APPENDIX G

Comments and Responses from Public Posting in the Federal Register

Comments on NUREG/CR-6886 were solicited via a Federal Register Notice dated September 16, 2005. A second Federal Register Notice was posted on November 30, 2005, extending the comment period on this document to December 30, 2005. The NRC received comments from a diverse group of external stakeholders, consisting of

Northeast High Level Radioactive Waste Transportation Project
Brotherhood of Locomotive Engineers and Trainmen
Agency for Nuclear Projects, State of Nevada
William Rothman, M.D. (private citizen)

Comments ranged from concerns about the potential consequences of the effects of the fire transient on spent fuel transportation packages to comments that raised questions related to the basis for the staff's analysis. A revised version of this document (NUREG/CR-6886, Revision 1) has been developed, which includes additional discussion addressing the issues raised in these comments, an expanded level of detail in the explanation of the analysis methodology, and additional analysis of the potential consequences of the accident scenario. The comments[19] submitted by external stakeholders and the staff's responses to those comments are summarized in the following table.

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[19] Some comments have been condensed slightly to remove redundancies or edited to correct typographical errors, without omitting any relevant point of the comment. Full text of the original comments, as submitted to the NRC point of contact for this document, can be obtained from the Agencywide Documents Access and Management System (ADAMS) under the accession number **ML062340334**.

Summary of Comments and Responses from Public Posting on the Federal Register (9/16/2005 through 12/30/2005) of NUREG/CR-6886
Spent Fuel Transportation Package Response to the Baltimore Tunnel Fire Scenario

No.	Comment	Response
1	On page 5.1 the statement is made that 66 ft. down-stream from the fire source is the shortest possible distance between the fire center and an SNF package because of the existence of a buffer car. This assumption seems problematic: even in the Baltimore Tunnel and certainly in wider tunnels with more than one track – it seems possible that the cask car and a buffer car could become uncoupled and slide past each other, that the buffer car could over-ride or be overridden by the package car or that the derailment could realign the cars in such a way that the minimum distance between the fire Center and the package could be only a few feet.	The 66-ft (20-m) location was chosen as a reasonable estimate of where the package could have been located in this particular fire, based on Federal regulations issued by the Department of Transportation (DOT). DOT regulations, in 49CFR174.85, require very specifically defined spacing between rail cars carrying hazardous materials of any kind, including flammable liquids and radioactive materials. Typical requirements specify that a rail car carrying radioactive material must be separated from cars carrying other hazardous material by at least one buffer car. Therefore, the package was placed in a realistic location for this particular accident, not a 'worst possible location' for any tunnel fire scenario. Additions to Chapter 5 address this issue in an expanded discussion of the fire scenario, the configuration of the derailed train cars, and the modeling approach. Additions to Chapter 1 evaluate the Baltimore tunnel fire in relation to the frequency and severity of rail transportation accidents involving hazardous material and severe fires.

No.	Comment	Response
2	The study assumes that the package remains horizontal with one end facing the fire source. It states that this orientation results in the maximum possible exposure and in the least post-fire free convection cooling. While I do not doubt that that is true, it would seem that there should be some discussion or study of an inclined or vertical package particularly, as I believe is pointed out later, because of the vertical temperature distributions both in the air and on the tunnel walls. (Would the seals in a vertical [c]ask where the end is near the heated ceiling of the Tunnel – or sitting just above a pool of flammable liquid – exceed rated service temperatures sooner than in the assumed position?)	The position and orientation of the package within the tunnel was selected to maximize heat input to the package from convection and radiation heat transfer. Peak gas and tunnel surface temperatures were used as boundary conditions on the package surface, as a conservative estimate of the distributed temperature gradients the package would actually see within the tunnel environment at any orientation. This is of particular importance in terms of maximizing heat input to the seals, because the package ends (and therefore the seals) are covered by the impact limiters, which shield the seal region from direct convection and thermal radiation from the tunnel environment. The heat input to the package side governs the rate of heat up of the seals, rather than heat input to the package ends, since the seals heat up primarily because of conduction from the package side. Additions to Chapters 5 and 6, which expand the discussion of the modeling approach, include a review of the conservative assumptions underlying the selection of the package orientation, location relative to the fire, and boundary conditions.
3	on page 5.7, the analysis assumed that the center axis of the package would be 8.2 ft. above the Tunnel floor. ... it is not obvious that it is a worst-case position .... (While I understand from the comment in the first numbered paragraph of section 6.1 that the peak gas temperature at the top of the Tunnel was used as the ambient temperature for active heat transfer to the upper surfaces of the packages, it is not clear to me that this is equivalent to assuming that the package itself were higher in the Tunnel.)	Using the peak gas temperatures for the boundary conditions is equivalent to assuming the package is located at that corresponding position in the tunnel. The 'worst case' for convection would be to assume that the package is positioned near the tunnel ceiling, and the peak air temperature is seen by all package surfaces; however, radiation view factors to the tunnel walls and floor would be attenuated. Since radiation heat transfer is at least an order of magnitude greater than convection, this position would not produce the worst heat transfer conditions for the package. The 'worst case' for radiation assumes the package is oriented horizontally, near the center of the tunnel, so that it has the most direct radiation view factors on all surfaces, particularly the sides of the package. This orientation is used in the analysis, and is arguably the 'most adverse orientation' for heat transfer during the fire and in the post-fire cool down. Additions to Chapters 5 and 6 expand the discussion of the modeling approach, including discussion of the conservative assumptions underlying the selection of the package orientation, location relative to the fire, and boundary conditions.

