Sandia National Laboratories
Albuquerque, NM 87185-0718

March 13, ~~1999~~ 2000

Penny Kinney
Mail Stop T-8-A-23
Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Kinney:

Enclosed is the Monthly Status Report for February 2000 for the Revalidation of NUREG-0170 Spent Fuel Shipment Risk Estimates Program (JCN J5160). The items included in the financial report meet the financial status requirements of Directive 11.7 consistent with Sandia's financial information system. If you have questions or comments, please phone, fax, or E-mail me at the numbers given below.

Sincerely,

Jeremy L. Sprung

Jeremy L. Sprung, DMTS
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Enclosure: Monthly Report

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C:\My Documents\Winword\0170\0170month.doc

Monthly Letter Status Report

Reporting Period	February 2000
Name and Address	Organization 6341, Mail Stop 0718 Sandia National Laboratories P. O. Box 5800 Albuquerque, NM 87185-0718
JCN	J5160
Title	Revalidation of NUREG-0170 Spent Fuel Shipment Risk Estimates
Principal Investigator	Jeremy L. Sprung
Project Period of Performance	November 1996 through May 1999

Objective

This study has three objectives:

Estimation of the radiological and non-radiological, routine and accident, transportation risks associated with the anticipated spent fuel shipments and determination of whether those risks are bounded by the estimates and projections of spent fuel shipment risks reached in NUREG-0170.

Examination of any outstanding spent fuel transportation issues or environmental concerns not resolved by NUREG-0170 and the Modal Study.

Documentation of the approach, data, and computational methods used to reestimate spent fuel transportation risks in detail sufficient to allow other transportation experts to fully understand the analyses performed, and preparation of brief and detailed summaries of the results in a form accessible to concerned citizens.

Technical Progress

The final draft of the report that documents the studies performed by this program was sent to NRC on 2 February by Federal Express. The report contains all of the changes made to address concerns raised by the external LLNL review team. Attached to this monthly letter is a table that summarizes the LLNL concerns and the changes made to address each concern.

Milestone Table for FY97, FY98, and FY99

No.	Task	MW				Start Date		Finish date		
		Sch	Actual			Scheduled	Actual	Scheduled	Projected	Actual
			97	98	99/00					
	Phase I									
Ia	Review of RADTRAN Input Parameters	5	4.6			10/96	11/96	12/96	12/96	12/96
b	Updated Truck and Train Accident Statistics	8	6.8	0.6	1.0	01/97	01/97	03/97	09/98	10/98
c	Route Characteristics	18	13.0	3.2	2.5	04/97	02/97	06/97	07/97	11/98
d	Representative Casks	2	1.7			06/97	06/97	07/97	08/97	09/97
e	Impact Methodology	3	2.8	0.2		07/97	06/97	08/97	08/97	09/97
f	Revised Proposal	4	3.8			09/97	09/97	09/97	09/97	09/97
	Subtotal	**40**	**32.7**	**4.0**	**3.5**					
	Phase II									
IIa	Cask Mechanical Response	20		13.2	6.7	10/97	11/97	01/98	10/98	03/99
b	Simple Cask Thermal Response	8		3.9	4.9	01/98	06/98	02/98	10/98	03/99
c	Accident Source Terms	22	1.2	14.5	6.1	02/98	03/97	04/98	10/98	02/99
d	RADTRAN Calculations	15	2.9	2.4	11.1	03/98	12/98	09/98	04/12/99	04/99
	Program Review Meeting	5			5.0					07/99
	Subtotal	**70**	**4.1**	**34.0**	**33.8**					
	Phase III									
IIIa	Other Topics	2			1.8	10/98	10/98	12/98	05/17/99	
b	Final Report									
	– Preliminary Draft	3			3.0	01/99	2/1/99	2/28/99	03/08/99	3/10/99
	– 1st Draft	6			6.6	01/99	2/1/99	3/31/99	04/26/99	5/17/99
	– Final Draft	2			15.3	05/99	4/21/99	5/31/99	09/30/99	2/02/00
	Executive Summary	2			0.2	05/99	9/20/99	5/31/99	09/30/99	2/02/00
	Brochure	1				06/99		6/30/99	10/31/99	
	Subtotal	**16**			**26.9**					
	Total	**126**	**36.8**	**38.0**	**64.2**					

Sch = Scheduled, Actual means "to date" for tasks underway.

Anticipated or Encountered Problem Areas

All funding for this project has now been spent.

Plans for Next Reporting Period

None

Property Acquired

No equipment with a value greater than $500 was purchased during the current month.

