too high H/X
  - 17 PuO_2 benchmarks not shown applicable
    - Low correlation to 6-22wt% Pu-content MOX
    - Comparison of fission spectra not sufficient
    - Increasing importance of ^{238}U capture at low Pu/(DU+Pu)
  - 38 applicable benchmarks → 1% NPM

Applicability of low-Pu



Applicability of low-Pu

Ck vs. Pu-content: MOX-water spheres



Low-Moderated MOX

- Recognized shortage of low-H/X MOX benchmarks
- OECD/NEA workshop held April 2004 in Paris
  - Share experience with MOX licensing issues
  - Assess need for additional benchmarks
  - Decide among 6 competing proposals
    - Most for reactor-grade (RG)-MOX
    - Most using close-packed fuel rods

Low-Moderated MOX

- NRC position:
  - Weapons-grade (WG)-MOX benchmarks useful to support future flexibility (given restrictions to AOA)
  - Not needed to license MFFF (given additional margin acceptable)
  - MOX powder benchmarks with WG isotopics preferable

Follow-on Actions

- TSUNAMI results part of basis for FSER
- Not available to DCS; not approved code (QAP)
- Part of supporting analysis for design basis not incorporated into DCS documentation
  - 13 follow-on areas for additional demonstration identified
  - FSER states basis will be reviewed by staff in license application
  - DCS has informed us they'll provide substantiation in separate submittal

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NMSS/FCSS/TSG

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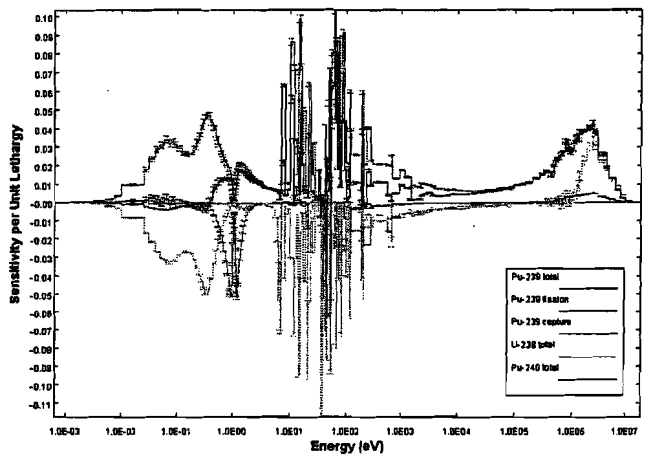
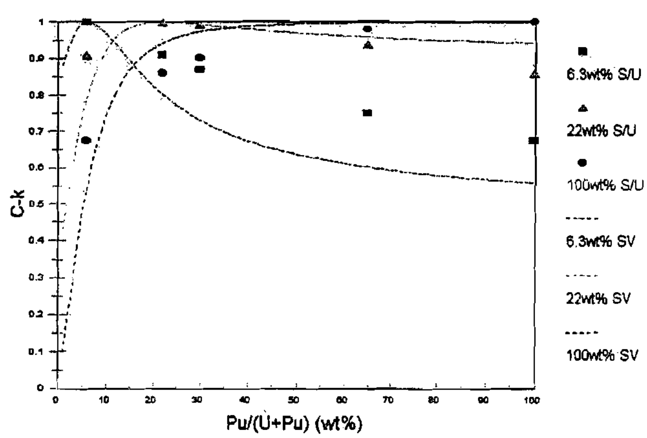


Applicability of low-Pu

Ck vs. Pu-content: MOX-water spheres



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  - Share experience with MOX licensing issues
  - Assess need for additional benchmarks
  - Decide among 6 competing proposals
    - Most for reactor-grade (RG)-MOX
    - Most using close-packed fuel rods

Low-Moderated MOX

- NRC position:
  - Weapons-grade (WG)-MOX benchmarks useful to support future flexibility (given restrictions to AOA)
  - Not needed to license MFFF (given additional margin acceptable)
  - MOX powder benchmarks with WG isotopics preferable

Follow-on Actions

- TSUNAMI results part of basis for FSER
- Not available to DCS; not approved code (QAP)
- Part of supporting analysis for design basis not incorporated into DCS documentation
  - 13 follow-on areas for additional demonstration identified
  - FSER states basis will be reviewed by staff in license application
  - DCS has informed us they'll provide substantiation in separate submittal

NRC Review of the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility

David Brown, Project Manager
Mixed Oxide Facility Licensing Section
Division of Fuel Cycle Safety & Safeguards
Office of Nuclear Material Safety & Safeguards

Outline of Introduction

- Purpose of this presentation
- Brief overview of the MOX project
- Regulatory framework for construction authorization
- Overview of project milestones
- Future project schedule

Purpose of this Meeting

- Purpose of this meeting is to seek ACRS endorsement of the staff's evaluation of the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility

MOX Project Overview

- September 2000 – U.S. and Russia agreed to each disposition 34 metric tons of surplus weapon grade plutonium
- The Department of Energy 's National Nuclear Security Administration, Office of Fissile Materials Disposition, is responsible for all activities relating to managing, storing, and disposing of surplus fissile materials.

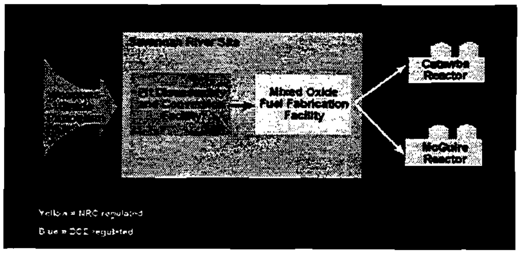
MOX Project Overview

- The National Nuclear Security Administration (NNSA) selected Duke Cogema Stone & Webster to design, build and operate the U.S. Mixed Oxide Fuel Fabrication Facility.
- In April 2002, the NNSA decided to disposition all 34 metric tons of U.S. surplus plutonium by irradiation of mixed oxide fuel in commercial nuclear power reactors.