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4	regarding the use of a seven-hour fire [based on the predictions of the NIST Fire Dynamics Simulator code calculations for the tunnel fire], ...there should be some discussion of both the confidence of the 7-hr FDS prediction and of the [potential consequences] of a fire lasting 10 or more hours.	Seven hours is an extremely conservative estimate of the possible duration of the Baltimore tunnel fire. Based on known facts about the Baltimore tunnel fire (e.g., from NTSB accounts of the accident and testimony of emergency responders at the scene), the most severe portion of the Howard Street tunnel fire lasted approximately 3 hours. Sensitivity studies conducted by NIST with the FDS model of the Howard Street tunnel evaluated variables in the fire scenario (e.g., tunnel geometry, fuel pool size, wall material properties), and determined that the heat release rate of the fire was limited to about 50 MW, due to oxygen starvation. Varying the fuel pool size can yield longer a duration fire, but peak fire temperatures are limited due to lack of sufficient oxygen in the confines of the tunnel. The 7-hr fire duration used to define the boundary conditions for the current study was obtained by assuming a fully ventilated fire that burned until all available fuel was consumed. The heat release rate for this fire scenario is approximately 500 MW, an order of magnitude higher than the heat rate predicted for a realistic representation of the fire conditions. Simulation of a longer fire requires reducing the burn rate or limiting the available oxygen for the fire, or both, which would result in lower fire temperatures. The scenario selected for the current study is a conservative representation of a potentially 'worst case' fire scenario for this accident. Additions to Chapter 2 expand the discussion of the fire scenario assumed in the FDS simulation used to determine the boundary conditions for the analyses of the SNF transportation packages.

No.	Comment	Response
5	In NRC's report on the Baltimore Tunnel fire, it appears that far too much emphasis is placed on investigating the possibility of loss of containment and not enough on the possibility of a loss of shielding scenario regarding the TN-68, Hi-Star 100, and NAC LWT SNF shipping casks. Loss of shielding is of particular concern to the Brotherhood of Locomotive Engineers and Trainmen for the following reasons:	Licensing regulations specified in 10 CFR 71 require that neutron and gamma shielding must be maintained within specified limits in all design basis accidents, including the regulatory fire transient. All three packages evaluated are expected to lose their neutron shield in the regulatory fire, and still maintain required neutron shielding. How this is accomplished is described in their respective SARs. Additions to Chapter 8 discuss the possible consequences of loss of neutron shielding and gamma shielding in terms of potential exposure. These analyses show that the potential dose would be below the limit of 1000 mrem/hr prescribed in 10CFR49 and 10CFR71 for all three packages in this fire scenario.
6	Shielding is an internal component of the cask design and any damage to the shielding would not be visually apparent to railroad employees.	All three packages evaluated can lose their neutron shield and still maintain external dose rates within regulatory limits, as documented in their respective SARs. Gamma shielding is provided by steel in the TN-68 and the HI-STAR 100 packages, and this shielding will not be reduced by any fire scenario. Some reduction of gamma shielding due to lead slumping as a consequence of melting and resolidifying is possible with the NAC LWT package. However, a significant increase in radiation dose from the NAC LWT would require physical damage to the package outer shell (such as a puncture), which could result in loss of lead shielding due to molten lead leaking from the package. Analysis of the conditions of this fire scenario show that the physical forces are not sufficient to result in damage to the package shell, and the lead shielding would remain within the cavity between the inner and outer shell during melting and resolidification. Potential dose increases due to possible slumping of the lead within the cavity are below the regulatory limit for accident conditions. Additions to Chapter 8 discuss the potential consequences of reduction in gamma shielding in the NAC LWT due to this fire scenario.
7	Train crews are not expected to be provided with dosimetry to measure off-link or on-link exposure during normal transportation, let alone emergency situations.	Additions to Chapter 8 discuss the potential consequences of loss of neutron shielding in all three packages, and potential reduction in gamma shielding in the NAC LWT due to this fire scenario. All three packages are designed to operate within regulatory limits without neutron shielding in place, and analysis shows

