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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	) Docket No. 72-22
	) ASLPB No. 97-732-02-ISFSI
PRIVATE FUEL STORAGE L.L.C.	) DEPOSITION OF:
(Private Fuel Storage Facility)	) **DR. MOHSIN R. KHAN**
	) (Utah Contention L/QQ)

Tuesday, March 5, 2002 - 12:10 p.m.

Location: Office of Parsons, Behle & Latimer
201 S. Main, Suite 1800
Salt Lake City, Utah

Reporter: Vicky McDaniel
Notary Public in and for the State of Utah

NUCLEAR REGULATORY COMMISSION

Docket No. ______ Official Exh. No. 89
In the matter of PFS
Staff ______ IDENTIFIED ✓
Applicant ✓ RECEIVED ✓
Intervenor ______ REJECTED ______
Other ______ WITHDRAWN ______
DATE 5-7-02 Witness ______
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SECY-02

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Q. And normally if you'd have a low coefficient the friction you would expect more sliding, correct?

A. In a -- if vertical is absent.

Q. Okay. But you said here that the primary motion was sliding and not vertical, correct?

A. If --

Q. Didn't you tell me just before that primary dissipation was going to be friction and it's going to be the horizontal movement that's going to control and not the vertical? I thought we had that discussion just before we broke.

A. Okay, let's -- let's say for the record, if you have a purely horizontal motion then the primary dissipation of energy is through friction in the horizontal direction.

Q. If you have a purely horizontal motion?

A. Purely, yes. But when a cask lifts up, the friction at that time is basically nonexistent and any horizontal motion would move it without any frictional effect. That's what's happening in the Case 1 and Case 2 and all these cases. When the vertical motion becomes higher, the effect of coefficient of friction on the displacement of this cask is not linearly related.

Q. Just tell me what's happening in Case 1 and

Case 2. What's happening to the cask?

A. What's happening to the cask?

Q. Yeah, in Case 1.

A. Case 1, the cask is displacing in the vertical direction 27 inches --

Q. Okay.

A. -- off the pad. Coefficient of friction has no meaning.

Q. And you're saying that the cask was off the pad?

A. For a significant duration of time, cask would be off the pad.

Q. Okay. And you're saying that the horizontal displacement during this period of time is 372 inches?

A. Yeah, because there is no resisting force acting.

Q. So you're saying the cask is going to have a horizontal displacement of 25 to 30 feet?

A. Well, that's what it says, yes.

Q. So you're saying the cask is going to move 25 to 30 feet?

A. This is the number, yes.

Q. Now, so you're saying that the cask has totally left the pad in this instance?

A. During the -- yes.

Q. That's what this Case 1, is happening in Case 1?

A. In Case 1 what's happening is for a significant duration of time, for a significant duration of time cask is jumping off the pad, and at that instance of time when you have a combined horizontal motion, there is no resistance to the cask from the horizontal motion, and it moves.

Q. How long is the cask staying up in the air?

A. I don't -- the entire duration I believe is what 24, 30 second duration.

Q. So this entire duration here, this run -- you've modeled the cask for 30 seconds is what you're saying?

A. Yeah. So it will move up, it will slide and come down bounce back. So you have to look at the whole time of duration. This is the maximum displacement that was seen at one of these nodal points at the cask during the uplift.

Q. So are you saying that -- what you're telling me, then, I guess -- I've got a pad, okay. Take this. And I have the -- cask bounces up and it moves in relationship to what? It's moving 25 to 30 feet in relationship to what, horizontally? In relation to the pad?