Travel

None

Budget Status

The financial reporting for this month is based on the revised 189 submitted at the beginning of January of 2000. $197.7 K was spent during FY97. $47.3 K was carried over into FY98. $207.3 K was spent during FY98. $20.0 K was carried over into FY99. $256.5 K was spent during FY99. $3.5 K was carried over into FY2000. $20 K was spent during October completing the version of the final report submitted to NRC on 8 October 1999; $95 K was spent during November, December, and January completing the version of the report submitted to NRC on 2 February 2000. As directed by the NRC program managers for this program and program J5285, all FY2000 costs for this program were initially costed against NRC program J5285. After $75 K of additional funding for this program was received on 25 January 2000, $75 K of 0170 labor costs were moved from program J5285 to this program. The following table presents the FY2000 costs incurred by this program after the recharging of 0170 labor costs was completed.

Month	October	November	December	January	February	**Total**
Costs	4299	0	<1074	46,814	27,962	**78,001**

Note that after the recharging of $75 K of 0170 labor costs was completed, $35 K of 0170 labor costs remain charged against the J5285 program.

JCN:J5160 PI: SPRUNG, J.L.
Date Printed: 03/01/2000 ORG: 06141 MS0718

MLSR FINANCIAL STATUS REPORT
FEBRUARY 2000

Job Code #: J5160 **SNL Project #** 2390 **NRC Office:** NMSS/PMDA/RMB
TITLE: REVALIDATION OF NUREG-0170 SPENT FUEL SHIPMENT RISK ESTIMATES

Project Period of Performance for this report: From 1/29/00 To 2/25/00

Life of Project (from Form 189) Proj. Start Date: 10/10/1996
Proj. End Date: 06/30/2000

No Cost Extension Date: No Cost Ext Date:

Total Project Ceiling Amount:	$	745,000
Total Funds Obligated to Date:	$	740,000
Total Current Fiscal Year Ceiling Amount:	$	83,400
Total Funds Obligated Current Fiscal Year:	$	75,000

	Current Month Hours	Fiscal Year To Date Hours	Cumulative (1) Project To Date Hours
DIRECT STAFF EFFORT (Hours)	200	591.25	5,558.75

"Hours" include all regular and non-regular employee time charges and, *effective FY2000*, are all computed in the "Burdened Labor" category, whereas FTE, *effective FY2000*, is only part of the "Burdened Labor" cost. Therefore, starting with the 2/00 MLSR, we will resume reporting Staff Effort in Hours.

Current Cost Incurred Status to the Actual Dollar

	Current Month	FY2000 to Date	Cumulative Project to Date (starting with FY2000)
Burdened Labor	27,148.12	75,729.45	75,729.45
Burdened Chargebacks (2)	0	0	0
Burdened Travel	0	0	0
Burdened Purchases (3)	0	0	0
TOTAL BURDENED COSTS (FY00 forward)*	27,148.12	75,729.45	75,729.45
DOE Added Factor (varies if project has waiver)	814.44	2,271.88	2,271.88
Total Costs (includes DOE Added Factor)	27,962.56	78,001.33	78,001.33
**BURDENS:(included in "Total Burdened Costs.") This includes ALL Corporate Assessments (G&A), plus labor loads which were previously reported under Direct Labor as "Overhead."*	*15,486.79*	*42,990.45*	

LIFE TO DATE (LTD) Costs (including DOE Added Factor):

Prior to FY2000	661,575.85
Entire Life of Project	739,577.18

Note: Billings are run after the MLSRs are printed, and reconciliation takes place during the last two weeks of the month. If you notice a discrepancy between MLSR and billing totals, please call Barbara Hawkins, (505) 844-2287, and she can assist you in identifying the correcting actions.

Total Uncosted Amount	422.82	Does not include commitments listed below.
FY00 Burdened Commitments	0	Includes Service Orders, Purchase Requests, Purchase Orders with all burdens

Percentage of available cumulative funds costed 99.94%
Percentage of available current fiscal year funds costed 99.46%
Foreign Funds(4)

(1) Cumulative from FY94 to date. Breakdown from previous FYs is not available in our system.
(2) Includes all cost transfers or adjustments and all services.
(3) Includes all subcontractor and materials purchases.
(4) Portion of Total Costs charged to Foreign Funds is not available in our system. If applicable, it will be covered in Financial Status section of the narrative portion of this report one month later, since our billings reports become available in our system approximately two weeks after financial costing information is available.

JCN: J5160
Date Printed: 03/01/2000

PI: SPRUNG, J.L.
ORG: 06141 MS0718

FEBRUARY 2000

Cost Totals by Project Task

TASK	Estimated Cost

NOT ABLE TO AUTOMATE FROM THE SNL FINANCIAL SYSTEM.

Monthly Spending Plan Update
(See 189 Page 3 Format)

THIS FORM WILL BE ATTACHED TO THE INITIAL MLSR, AND WHEN CUMULATIVE-TO-DATE COSTS VARY BY 20% OR MORE FROM PLANNED SPENDING.