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		that the NAC LWT also maintains radiation shielding within regulatory limits even when the potential reduction in gamma shielding is considered. Train crews that observe current regulations and procedures (e.g., 49 CFR part 171: §§ 171.15 and 171.16, 49 CFR part 172: subparts C G, and H, 49 CFR part 174: subparts A through D and K) governing the transportation of hazardous materials (including radioactive material) would not be at risk of exposure to hazards beyond the current regulatory limits for accident conditions from an SNF package subjected to the conditions of the Baltimore tunnel fire. It is the purpose of OCRWM and DOE to ensure that all appropriate measures are taken to protect carriers, workers, and the general public from adverse consequences associated with shipments of spent nuclear fuel and high-level radioactive waste. Regulations and procedures are currently in place that are designed to further the safety and security of SNF shipments. This includes instituting a "no pass" rule in tunnels for trains carrying radioactive material and trains carrying hazardous or flammable materials, to further reduce the extremely low probability of a tunnel fire accident involving an SNF transportation package (See discussion of AAR Circular OT-55 in Chapter 1.) This analysis of the Baltimore tunnel fire and previous evaluations (as discussed in Chapter 1) show that the risks associated with SNF shipments are extremely low. Additional measures under consideration to further mitigate the risk of this activity include - providing dosimeters for specific workers involved in the normal handling of SNF shipments - instituting 'dedicated' rail lines on specific sections of transportation routes where the consequences of an accident are deemed severe enough to warrant such precaution, despite the low probability of a severe accident

No.	Comment	Response
8	There are no plans to equip locomotives with radiation detectors to alert crews to dangerous spikes in dose rate.	See response to Comment 7 above.
9	In all three models, the loss of neutron shielding was a given, but loss of gamma shielding was scarcely touched upon. Lead has a melting point of 621 degrees[F (328°C)]. In all three models, the gamma shield exceeded that temperature. The TN-68 exceeded that temperature after 5 hours, both the Hi-Star 100 and the NAC LWT casks reached that point in just two hours. The NAC LWT uses lead rather than carbon steel as its gamma shield. The shielding would have likely failed at the two-hour mark, eventually reaching 1378 degrees[F (748°C)] after 6.75 hours in the fire.	Gamma shielding is not lost in the TN-68 or HI-STAR 100 during the Baltimore tunnel fire, since these packages use steel for gamma shielding, not lead. For the NAC LWT, the lead reaches its melting point, but in this accident scenario, the lead remains encapsulated within the steel shell of the package body and base, and continues to function as a gamma shield. Additions to Chapter 8 provide an expanded discussion of the consequences of the lead melting during the fire, and the consequent effect on gamma shielding in the NAC LWT. The analyses presented show that this package maintains shielding such that the dose rate at 1 meter from the package surface is below 1000 mrem/hr, as required in all accident conditions. (See response to Comments 5, 6, and 7.)
10	The final version of NUREG/CR-6886 should include an expanded introductory section summarizing previous NRC studies of spent fuel shipping cask response to severe fire environments, including an explanation of the relationship between this report and NUREG/CR-6672 (SAND2000-0234).	There is no direct relationship between NUREG/CR-6672 and NUREG/CR-6886. NUREG/CR-6672 undertakes a detailed study of the risks associated with the transport of spent nuclear fuel by all possible modes, considering both mechanical loads and thermal loads imposed by conservatively defined bounding accident scenarios. Thermal loads were evaluated by postulating an extremely long duration (11 hours) fully engulfing pool fire at 1832°F (1000°C), which readily envelopes the "worst case" possibilities presented by any historical fire accident, including the Baltimore tunnel fire. The analyses in NUREG/CR-6672 use extremely conservative assumptions and highly simplified models of SNF packages for the thermal analyses, which tend to severely over-estimate the peak temperatures within the package, and do not consider the three-dimensional effects of a tunnel fire or any specific historic accident scenarios. The main effect of the modeling simplifications and conservatisms in