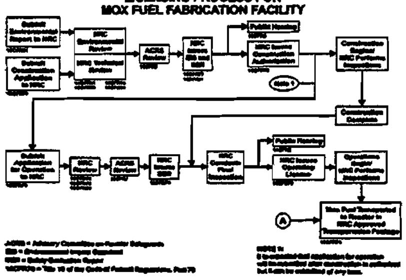
MOX Project Overview

- NNSA will construct two adjacent facilities at the Savannah River Site near Aiken, SC, to support the Surplus Plutonium Disposition Program
  - Pit Disassembly and Conversion Facility
    - Includes the Waste Solidification Building
  - Mixed Oxide Fuel Fabrication Facility

MOX Project Overview



MOX Regulatory Framework



MOX Regulatory Framework

- Two approvals needed for plutonium facilities:
  - **Construction Permit**
  - License to possess and use licensed material
- Construction Permit - 10 CFR 70.23(b)
  - A safety assessment of the <u>design bases</u> of principal structures, systems, and components (PSSCs)
  - Description of the quality assurance program
  - Environmental impact statement - 10 CFR 70.23(a)(7)

MOX Regulatory Framework

- 10 CFR 50.2 Definition of Design Bases:
  - "Design Bases means that information which identifies the specific functions to be performed by a structure, system, or component of a facility and the specific values or ranges of values chosen for controlling parameters as reference bounds for design..."

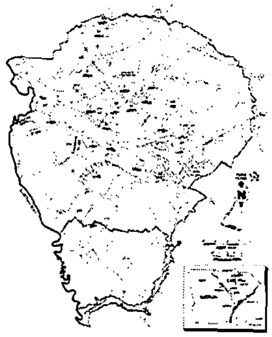
MOX Regulatory Framework: 10 CFR 70 Risk-Informed Regulations

	Highly Unlikely	Unlikely	Not unlikely
High Consequence Publ Dose > 25 rem Worker Dose > 100 rem	Acceptable		
Medium Consequence Publ Dose 5 - 25 rem Worker Dose 25 -100 rem Env releases > 5000 Tbl 2	Acceptable	Acceptable	
Low Consequence Publ Dose < 5 rem Worker Dose < 25 rem	Acceptable	Acceptable	Acceptable

MOX Project Milestones Construction Authorization

- Construction Authorization Request (CAR), Environmental Report and Quality Assurance Program Plan submitted to NRC by February 2001.
- First draft Safety Evaluation Report (SER) in April 2002 with 56 open items.
- Revised CAR in October 2002, after NNSA decision to cancel Plutonium Immobilization Project.
- Draft EIS issued by NRC in February 2003 – no significant impacts
- Second draft SER in April 2003 with 19 remaining open items
- November 2003 – ACRS meeting with 11 remaining open items; NNSA announcement of new Controlled Area Boundary

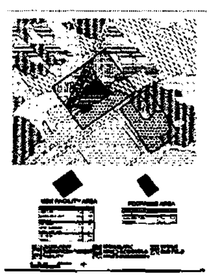
Controlled Area Boundary



- First CAB encompassed almost entire Savannah River Site
- CAB was 800 square kilometers
- CAB would now be < 0.06 square kilometers

New Controlled Area

MOX facility is located adjacent to the proposed Pit Disassembly and Conversion Facility



MOX Project Milestones

- CAR change pages received by NRC in June 2004
- Applicant made few MOX Facility changes resulting from Controlled Area Boundary change
- Safety assessment change attributed to change in CAB
  - Process Cell Exhaust System is included in the set of facility principal structures, systems, and components (PSSCs).

MOX Project Milestones

- Other changes in the June 2004 CAR include:
  - Removed uranium oxide dissolution system – replaced with uranyl nitrate system
  - Added Waste Organic Solvent unit
  - Updated chemical inventory list
  - Revised waste stream volume estimates
  - Other PSSCs added as a result of open item closure
    - Red oil, use of TEELs, and uranium burnback
  - Other editorial changes and corrections.

MOX Project Future

- If the SER is approved and the CAR is granted in February 2005;
  - NRC will start construction inspections and exercise enforcement authority
  - DCS will file a License Application and Integrated Safety Analysis Summary
  - Other license application documents will be filed
    - Facility Security Plan
    - Fundamental Nuclear Materials Control Plan
    - Emergency Plan, if required

Open Item Status

- Presenters:

Alex Murray, Senior Chemical Process Engineer

Bill Troskoski, Senior Chemical Engineer

Rex Wescott, Senior Fire Protection Engineer

Chris Tripp, Senior Nuclear Process Engineer

FSER Open Item Resolution Since November 2003: Chemical Safety Review Area

Alex Murray
Lead Chemical Safety Reviewer
NMSS/FCSS/SPB/MOFLS

Overview

* Discuss closure of open items from staff's RDSER (April 2003) and November 2003 ACRS Meeting

- CS-01: Red Oil
- CS-02: HAN/Hydrazine
- AP-03: Electrolyzer /Titanium Fire
- MP-01: Uranium Burnback
- CS-05b: Chemical Limits/TEELs
- CS-10: Control Room Habitability
- CS-09, AP-02, AP-08, and AP-09: Flammability

* Provide summary

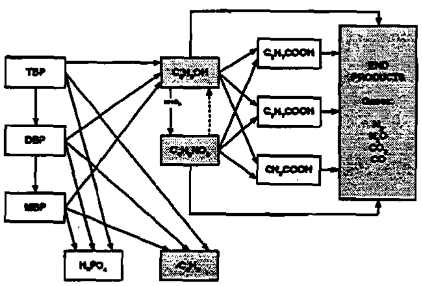
CS-01: Red Oil Introduction

- Aqueous Polishing uses an optimized PUREX solvent extraction process
- Generally two phases:
  - Aqueous: concentrated nitric acid (10-13.6 N)
  - Organic: Tributyl phosphate and branched dodecane mixture
- Nitrated TBP/organic compounds form
- Collectively termed "red oil" for the mixture