Overall Funding Status (in actual dollars)

FY99 Carryover to FY00	FY 00 Project Funding Level	FY 00 Funds Received to Date	FY 00 Funding Balance Needed	Projected Carryover To FY 2001
Actual: $3,424.15				
Plan (189): $3,400	$80,000	$75,000	$5,000	$0

Total Estimated Project Amount	Total Project Cumulative Amount Obligated	Total Project Balance Needed	Total Project Cumulative Amount Costed
$745,000	$740,000	$5,000	$739,577.18

NOTE: FOR TASK ORDERING AGREEMENTS: Individual reports for Task Orders under Task-Ordering Agreements are attached for those projects which have appropriate Project structures for this type of reporting.

SNL Responses to the Comments of LLNL on the Spent Fuel Risk Reexamination Report

Comment	Response
1. The incident-free dose is directly proportional to the TI input used in RADTRAN. Although improvements have been implemented in the revised draft, the TIs used in this study still appear to underestimate radiation doses.	TI values are selected by sampling a distribution of TI values that has its upper bound set equal to the maximum regulatory surface dose rate at 1 m. Thus, the distribution reflects the range of surface dose rates produced by fuels of very different ages and captures the fact that some shipments will have surface dose rates just below the regulatory limit while none will exceed the regulatory limit. Thus, our TI values provide a reasonable estimate of the range and distribution of real surface dose rates (i.e., they are not underestimates).
2. In addition to the concerns over radiation levels and shielding design, the assumption that Cf-252 is the only significant neutron emitter in spent fuel illustrates an unfamiliarity with spent-fuel decay.	1. The value of the neutron emission factor for californium-252 was double-checked. The commentor correctly identified an error due to units conversion. The corrected value is 4.25E+09 n/Ci-sec. This was derived directly from the yield value of 1.15E-01 n/Bq-sec given in ICRP 38, rather than from the original source (Shleien, 1992), where the value was given in units of n/g-sec (and erroneously converted). The values for the other nuclides in the RADTRAN database that emit neutrons by spontaneous fission were also double-checked and found to be correct [Cm-242, Cm-244, and Pu-238, Pu-240, and Pu-242]. Among the other neutron-emitting nuclides found in spent fuel, even Cm-244 at 1.38E+05, still has a neutron emission factor over 4 orders of magnitude smaller than the Cf-252 value. The only reason the curiums are contributors of any significance is their somewhat larger inventory in the spent fuel's modeled. [Note: All RADTRAN 5 radionuclide data files are currently undergoing routine quality checking, and this error would have come to light as a result. Nevertheless, we appreciate the commentors' identification of it.] 2. The use of neutron emission factors is recommended only for analysis of smaller packages in severity categories in which all or most of the contents of a package might be exposed following an accident. Special-form material and spent fuel should instead be modeled in a manner similar to a stop – i.e., as a discrete source with a dose-rate derived from the unshielded surface dose rate of the material or fuel assemblage. That is, in fact, what was done in the lead-slump analysis in the report. Thus, the neutron emission factors of any or all of the constituent nuclides are irrelevant. The dose rate was reported in rem/hr, and it was treated as being 100% gamma radiation, for both simplicity and conservatism. It is conservative because neutrons are much more rapidly attenuated by air, humidity and intervening barriers (e.g., the steel skin of the cask) than are gamma rays. 3. The confusion was probably compounded by the discussion of neutron emission factors in Table 3-4 and in the text, and by the unfortunate abbreviation of the latter. RADTRAN is constructed so as to permit analysis of many different kinds of packages and materials, not merely spent fuel. The original text stated that Cf-252 is the only neutron-emitting radionuclide of significance because it is the only such nuclide that is routinely transported in commerce as a separated nuclide. [Note: Cm-242 targets are transported on-site at ORNL, but Cf-252 is shipped on the public highways.] Table 3-4 is an outline of the full spectrum of RADTRAN 5's capabilities, not merely of the subset of its capabilities applied to the spent-fuel analysis. Perhaps it should be edited down to the latter to prevent confusion in the future.