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		NUREG/CR-6672 is to grossly over-estimate the peak predicted temperatures in an SNF package in the response to any fire scenario. Even with extremely conservative bounding assumptions, including assumptions related to accident frequency, severity and consequences, the analysis in NUREG/CR-6672 shows that the risks associated with the shipment of spent nuclear fuel by truck or rail are very small. The report further concludes that current regulations governing the transportation of spent nuclear fuel "adequately protect public health and safety."
11	The final version of NUREG/CR-6886 should include a more detailed discussion of the Nation[al] Transportation Safety Board (NTSB) investigation of the Baltimore Tunnel Fire, including the NTSB safety recommendations (R-04-15 and -16, issued January 5, 2005) and the NTSB decision not to issue an official report on the cause and history of the fire.	As discussed in Chapters 1, 2, 3, 4, 5 and 6 of NUREG/CR-6886, information from the NTSB was used in the process of determining a conservative representation of the Baltimore tunnel fire scenario, as well as consultations with experts at NIST and CNWRA. The NTSB performed a thorough investigation of this accident, but declined to issue a final report because the Board could not come to a decision on the cause of the accident. The cause of the accident is not relevant to the analyses presented in NUREG/CR-6886, which accepts as a given that the accident did indeed occur. Similarly, the NTSB safety recommendations R-04-15 and -16 are not relevant to the fire analysis. These recommendations concern the need for improved communications between CSX and the city of Baltimore, and improvements to the city's emergency preparedness plans.
12	The final version of NUREG/CR-6886 should include a detailed discussion of the 2001 analysis of the Baltimore Tunnel Fire prepared by Radioactive Waste Management Associates for the State of Nevada.	NUREG/CR-6886 is a case study of a historical event, not a peer review of other work related to general transportation accidents involving radioactive materials. The RWMA study is particularly problematic, since it is based on significantly different assumptions regarding the fire and the properties of the SNF packages, such that it is impossible to make meaningful comparisons between the two reports. The RWMA study was released less than 3 months after the accident, long before the NTSB, CNWRA, NIST, and NRC had finished investigating the event, and as a result the RWMA study is based on inaccurate and unsubstantiated assumptions about the nature, duration, and intensity of this fire scenario. The RWMA report overstates the intensity and duration of the fire (assuming a 5-day