A. Yes.
Q. Or in relation to the ground, or same thing?
A. A rigid surface. It suggests a rigid surface.
Q. Are you assuming in the model that the pad and the ground act in unison?
A. No.
Q. What's it is -- is the pad moving in this analysis you're doing?
A. The top of the pad is applying the input motion. Top of the pad is applying the input motion. It excites the vertical spring and it excites the horizontal.
Q. It moves -- you're telling me that in Case 1 we have 372 inches, which is roughly 30 feet, right?
A. Yes.
Q. That's 30 feet movement with respect to what? The earth? With respect to the pad or the earth, or both?
A. With respect to earth and the pad both, because pad is, in our analysis is the ground.
Q. So that's 30 feet motion with respect to the pad --
A. Yes.
Q. -- or the ground, okay. So what you're

telling me is that basically you have this cask on the pad, right? It comes up, and then while it's up in the air, is the ground and the pad moving in relationship to the cask? Or is the cask moving in relationship to the ground and the pad?

A. They both are moving relative to each other. Both cask and the ground is moving relative to each other, because ground motion is already defined.

Q. Do you know what the maximum free field ground motion would be in an earthquake, design basis earthquake? Do you know what the maximum free field ground motion is for the PFS design base earthquake?

A. Yes, those are the time histories that we used.

Q. Yeah, but do you know how much it moves?

A. I don't know in terms of displacement.

Q. That's --

A. That's just the ground.

Q. Does two feet sound about right?

A. Could be. I haven't calculated, but could be.

Q. Assuming that the ground moves two feet, are you saying the pad moves -- you're saying when the ground moves two feet, you would have this cask move 31 feet?

A. Yeah, relative to -- if you look at this way. You could -- if you have -- you walk on ice and you slip, you could continue sliding for --

Q. We're not talking about sliding here. You're saying there's no sliding. You're saying it's off the pad, basically --

A. Okay.

Q. -- is what you're saying. The sliding, I might understand it, but you're not saying that.

A. That's exactly what in the model is happening. When it lifts up, at that point when the cask is above the pad, the effect of coefficient of friction is nothing. That part of energy dissipation is zero. When it comes down, attaches to the ground, then .8 becomes effective. So if you have a cask that keeps on jumping higher and higher and the horizontal motion keeps on acting, there is no force to resist it.

Q. So you're saying that while the cask is going up, you also have this big horizontal motion pushing the cask at the same time. --

A. That's right.

Q. -- is what you're saying?

A. So you have initial velocities, instantaneous initial velocities --

Q. Now, why would the horizontal motion move the cask -- why are you having all this horizontal motion in the cask of 30 feet when the ground itself is only moving two feet?

A. The ground is simply applying the force and let the object move whatever it wants to move.

Q. What other types of analysis have you done like this, Dr. Khan? You've done none, right?

A. I mean, it has nothing to do with any analysis or -- it's just a simple structural analysis.

Q. Well, isn't it also true that you're warned by computer programs that you should make sure that the program doesn't blow up when you run it, that it provides a realistic solution?

A. What is a realistic solution?

Q. First of all, isn't it true that the manuals tell you that?

A. Every program says that you should use input values, and we use input values that we -- that in our judgment, in our judgment are consistent and realistic, and we analyzed it.

Q. And what judgments do you have to pick out -- how many times have you picked contact stiffness as an input value?

A. How many times?

Q. Yeah.

A. We use stiffness values all the time, every time we analyze the structure. For an anchored cask it could be zero in the upward direction.

Q. So how many times have you picked a contact stiffness value for sliding analysis?

A. A program --

Q. How many times have you picked a contact stiffness value for sliding, for lift-off analysis?

A. For this case?

Q. No, just in general. How many times have you picked a contact stiffness analysis for purposes of analyzing sliding or tipping?

A. This is the case.

Q. This is the first case?

A. Yes.

Q. First time you've done it, correct?

A. That's right.

Q. Okay. Dr. Khan, you say in paragraph 70, I believe it is, "The Altran analysis did not take into account for the amplification due to soil structural interaction in the 2,000-year earthquake input time histories." Then you go on to say, therefore, the vertical input motions at the base of the cask should be higher. I'm confused what you're saying in that paragraph 70. I think you also have something in your