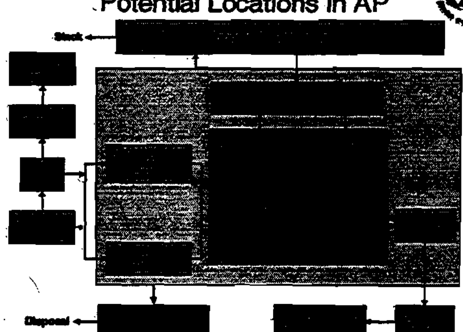
CS-01: Red Oil
Spectrum of "Red Oil"

The solution on the far left is the normal organic phase containing U and TBP. The far right is the material recovered following an overpressurization event. Color is dependent mainly on amount of heating and the type of hydrocarbon diluent employed.

CS-01: Red Oil
Sample Pathways and Intermediates



CS-01: Red Oil
Potential Locations in AP



CS-01: Red Oil

Safety Issue

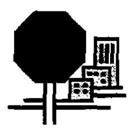
- Red oil species can undergo exothermic reactions, involving small quantities (< 100 gal)
- Reactions can "runaway" and overpressurize vessels

- Several incidents (e.g., "knocking")
- Several accidents with significant equipment damage and release of radionuclides

CS-01: Red Oil

Applicant's Safety Approach

- Applicant has identified this as a high consequence event
- Selected a preventative strategy to render the event highly unlikely



- Safety controls:
  - Original application: 1 PSSC with 1 safety function
  - RCAR June 2004:
    - 3 PSSCs with 5 safety functions
    - commitment to further research and experiments

CS-01: Red Oil

Applicant Definitions

Two red oil cases:

- **Open Systems:**
  - Vent provided – pressure relief
  - No overpressurization from full runaway reaction
  - Can contain 100% organic compounds
- **Closed Systems:**
  - Vent provided – pathway for evaporative cooling
  - Cannot prevent overpressurization from full runaway reaction
  - Can contain substantial – but not 100% - organic compounds

CS-01: Red Oil

Applicant's Safety Controls (I)

PSSC#1: Offgas Treatment System

- Provide venting/avoid pressurization
- Allow path for evaporative cooling
- Open system: avoid pressurization
  - 0.008 mm^2/g organic (12.5 kg/cm^2)
- Closed System: evaporative cooling
  - 1.2 times [energy input from steam + reaction enthalpy]

CS-01: Red Oil

Applicant's Safety Controls (II)

PSSC#2: Process Safety Control Subsystem

- Control reaction enthalpy by limiting steam temperature (to 133 C)
- Limit organic compound residence time (exposure) to oxidizers and radiation
- For closed systems, use aqueous phase addition to:
  - Limit solution temperature to 125 C
  - Limit maximum heatup rate of 2 C/min

CS-01: Red Oil

Applicant's Safety Controls (III)

PSSC#3: Chemical Safety Controls:

- Ensure no cyclical organic compounds in diluent

CS-01: Red Oil

Applicant Commitment

Further research and experiments to:

- Define reaction kinetics
- Determine effects of impurities
- Establish operational limits and setpoints

CS-01: Red Oil

FSER Evaluation/Conclusions

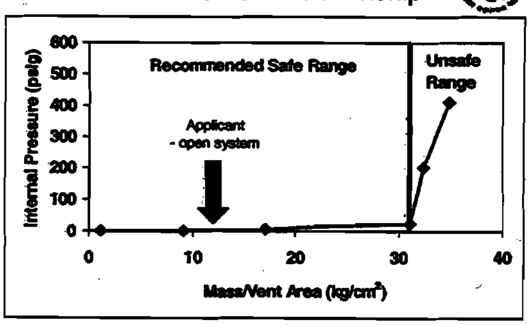
Open Systems:

- Preventative strategy acceptable
- Multiple PSSCs and safety functions
- Offgas (vent) PSSC design basis well within DOE experimental safety range (12.5 versus limit of approx. 32 kg/cm2)
  - System cannot pressurize
  - Physicochemically limited to not exceed NBP of azeotrope (120.4 C)
- Below red oil runaway conditions
- Accepted by staff

NBP = Normal Boiling Point

CS-01: Red Oil

Pressure Vent Relationship



CS-01: Red Oil
FSER Evaluation/Conclusions

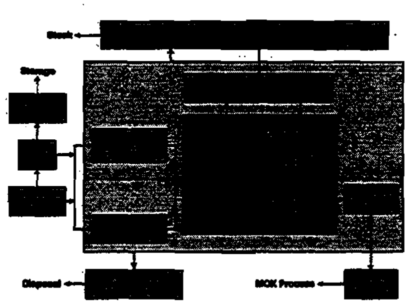
Closed systems:

- Solution temperature not to exceed 125 C
  - 5 C margin below DOE safe initiation limit
  - 9-12 C below recent SRS test runaway initiation temperatures
- Organic exposure and diluent selection controls
  - prevent participation of other species (butyl)
  - avoid initiation temperatures below 130 C
- Temperature ramp control limits runaway enthalpy effects
- Aqueous phase addition and vent provide for evaporative cooling (20% margin) that limits temperature
- Applicant commitment to further research and experiments
- Accepted by staff

CS-02: Hydroxylamine Nitrate (HAN)/Hydrazine - Introduction

- Aqueous Polishing uses an optimized PUREX solvent extraction process
- A dilute nitric acid solution containing Hydroxylamine Nitrate (HAN) and hydrazine is used to reduce the extracted Pu(IV) to Pu(III) in the pulsed stripping column.
- This transfers (strips) Pu(III) into the aqueous phase
- A similar nitric acid/HAN/hydrazine solution recovers unstripped Pu in the last stage of the plutonium barrier.
- (Plutonium Barrier is to remove the last traces of Pu in the solvent prior to solvent regeneration).
- Hydrazine both stabilizes the HAN and reduces some Pu(IV).