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		fire duration for the intense portion of the fire vs. the 3-hour duration confirmed by NTSB investigations.) The RWMA study inappropriately uses temperature predictions from the long-duration pool fires analyzed in NUREG/CR-6672 to estimate the tunnel fire environment. The RWMA report incorrectly models the behavior of the package and spent fuel, assuming an incorrect failure mechanism for fuel cladding (i.e., creep vs. pressure rupture), and neglects credible resistances in the release pathway (e.g., metal to metal contact and lid torque.) The RWMA report also overestimates the amount of Cesium that is available for release from the fuel rods. As a result, the RWMA report vastly overestimates the potential consequences of the Baltimore tunnel fire scenario when applied to an SNF package, and does not present a reliable analysis that could assist in determining the risks associated with transportation of spent nuclear fuel by rail.
13	The final version of NUREG/CR-6886 should include a detailed discussion of the 2002 analysis of the Baltimore Tunnel Fire prepared by the U.S. Department of Energy as part of the Final Environmental Impact Statement for Yucca Mountain (DOE/EIS-0250).	A direct comparison between the analyses in NUREG/CR-6886 and in DOE/EIS-0250 is not meaningful. The analysis in EIS-0250 does not evaluate the Baltimore tunnel fire specifically; instead it considers the maximum reasonable foreseeable accident, which is considered to envelope events such as the Baltimore tunnel fire scenario.
14	The final version of NUREG/CR-6886 should include side-by-side fire transient results and consequence analyses of the NAC LWT cask, with and without enclosure in an ISO container. (The discussion at page 7.17 implies that these analyses were performed, but they apparently were not reported.)	The NAC LWT was not analyzed without an ISO container in this study. This package was analyzed enclosed in an ISO container because that is the anticipated mode of transport when it is shipped by rail. The CoC for the NAC LWT requires that it be enclosed in either a personnel barrier (PB) or an ISO container. PBs commonly used for trucks are not shippable by rail, so for rail transport, an ISO would generally be required. Current DOE policy requires an ISO for truck packages shipped by rail, and every rail shipment of the LWT to date has been in an ISO container. The discussion on p. 7.17 is intended to show that the ISO container does not substantially shield the NAC LWT package from the fire, and peak component temperatures would be essentially the same, with or without an ISO container.

No.	Comment	Response
15	The final version of NUREG/CR-6886 should include an additional cask analysis, parallel to the approach described in Section 5, of a General Atomics GA-4 legal-weight truck cask, shipped on a rail car without enclosure in an ISO container.	This study evaluated the performance of three representative packages currently in service, based on resources that are postulated to be used. Including analyses for the GA-4 package in NUREG/CR-6886 would not be expected to substantially alter the results or conclusions obtained in this study. In addition, the thermal performance of the GA-4 package in an extra-regulatory fire has already been examined in NUREG-1768, *United States Nuclear Regulatory Commission Package Performance Study Test Protocols*. Additional analyses may be warranted for future studies, if the staff believes large scale use of a particular package is expected.
16	The final version of NUREG/CR-6886 should include an additional thermal analysis for each of the four casks, parallel to the approach described in Section 5, assuming that the cask is located 5 meters (16 feet) from the fire center.	As noted in the response to Comments 1, 2, and 3, the selected location of the SNF packages for this analysis is consistent with the physical attributes of the tunnel and the possible shipping configurations for an SNF package in the Baltimore tunnel fire scenario.
17	The final version of NUREG/CR-6886 should include an additional thermal analysis for each of the four casks, parallel to the approach described in Section 5, assuming that the cask is located within the hottest region of the fire.	See response to Comments 1, 2, 3, and 16.
18	The final version of NUREG/CR-6886 should include a re-examination of the potential for fuel cladding failure and release of radioactive materials, including fission products, at temperatures below the projected burst temperature of 1382˚F (750˚C) for Zircaloy cladding. (Additional attention should be given to the presence of older fuel with brittle and/or previously failed cladding.)	The limit of 1382˚F (750˚C) is a conservative lower bound on the temperature at which Zircaloy cladding might be expected to fail by burst rupture. There is no reason to suppose that this limit is not sufficient for fuel within the TN-68 cask when exposed to the Baltimore tunnel fire scenario, since this cask is licensed to carry only intact fuel assemblies. The HI-STAR 100 is licensed to carry failed fuel, but this analysis shows that this cask would not be expected to lose containment in the Baltimore tunnel fire scenario. This package design employs an inner canister (MPC) that is conservatively predicted to maintain its integrity throughout the entire fire transient. Radioactive materials, including fission