Comment	Response
3. The choice of representative routes selected for the study appears to have no logical justification. After presenting a rationale for selecting 474 specific routes based on the current distribution of spent fuel and hypothetical interim and final storage sites, another 274 routes are mixed with this sample, apparently only because data on these additional routes were readily available. The length of a route and its population density are significant variables in the risk analysis. If this study is intended to look at national averages and extremes, other methods appear much more suitable than Latin Hypercube Sampling (LHS). If it is to be based on representative spent-fuel-shipment routes, sampling from a mixture of unrelated routes is meaningless. If the current approach has merit, its justification should be explained in more detail.	Route parameter distributions were constructed so that the full range of possible routes could be examined even though the actual shipment routes are presently unknown because the locations of possible interim and permanent storage locations have not yet been selected. Because these distributions are sampled by LHS sampling, the resulting LHS sample of size 200 contains routes that span the full range of possible route parameter values. Thus, both average an extreme routes are examined and the resulting CCDFs provide both a good representation of the range of possible results and the expected (mean) result. The data for the two sets of routes were pooled because they each produced similar distributions but had different route termini. Examination of some set of real routes would have allowed critics to claim that the real future routes had not been examined.
4. The NRC should consider whether it really wants to be subjected to accounting for radiation in groundshine for 50 years. Groundshine is certainly important in the short term after an accident, until people are segregated from a contaminated patch or until the contamination is cleaned up below (EPA) regulatory limits. Once segregation or regulatory limits are achieved, there should not be a penalty for accounting for residual radioactivity below general use MCL's.	All reactor and transportation risks assessments assess groundshine dose over the first 50 years following an accident. Not doing this for this study would be indefensible. As used for this study, RADTRAN assumed that persons residing on property (ground) contaminated to levels > $\mu Ci/m^2$ evacuate at the close of day 1 and then return only if the ground can be decontaminated to levels $\leq \mu Ci/m^2$. This exceedingly stringent decontamination criterion assures that long-term groundshine exposures are minimal.

Comment	Response
5. Although many values for RADTRAN input are specifically identified, the lack of information on input values selected by the LHS routine (which are by definition important) inhibits an interested party from reproducing the study results. Furthermore, for the reader unfamiliar with the details of RADTRAN, the lack of explanation on how the input is used is likely to increase doubt on the credibility of the calculations. Sufficient information should be included in the main report and appendices to enable a knowledgeable reader to reproduce the results and to convince the novice reader that the results are credible.	RADTRAN is fully documented and the code and the documentation are both available to any interested parties via the TRANSNET system, which is accessible from the internet. If NRC wishes, we could place some or all of our 0170 input files on TRANSNET which would allow any interested party to duplicate our calculations. Illustrative RADTRAN input files are provided in Appendix E. Provision of all of the RADTRAN input data used in the report, full descriptions of that data, and full descriptions of RADTRAN (both models and computational structure) that would be needed to make a "novice" reader comfortable is entirely beyond the scope or objectives of the main report.
6. The accident risk is essentially proportional to the release of nuclides from a cask. The explanation of nuclides available for release and the quantity released under various accident conditions is lengthy and unclearly described. Beginning with nuclides calculated to be present in the spent fuel (Table x.x), a concise summary (with additional tables as appropriate) should be presented in the main body of the report to illustrate the fraction of each in releasable form.	Release fractions for each chemical element class (Kr, Cs, Ru, particles, and CRUD) are specified in Table 7.31 for each of the 18representative truck and 20 representative rail accidents that ar edeveloped by this study. PWR and BWR cask inventories are specified in Table 7.9 and the assignment of radionuclides to chemical element classes is described in Section 7.2.4. Thus, the fraction or the amount of each radionuclide in each representative source term can be calculated from the data provided.
Radioactive material releases from hole sizes smaller than 1mm^2 should be evaluated because significant releases can occur for hole sizes as small as .01 mm^2.	The oblong shape of seal failures and the log-normal character of particle size distributions means that the heights of seal failures with cross-sectional areas significantly smaller than 1 mm^2 are too small to pass significant quantities by mass of respirable particles and are also highly likely to become plugged by particulates that try to exit them.

Comment	Response
7. For the shielding and thermal analysis the study should use fuel assemblies with burnup/cool times such that the heat load per assembly ≤ 1 kW. This approach will be consistent with current spent fuel dry storage and transport practices.	Decay heat fluxes to the inner surface of the cask for high burnup 3-yr cooled fuel were deliberately used in order to underestimate the durations for engulfing fires that would be required to heat the cask to rod burst rupture temperatures.
8. The study should provide better justification for selecting a 4% failure strain for the fuel rods and clarify if PCI/SCC affects are included.	See Section 5.4.1 fully describes the development of the 4% rod strain failure criterion.
9. The study presents a lengthy hypothesis and analysis of selected phenomena (i.e., release of nuclides from damaged fuel rods) while for other equally important phenomena it appears to assume simplistic conclusions (i.e., size of seal failure and resultant release). Either the level of detail should be more appropriately balanced or additional justification should be presented for the assumptions used in this report.	The discussion/description of different phenomena is consistent with the amount of information available to support the chosen analysis methods and the character (standard method or new methodololgy) of the analysis (e.g., finite element analysis is a standard methodology while the source term methodology is wholly new). Thus, the level of detail of all treatments need not be the same and some can't be the same as given the available data, they are not similarly detailed.