CS-02: HAN/Hydrazine
Potential Locations in AP



CS-02: HAN/Hydrazine
Safety Issue

- HAN a reactive chemical
  - can undergo rapid autocatalytic decomposition
  - Nitrous acid/nitric acid reactions
  - Large quantities of gas evolved, pressure excursions

- Multiple events and accidents in industry
  - Hanford
  - SRS
- Involved quantities comparable to proposed MOX facility

CS-02: HAN/Hydrazine
Applicant's Safety Approach

- Applicant has identified this as a high consequence event
- Selected a preventative strategy to render the event highly unlikely
- Safety controls:
  - Original Application: partial application of DOE recommendations
  - Revised approach involves multiple parameters and controls

CS-02: HAN/Hydrazine
Applicant Definitions

<u>Safety strategy focuses on prevention for two areas:</u>

- <u>Case 1:</u> Vessels with HAN/hydrazine, no NO_X addition
  - Avoid decomposition reactions
- <u>Case 2:</u> Vessels containing HAN/hydrazine, with NO_X addition
  - Induce decomposition to avoid recycle and accumulation

CS-02: HAN/Hydrazine
Applicant – Case 1 Analyses

- Developed kinetic model based upon multiple reaction mechanisms (5 PDEs)
- Used kinetic parameters from the literature
- Solved model using commercial software
- Predicted regions of stability and safety design basis limits
- Applicant committed to confirmatory testing to substantiate the model

PDE = Partial Differential Equation

CS-02: HAN/Hydrazine
Applicant Controls for Case 1

PSSC	Safety Function	Controlled Parameter	Design Basis
[redacted]			

CS-02: HAN/Hydrazine
Staff Analysis

- Reviewed literature equations
- Developed and exercised similar model
- Found:
  - Regions of stability
  - Regions of instability
  - Margin in proposed design bases

CS-02: HAN/Hydrazine

Staff Analysis of Case 1 DBs

Controlled Parameter	Design Basis	Stable Value	Margin (%)
[redacted]			

December 15-16, 2004 ACRS Subcommittee on Reactor Fuels 25

CS-02: HAN/Hydrazine

Applicant Controls for Case 2

PSSC	Safety Function	Controlled Parameter	Design Basis
[redacted]			

December 15-16, 2004 ACRS Subcommittee on Reactor Fuels 26

CS-02: HAN/Hydrazine

Staff Conclusions

Case 1: No NOx

- Model and literature predict stability
- Commitment to confirmatory testing
- Acceptable for construction

Case 2: With NOx

- Codes/standards consistent with industry, RAGAGEP
- Code methodology leads to DB values/ranges
- Acceptable for construction

RAGAGEP = Reasonably And Generally Accepted Good Engineering Practices

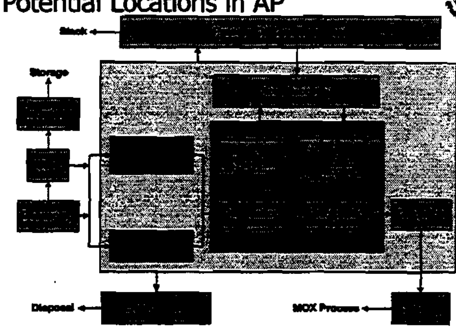
December 15-16, 2004 ACRS Subcommittee on Reactor Fuels 27

AP-03: Electrolyzer/ Titanium Fire - Introduction

- Purification requires dissolution of PuO_2
- Dissolution can be difficult for some oxides
- Applicant selected electrolytic process based upon DOE/PNL program and Cogema use
- Electrolysis generates Ag[II], which dissolves PuO_2, circa 30 C, 6 N HNO_3
- Titanium used for corrosion resistance to Ag[II]

AP-03: Electrolyzer/Titanium Fire

Potential Locations in AP



AP-03: Electrolyzer/Titanium Fire

Safety Issue

- Titanium is a reactive metal
- Normal conditions: large currents and presence of oxygen (in HNO_3, oxides)
- Electrical fault could initiate titanium reactions (conditions exceed welding)
  - Planned fire protection may be ineffective, exacerbate situation due to Ti reactivity
  - Ti event would be difficult to predict and mitigate

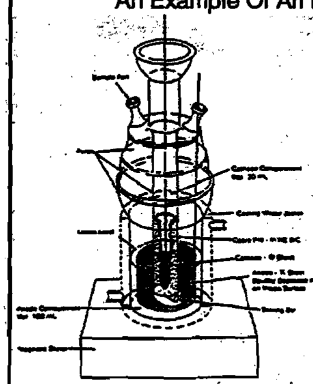
AP-03: ELectrolyzer/Titanium Fire

Applicant's Safety Approach

- Applicant has identified this as a high consequence event
- Selected a preventative strategy to render the event highly unlikely
- Safety controls:
  - Original application: no controls
  - Revised approach involves passive and active engineered controls (PECs/AECs)

AP-03: Electrolyzer/Titanium Fire

An Example Of An Electrolyzer



Key Attributes:
- Cylindrical geometry
- Center cathode and compartment
- Porous frit/barrier
- Annular anode and compartment
- Electrical connections
- Gas ullage and connections
- Insulators
- Means for agitation, cooling
- Silver[II] generated in anolyte