No.	Comment	Response
		products, would not be released from this package, even under conditions as severe as the Baltimore tunnel fire scenario. The NAC LWT is also licensed to carry failed fuel, but this package is quite small and can carry only a limited amount of spent nuclear material, its largest payload consisting of a single PWR assembly. Analysis of the consequences of postulating 100% failure of all rods in a single PWR assembly consisting of high burn-up, 3-yr-cooled fuel (see NUREG/CR-6672) shows that the potential release from this package remains below an A_2 quantity for this fire scenario, as discussed in Chapter 8.2.5. The available fission products from one PWR assembly of this type far exceeds that of any failed fuel the NAC LWT is licensed to carry. A payload that includes failed fuel does not adversely affect the potential consequences of the Baltimore tunnel fire scenario. Additional discussion of the potential consequences of the Baltimore tunnel fire scenario for the HI-STAR 100 and the NAC LWT when carrying failed fuel has been added to Chapter 8.
19	The final version of NUREG/CR-6886 should include a reexamination of the potential for fuel cladding failure and release of radioactive materials for higher burn-up fuels, specifically addressing the issues of radiation embrittlement, pellet degradation due to thermal cycling, and fission product buildup.	This analysis was performed assuming that all of the packages would be loaded with design basis fuel, based on the cask's licensing qualifications. The TN-68 and HI-STAR 100 packages are not licensed to carry high burn-up fuel. The NAC LWT is the only package considered in this study that is licensed to carry high burn-up fuel, in which case the total fuel load is limited to no more than 25 rods. As noted in the response to Comment 18, an analysis assuming 100% failure of all rods in a single high burn-up, 3-yr-cooled PWR assembly shows that the potential release from this package remains below an A_2 quantity for this scenario. The available fission products from one PWR assembly of this type far exceeds that of the maximum of 25 high burn-up fuel rods the NAC LWT is licensed to carry.

No.	Comment	Response
20	The final version of NUREG/CR-6886 should include a reexamination of the potential for release of radioactive materials for fuel assemblies with higher levels of CRUD activity (e.g., BWR assemblies with surface concentration up to150 $\mu Ci/cm^2$).	The current analysis (see Chapter 8) was performed assuming maximum CRUD activity of 300 $\mu Ci/cm^2$, and corresponding average activity of 150 $\mu Ci/cm^2$ for the TN-68. Given the conservative assumptions on the amount of CRUD that can detach from the rod surfaces and plate out, and the fact that 90% of the rods are cleaner than this assumed level of activity, this assumption is appropriately conservative for this analysis.
21	The final version of NUREG/CR-6886 should include a reexamination of the mechanisms for seal failure and release of radioactive materials, including seal failure long before maximum seal temperatures are reached, bolt failure, and pressure-induced blowout of failed seals.	Failure due to exceeding temperature limits is the only credible cause of seal failure in this accident scenario. The specified limits are inherently conservative, in that they are based on long-term service temperature limits, rather than transient limits. Temperatures are not high enough to consider bolt failure possible, and internal pressure increase is not sufficient by itself to compromise seals. As discussed in Chapter 8, the potential release of radioactive materials is not limited by the condition of the seals or by the time required for the seals to fail. The conclusion that there would be no release from the HI-STAR 100 is based on the welded inner canister remaining intact, not simply the integrity of the seals. For the TN-68 and the NAC LWT, the seals are assumed to fail, and the amount of the potential release is based primarily on the amount of CRUD material available for release from the package. It is not dependent on the time or mode of seal failure. The potential release is determined using a model developed by Sandia National Laboratory for analysis of CRUD contribution to shipping package containment requirements (SAND88-1358; see Ref. 26).
22	The final version of NUREG/CR-6886 should include a reexamination of the role of the HI-STAR 100 train carriage and cask restraints regarding heat shielding and heat conduction.	Heat shielding effects of these structures during the fire would act to decrease the heat load on the package during the fire; heat conduction after the fire would serve to hasten cool-down. Assumptions made in the analysis are conservative for both the fire and post-fire cool down.

No.	Comment	Response
23	The final version of NUREG/CR-6886 should include a discussion of the emergency response implications, and cask recovery implications, of the predicted damage to the neutron shielding for all three considered casks, and the loss of gamma shielding for the NAC LWT.	The loss of neutron shielding is expected in all 3 designs as a consequence of the regulatory fire (i.e., 30 minutes at 800°C). Existing regulations and procedures regarding emergency response should be sufficient for this scenario, as well. The NAC LWT does not lose its gamma shielding in this scenario. The lead melts during the fire, but is confined and held in place by the steel package body. Additional discussion has been added to Section 8.1 evaluating the consequences of lead melting and resolidification in this package. (See responses to Comments 5 through 9 above.)
24	The final version of NUREG/CR-6886 should include a reexamination of the uncertainties associated with the NIST FDS simulations of gas and wall temperatures 20-30 meters from the fire center. (These issues include the construction and benchmarking of the FDS code, selection of the conductivity value for the tunnel bricks, and potential inconsistencies with the materials analyses.)	Because of uncertainties and unknowns related to the fire scenario, the FDS simulation and the package analyses were performed using conservative assumptions. The results of the FDS simulations using realistic assumptions are in close agreement with the peak temperatures estimated from analyses of material recovered from the tunnel after the fire. (See the discussion in Chapter 3.) In addition, sensitivity studies were performed with FDS to determine the effect of varying parameters that could potentially affect peak predicted temperatures, including the thermal conductivity of the tunnel wall surfaces. The analysis predicting a fire duration of 7 hours is the result of specifying parameters that assume an unrealistically high rate of oxygen flow to the fire, in order to achieve complete combustion of the entire inventory of available fuel. The resulting fire conditions are an order of magnitude hotter than conditions predicted using realistic assumptions for the fire scenario. Variation in parameters due to uncertainties would generally result in a less severe fire transient. Additions to Chapters 2, 4, 5 and 6 expand the discussion of the conservatisms in the FDS analysis of the fire scenario and the modeling approach used in the analyses of the SNF packages.

No.	Comment	Response
25	The final version of NUREG/CR-6886 should include a comprehensive analysis of uncertainties in the following factors, and how these uncertainties might affect the results of the consequence assessment: fire size, location, and duration; gas and wall temperatures from the NIST FDS simulations; CNWRA metallurgical analyses; uncertainties in the package models; seal and cladding temperature limits; and heat transfer models for the neutron shield (including gap radiation in charred solid, and boiling heat transfer in liquid) and impact limiters.	Relevant discussions of all of these issues are included in the publicly posted version of the report, and have been expanded in Chapters 2, 5, 6, and 8 of the current Revision 1. Uncertainties related to all of these enumerated issues were considered and accounted for in a conservative manner in these analyses. Evaluation of less conservative variations within the range of uncertainties in these factors would result in shorter fire durations and lower fire temperatures, which would lower predicted package component temperatures.
26	The final version of NUREG/CR-6886 should include a discussion of any peer reviews conducted for this report, and any peer reviews conducted for two of the major supporting studies, NUREG/CR-6793 (NIST) and NUREG/CR-6799 (CNWRA).	NUREG/CR-6886 has not been subjected to external peer reviews. Instead, this document has undergone intense internal technical peer reviews by PNNL and NRC before publication, and was made available for public comment for a period of approximately 3 months. This permitted independent review by any and all interested parties. All public comments on this document are included in the final publication. An external peer review was not deemed necessary because of the very low risks associated with this scenario. This is due to the low frequency of the type of accident and the minimal consequences of postulated accident conditions. The observed frequency is once during 21 billion miles of train travel, which comprises the last 30 years of historical rail shipments. The potential consequences are estimated to be less than 0.3 of an A_2 quantity of release, and the analysis predicts large margins of temperature against cladding failure. For this study, a peer review would not be cost effective.

No.	Comment	Response
27	The possibility of fuel oil fire temperatures of 1650-2000°C for periods of time far in excess of the 30-minute test characteristic of Type B casks, make it impossible to consider that the circumstances know[n] about the Baltimore tunnel fire would be the worst circumstances that would be likely to apply in a fire situation affecting nuclear waste casks, during their transport.	The analyses in NUREG/CR-6886 predict the effects that a particular historical fire accident could be expected to have on three specific SNF transportation packages. This report does not attempt to define the worst possible fire accident. However, this is an extremely severe accident with a statistical frequency on the order of one such accident in 21 billion miles of train travel. This accident is bounded by the analyses in NUREG/CR-6672 and NUREG-0170 evaluating the risks associated with transportation of spent nuclear fuel.
28	The Advisory Committee on Nuclear Waste (ACNW) inquired during a public meeting on September 21, 2006, as to whether or not the figure of 21 billion rail miles traveled between 1975 and 2005, cited in the report, included DOE Naval Nuclear Propulsion Program waste shipments.	This mileage figure includes all commercial rail transportation for this period of time; however, it was not broken down into specific categories of rail transportation. DOE Naval Nuclear Propulsion Program waste shipments are commonly done on commercial railways and, as a result, would be included in this number.