[from DOE/PNL experimental studies]
[Applicant's design would likely have more metallic components]

AP-03: Electrolyzer/Titanium Fire

Applicant's Safety Controls

Controls identified for:
- Maintenance/shutdown
- Seismic Event during operation
- Electrical fault during operation

AP-03: Electrolyzer/Titanium Fire

Controls During Maintenance

- Administrative controls
  - Isolate (terminate) power
  - Other requirements in procedures in License Application (LA)
- Staff Evaluation/conclusion:
  - Administrative controls RAGAGEP (Reasonably And Generally Accepted Good Engineering Practice, e.g., DOE, NFPA)
  - Other details in LA OK
- Acceptable for construction

AP-03: Electrolyzer/Titanium Fire

Controls during Seismic Event

- PSSC#1 is electrolyzer structure
  - Resist seismic events
  - Withstand turbulent flow
  - Not induce vibrations
  - Maintain geometry for criticality purposes
- PSSC#2: seismic trip system (part of PSCS)
  - Isolates power to electrolyzer during seismic event

AP-03: Electrolyzer/Titanium Fire

Staff Review of Seismic Event

Staff notes:

- Two independent controls
- Low frequency of seismic events
- Termination of power prevents Ti event
- Combination should have the ability to render event highly unlikely
- Acceptable for construction

AP-03: Electrolyzer/Titanium Fire

Controls for Electrical Fault

Passive Engineered Controls (PECs):

- PSSC#1: Sintered frit/barrier (Si_3N_4) – separates the anode from cathode in nitric acid
- PSSC#2: PTFE – separate anode from cathode and anode from ground
- PSSC#3: Guide sleeves – separate anode from titanium shell

AP-03: Electrolyzer/Titanium Fire

Controls for Electrical Fault (cont)

Active Engineered Controls (AECs):

- Current leakage detection system – shut down if > 10 mA
- Rectifier Trip Circuit: shut down if > 420 A
- Both part of PSCS (control system)
- No other related information (experience, references, codes etc.) provided

AP-03: Electrolyzer/Titanium Fire

FSER Conclusions

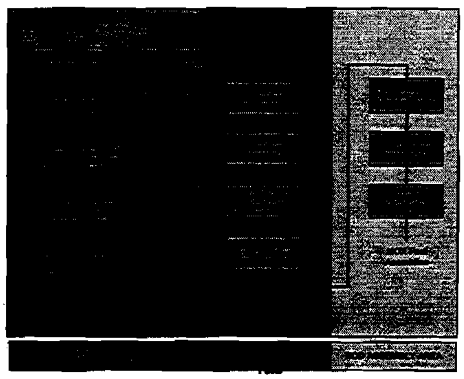
- Analyzed as top-level fault tree
- Used generic information from SRS, INEEL, codes
- Found combination of PECs and AECs capable of achieving highly unlikely
- AECs also RAGAGEP
- Conclude it is acceptable for the construction authorization

MP-01: Uranium Burnback Introduction

- Depleted UO_2 used as the matrix in MOX
- MOX requires blending of fine PuO_2 and (Depleted) DUO_2 powders
- UO_2 thermodynamically unstable under normal conditions
- "Burnback" refers to unexpected oxidation of uranium dioxide powders, e.g., on HEPA filters

MP-01: Uranium Burnback

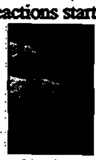
MP Location



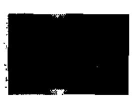
MP-01: Uranium Burnback

Safety Issue

- Burnback reactions can achieve high temperatures quickly
- Burnback can initiate other reactions/fires, disperse radioactivity, breach confinement, and damage HEPA filters
- Main concern is ball-milled DUO_2 powder ready for blending with PuO_2
- Such fine (< 10 micron) powders can burnback in exothermic reactions starting at room temperature



(HEPA = High Efficiency Particulate Air filter)



MP-01: Uranium Burnback
Applicant's Safety Approach

- Applicant has identified final HEPA filters as PSSCs for other safety strategies
- Selected a preventative strategy to remove fine particles and allow HEPA filters to perform their safety functions
- Safety controls:
  - Original application: no controls
  - RCAR strategy (June 2004): 2 high strength metal prefilters identified as PSSCs; also additional protective features (APFs) included

MP-01: Uranium Burnback
Applicant's Safety Controls

- High strength stainless steel mesh prefilters (spark arrestors)
- Protected two-stage final HEPA filters with structural integrity of >10 inches of water
- Multi redundant ventilation fan systems
- Ventilation system design ensures adequate air flow dilution
- Ventilation system design ensures a pressure drop of <10 inches of water across the HEPA filter elements
- Fire areas protected by two-hour minimum rated fire barriers
- Administrative control for inspection/maintenance of HEPAs/filters

MP-01: Uranium Burnback
Prefilters (Spark Arrestors)

- Prefilter 1: stainless steel wire mesh in stainless steel frame
- Prefilter 2: stainless steel and fiberglass mesh
- Safety Function: protect final HEPAs by removing particles from the airstream
- Design Basis: > 90% removal for particles > 1 micron size

Note: applicant states particle size is circa 100 micron upon receipt and circa 2 micron after ball milling

MP-01: Uranium Burnback
Applicant's APFs

- UO_2 delivered to the facility site and stored in sealed, 30 gallon drums.
- UO_2 is double-bagged within the drums, under nitrogen atmosphere.
- UO_2 is maintained in a nitrogen atmosphere throughout the process.
- Fire detection and suppression systems provided for gloveboxes (CO_2 injection) and process rooms (clean agent).
- Use noncombustible or nonflammable materials for process equipment construction and finishing.
- Control of combustible materials

APFs = Additional Protective Features – not PSSCs

MP-01: Uranium Burnback
Staff Evaluation/Conclusions

- Staff postulated a glovebox spill or fire could disperse fine UO_2 into ventilation system (C4)
- Staff analysis:
  - Ball milled material
  - Amount deposited on HEPAs 10-25% of that needed to cause temperature damage
- Staff concluded adequate safety strategy
  - HEPAs would survive burnback
  - HEPAs would continue to perform safety function

CS-05b: Chemical Limits - TEELs Introduction

- Limits required for assessing consequences from NRC-regulated chemical events
  - 70.61: protect from high and intermediate consequence events involving acute chemical exposures
  - 70.65(b)(7): "description … quantitative standards … from acute chemical exposure …"

CS-05b: Chemical Limits: TEELs
Safety Issue

- Chemical limits used to determine PSSCs and design bases
- SRP – NUREG-1718 examples:
  - AEGLs – Acute Exposure Guideline Levels
  - ERPGs – Emergency Response Planning Guidelines
  - Other cited values, such as OSHA and NIOSH [PELs, STs, Cs etc.]
- Applicant may use an alternative
- Significant variations between different limits
- Variations affect presence or absence of PSSCs

CS-05b: Chemical Limits: TEELs
Applicant's Safety Approach

Chemical Limits:

- Initial Application: none
- Revised Application:
  - Use AEGLs or ERPGs, where available
  - Use TEELs otherwise
  - Several significant variations in values
- Revised Application (June 2004):
  Table 8-5 values – TEELs and ERPGs

TEELs = Temporary Emergency Exposure Limits

CS-05b: Chemical Limits: TEELs
Applicant's Chemical Limits

Consequence Category	Worker (Facility and Site)	IOC/Public
[redacted]		

Site Worker = 100 m receptor

IOC = Individual Outside Controlled Area Boundary = 160 m receptor

CS-05b: Chemical Limits: TEELs

Applicant's Commitments

Consequence Category	Worker (Facility and Site)	IOC/Public
High	< Level 2	< Level 1
Intermediate	< Level 2	< Level 1
Low	< Level 2	< Level 1

CS-05b: Chemical Limits: TEELs

FSER Evaluation/Conclusion

- Multiple limits available
- Level 3 values trend towards high range of all the limits
- Level 2 values:
  - Much lower
  - All below IDLHs
  - More consistency with other limits
- Applicant commitment to < Level 2 (worker) and < Level 1 (IOC/public) addresses concern
- Level 1 approximates habitability limits
- FSER finds Tables 8.5-8.7 approach acceptable for construction

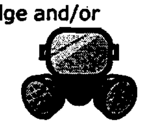
CS-10: Control Room Habitability - Introduction

- The proposed facility has multiple control rooms and control areas
- The applicant has identified two Emergency Control Rooms (ECRs)
- ECRs have two main functions:
  - maintain a habitable environment for operators
  - provide cooling to emergency electrical rooms

CS-10: Control Room Habitability

ECR Ventilation Systems (HVAC)

- System consists of two, 100% capacity air filter trains (1 for each ECR)
- Each ECR train has one intake
- Each ECR train consists of a filtration unit and booster fan for each intake
- Each filter consists of:
  - hazardous gas removal cartridge and/or organic vapor cartridge
  - HEPA filter cartridges



CS-10: Control Room Habitability

Safety Issue

- Several chemicals onsite could affect habitability
  - Liquids: HNO_3, N_2H_4, solvent
  - Liquid/gas: N_2O_4, chlorine
- Releases of these chemicals could prevent ECR operators from performing safety functions

CS-10: Control Room Habitability

Applicant's Safety Approach

- Applicant has identified chemical release events as affecting the ability of ECR operators to perform safety functions
- Initial application: PSSC but no DB
- FSER: permit condition requires habitable DB

CS-10: Control Room Habitability

Applicant's Safety Controls

- ECR ventilation (HVAC) identified as PSSC
- Safety function is to maintain habitability for operators to perform safety functions
- Design bases use (FSER Table 8-12):
  - IDLHs from R.G. 1.78/OSHA
  - Level 2 values (Table 8.5) if no IDLH
  - Level 3 values if < IDLH

December 15-16, 2004 ACRS Subcommittee on Reactor Fuels 58

CS-10: Control Room Habitability

Other Aspects of Approach (I)

- Each ECR intake is continuously monitored for hazardous chemicals.
- Upon detection of a hazardous chemical above allowable limits, the intake is automatically isolated and switched to the recirculation mode using a filtration unit with HEPA filtration and hazardous gas removal elements.
- An alarm sounds if hazardous chemical levels are detected at both intakes.
- The alarm alerts operators to don emergency self-contained breathing apparatuses (SCBAs).

December 15-16, 2004 ACRS Subcommittee on Reactor Fuels 59

CS-10: Control Room Habitability

Other Aspects of Approach (II)

- Applicant stated that monitoring would be performed for those chemicals whose unmitigated release could result in control room concentrations exceeding the limits (RCAR Table 8-5a)
  - The emergency actions would be initiated when the chemical concentrations are at or below the TEEL-3 limit
  - Specific setpoints would be determined during the final design

December 15-16, 2004 ACRS Subcommittee on Reactor Fuels 60

CS-10: Control Room Habitability

Asphyxiation

- Design Approach (LA):
  - During detailed design, individual rooms and areas will be addressed on a case by case basis to establish if air monitors with alarms are required.
  - To avoid asphyxiating atmospheres, high ventilation rates are specified to preclude the creation of an asphyxiating atmosphere.
  - *Publication P-14 of the Compressed Gas Association (CGA), "Accident Prevention in Oxygen Rich and Oxygen-Deficient Atmospheres"*

CS-10: Control Room Habitability

Staff Evaluation

- Applicant has:
  - Identified a safety function for ECR operators
  - Identified a safety function to maintain habitability in ECRs for operators
  - Identified a PSSC of ECR HVAC
- Staff found:
  - Table 8-5a values correspond to short exposures (2 minutes per R.G. 1.78)
  - These are inconsistent with habitable conditions

CS-10: Control Room Habitability

Staff Conclusions

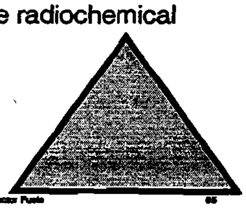
- Habitable conditions approximated by Level 1 values in Table 8-5.
- Proposed Permit Condition:
  - additional safety function of ECR HVAC shall maintain chemical concentrations below Level 1 values for duration of the event
- Staff concludes approach and permit condition provide for adequate assurances of safety

CS-09, AP-02,08,09: Flammability - Introduction

- The proposed facility uses flammable gases and combustible liquids
- Flammability control approach needed:
  - CS-09: Solvent Temperature DB
  - AP-02: Electrolyzer Flammable Gas Generation
  - AP-08: Offgas Unit Flammable Gases
  - AP-09: Offgas Solvent Flammability

CS-09, AP-02,08,09: Flammability Safety Issue

- Flammable and combustible materials can initiate fires and explosions
- Fires and explosions can breach confinement and release radiochemical materials



CS-09, AP-02,08,09: Flammability Applicant's Safety Approach

- Proposed a preventative strategy
- Adopted NFPA 69 as DB
- Identified 6 Areas of Applicability (AOAs) and associated PSSCs:

1: SX, Recovery, Wastes	4: Low T in Acid Recovery
2: Oxalic Precip/Mother Liquor	5: Hydrogen from radiolysis
3: Higher T in Acid Recovery	6: Hydrogen from electrolysis

(Proposed PSSCs and DB (25% of LFL) around Sintering Furnace and LFL methodology already accepted)

CS-09, AP-02,08,09: Flammability

Staff Review

- Reviewed NFPA 69
- Reviewed other guidance
- Reviewed electrolysis

CS-09, AP-02,08,09: Flammability

NFPA 69 (I)

- Standard on Explosion Prevention Systems
- Provides guidance on oxidant/combustible concentration reduction, suppression, containment, and spark extinguishing
- Combustible concentration
  - At or below 25% of LFL
  - Exception: at or below 60% of LFL provided automatic instrumentation with interlocks

CS-09, AP-02,08,09: Flammability

NFPA 69 (II)

Basic Design Considerations (Section 3-2):

- Required concentration reduction
- Variations in process, temperature, pressure, and materials
- Operating controls
- Maintenance, inspection, and testing

CS-09, AP-02,08,09: Flammability

NRC SRP Guidance (I)

MOX Standard Review Plan – NUREG-1718

- Chapter 7 – Fire
  - use and interpretation of codes and standards
  - some specific recommendations
- Chapter 8 – Chemical Safety
  - specific interactions (e.g., radiolysis, degradation)
  - analyze potential accidents

CS-09, AP-02,08,09: Flammability

NRC SRP Guidance (II)

Recommendations on Hydrogen Supply

- Designed to withstand seismic events or no internal leaks or shutoff so that 2% not exceeded
- Bulk storage outside
- Master shutoff valves on hydrogen tanks
- Inerting mentioned - around reducing furnace doors and purging during automatic shutdown

CS-09, AP-02,08,09: Flammability

NRC SRP Guidance (III)

Other Recommendations Involving Hydrogen

- Inert gas use: oxygen content not to exceed 25% of the level needed for combustion
- Inert gas purge and vent on SNM bearing solution tanks
- If inerting not used, other recommendations, such as ventilation so that hydrogen concentrations maintained below 25% of LFL in tanks, pipes, etc. under all expected process conditions

CS-09, AP-02,08,09: Flammability

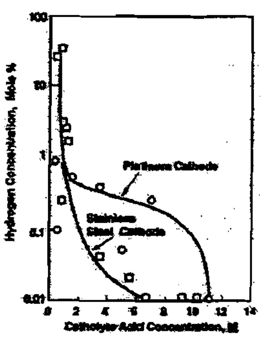
Related NRC Guidance & Activities

- Report on Hanford Tank Wastes:
  - NFPA 69 applied inside vessels
  - Hydrogen not to exceed 25% of LFL
  - Based on interpretation of NFPA 69, as applied to the situation

CS-09, AP-02,08,09: Flammability

Electrolytic Hydrogen

* Shows acid Concentration can Control hydrogen



CS-09, AP-02,08,09: Flammability

FSER Conclusions

- Staff accepts preventative strategy
- Staff accepts general use of NFPA 69 as DB
- Staff will review implementation to check that any proposed interlocks can perform safety functions
  - Applicant has different strategies to pursue
  - Clear calculational and experiential basis needed, with setpoint analysis
  - Deferred until ISA in LA
- Acceptable for construction

Summary
70.61: Performance Requirements

- Previously identified open items from:
  - DSER
  - Revised DSER

  have been satisfactorily addressed by additional controls and safety strategies
- Staff concludes, pursuant to 70.23(b), that DBs of PSSCs proposed by the applicant will provide reasonable assurance of protection against NPH and accidents

76

Summary
70.64: Baseline Design Criteria (BDC)

- BDC 3 for fires/explosions and 5 for chemical safety
- Applicant:
  - Proposed many strategies, PSSCs, and DBs
  - Used many specific codes and standards
  - Adopted RAGAGEP in many areas
  - Provided information to resolve open items
  - Stated BDCs are incorporated (RCAR 5.5.5.4)
- Staff concludes applicant has met BDC

77

Overall Summary

- Unique licensing
  - First significant application of revised Part 70
  - Plutonium facility
  - Two-part licensing
- Many NRC/applicant interactions and working together have resulted in:
  - Improved safety controls
  - Significant improvements in applicant's safety strategies
  - Greater assurances of safety
- The licensing process has added value

78

FSER Open Item Resolution Since November 2003: NCS Review Area

Christopher S. Tripp
Criticality Safety Reviewer
NMSS/FCSS/TSG

NCS-04: MOX Validation

- Prior to last ACRS meeting:
- Previously closed for areas of applicability:
  - AOA(1): Pu-nitrate solutions
  - AOA(2): MOX pellets, rods, assemblies
  - AOA(5): Miscellaneous Pu-compounds
- Still open:
  - AOA(3): PuO_2 powders
  - AOA(4): MOX powders

NCS-04: MOX Validation

- Current Status: Closed
  - AOA(3): Approved
  - AOA(4): Approved with permit condition:
    - Additional 1% margin in k_{eff}
    - Reduced parametric range
      - Narrowed range in H/X
      - Narrowed range in EALF
      - Limited to <60cm DU reflector
  - Permit condition required due to reduced number of benchmarks for MOX powders

K_{eff} Margin

- Benchmarks for AOA(4) non-normal
- Committed to follow NUREG/CR-6698
- Nonparametric Method:
  - Uses lowest calculated k_{eff} & nonparametric margin (NPM)
  - NPM depends only on total number of benchmarks
- Method applied to AOA(3) & AOA(4)

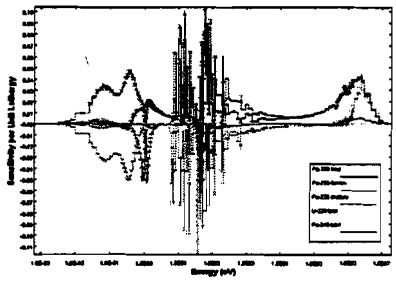
Application of NPM

- AOA(3):
  - 25 PuO_2 & 24 Pu-metal benchmarks
  - PuO_2 benchmarks found acceptable based on:
    - Similar materials, geometry, energy spectra
  - Pu-metal benchmarks found acceptable based on:
    - Differ from oxide only by density & chemical form
    - Staff calculations showed k_{eff} insensitive to density
    - Effect of oxygen on k_{eff} negligible
    - Confirmed by ORNL S/U code (TSUNAMI)
  - 49 applicable benchmarks → 0% NPM

Application of NPM

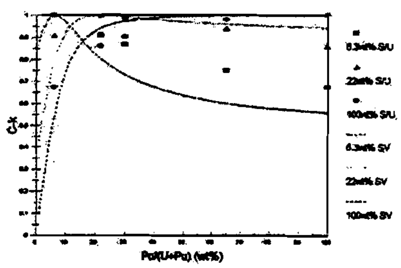
- AOA(4):
  - 42 MOX & 17 PuO_2 benchmarks
  - 38 MOX benchmarks found acceptable
  - 4 MOX benchmarks too high H/X
  - 17 PuO_2 benchmarks not shown applicable
    - Low correlation to 6-22wt% Pu-content MOX
    - Comparison of fission spectra not sufficient
    - Increasing importance of ^{238}U capture at low Pu/(DU+Pu)
  - 38 applicable benchmarks → 1% NPM

Applicability of low-Pu



Applicability of low-Pu

Ck vs. Pu-content: MOX-water spheres



Low-Moderated MOX

- Recognized shortage of low-H/X MOX benchmarks
- OECD/NEA workshop held April 2004 in Paris
  - Share experience with MOX licensing issues
  - Assess need for additional benchmarks
  - Decide among 6 competing proposals
    - Most for reactor-grade (RG)-MOX
    - Most using close-packed fuel rods

Low-Moderated MOX

- NRC position:
  - Weapons-grade (WG)-MOX benchmarks useful to support future flexibility (given restrictions to AOA)
  - Not needed to license MFFF (given additional margin acceptable)
  - MOX powder benchmarks with WG isotopics preferable

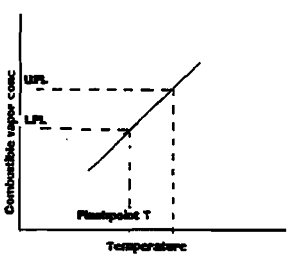
Follow-on Actions

- TSUNAMI results part of basis for FSER
- Not available to DCS; not approved code (QAP)
- Part of supporting analysis for design basis not incorporated into DCS documentation
  - 13 follow-on areas for additional demonstration identified
  - FSER states basis will be reviewed by staff in license application
  - DCS has informed us they'll provide substantiation in separate submittal

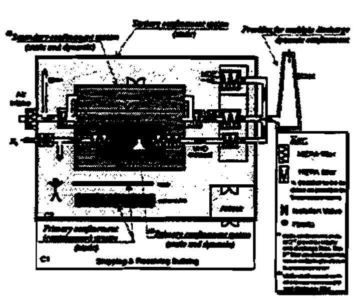
Additional Slides

- Safety Evaluation Report on the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility

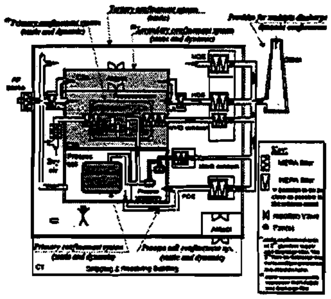
Flammable Vapor Concentration vs. Temperature Curve



MOX Fuel Fabrication Process (MP) Ventilation Confinement



MOX Aqueous Polishing (AP) Ventilation Confinement



Final HEPA Filtration Units

- 1^{st} stage spark arrester is stainless steel wire mesh
- 2^{nd} stage spark arrestor is stainless steel mesh with interwoven fiberglass to remove particles > 1 micron diameter
- HEPA are glass media with metallic frames, silicone gaskets
- DB temperature: 450 F
  DB press. = 10 in WG