GARRICK: Okay. We'll, quite likely, take them up when we get to the public comment period.

I'd like now to ask Steve Frishman to come and introduce our next topic and our next speaker.

FRISHMAN: I'm Steve Frishman with the State of Nevada.

For quite some time, we've been interested in tunnel stability issues and that led us next to wondering why we're interested in tunnel stability issues. When we started looking at a basis for looking into tunnel stability, it sort of led us to a couple different areas, and once we got into those areas, we started thinking, well, it's really more than tunnel stability. It's the operational aspects of a couple areas and those are areas that have had some discussion, at least one as late as yesterday, but still have never been aired at the level that we think they have importance and that has to do with the whole concept of drip shields operationally and the concept of retrieval operationally. These are both of real importance. We think about them in terms of license application where retrievability is not only a requirement of the Nuclear Regulatory Commission, but also a statutory requirement and the use of drip shields has become integral to the performance.

So, we decided that it was time to actually take a look at what DOE, at least, has made available in documentation about the operational approaches to drip
shield and also where retrievability is implementable. There have been a lot of questions about it in the past. We've heard the--I'll use the word again--the glib statement that it's just the opposite of emplacement. Well, it isn't. There's much more to it.

So, what we did was we asked Frank Kendorski who has, oh, about 30 years experience in a broad range of underground operations and evaluations in a lot of different specialized areas. We asked him to take a look at what's available from DOE on the drip shield concept and on the retrievability concept and he's looked into it, has what we think is kind of an interesting and revealing report on the state of those issues at this point. So, I guess we have about 20 minutes and Frank will go through some of the things that he has discovered and applied his own experience to out of the available documentation from DOE on those two subjects.

ABKOWITZ: Do we have the report, as well?

FRISHMAN: No, we don't, but we will when we've got a final copy of the report.

KENDORSKI: Thanks, Steve. I'm trying to get a cold. I hope I can be heard.

What I'm going to talk about this morning is a review of titanium drip shield concept and critique of that, retrieval concept and critique, review of features common to drip shield and retrieval concepts, identification of issues that arise from this.
The titanium drip shield, this is already out-of-date from what I saw from Charlie yesterday. The pin arrangement on the leading front end there has now changed to an overlapping ridge arrangement. I'm not sure what the correct term for it is, but a lot of the issues are much the same.

Drip shield requirements are to provide an additional corrosion-resistant engineered barrier over all waste packages and also to provide a physical barrier to protect the waste packages from rockfalls. The overlapping and interlocking are to be a continuous shield for the length of the waste packages in the drift. Each drip shield is made from Titanium Grade 7 and Titanium Grade 24. Each drip shield weighs approximately four metric tons. I made a lot of pains in this presentation to make everything metric. Everything else is in English units. 12,500 drip shields will be needed from the most current information I can find. The total weight of titanium or titanium alloy—and the alloy is 90 percent titanium—is 38,000 to 50,000 metric tons.

This is the from the United States Geological Survey website. The United States Geological Survey is tasked by the Department of Interior and the government to track metal statistics and mineral commodity statistics worldwide and in the U.S. This is titanium statistics for the United States. The consumption for the last five years—2005, of course, is still current—the mean consumption in
the United States is 20,000 metric tons of titanium metal. This is the domestic production from United States mines. It's about 13,500 metric tons. The total weight of titanium as we discussed is 38,000 to 50,000 metric tons. That will be installed and manufactured over approximately a 10 year period. This amounts to two-and-a-half years of annual domestic consumption. It's not going to shut down consumption or absorb all the consumption; it's going to make a major dent in domestic consumption of titanium. The total is about three-and-a-half years of domestic production of titanium. This is going to be a major impact on the titanium market and supply in the United States and the world. When we first heard about this business, everybody said, well, go out and buy ASARCO stock and it's going to be a hot item at that time.

Next one, please? Where does titanium ore come from? Titanium has two major uses. The primary use for titanium is titanium dioxide white pigment. Most paints that we use are based on titanium dioxide. That's probably half or more of the titanium consumption in the world. The rest of the titanium goes into metal production for aerospace and structural uses. The largest suppliers of titanium in the world are South Africa, Australia, and Canada. The United States is the purple field at the upper top here. We're a little minor player in the world market of titanium. China has become a major importer of almost all mineral commodities in the last four or five years and
that's going to continue. And, they are consuming a lot of
titanium now rather than exporting it. That's going to be
a significant factor in the future.

KADAK: What's the world production of titanium?

KENDORSKI: That's a difficult number to come up with.
We have the ore production. We don't have the metal
production because a lot of countries restrict that
information.

Drip shield installation, we install just prior
to closure and before retrieval if retrieval ever happens.
Minimum of 50 years after first waste emplacement will be
installed. And, possibly a 100-year, 300-year preclosure
period while the waste packages wait for drip shields to be
installed. This environment is going to be 50 degrees
Centigrade and the last information I have 122 degrees
Fahrenheit. Not bad; I've worked in 140 degree
environments underground. It's going to be radioactive
which I don't work in. Ventilated, but overall 15 cubic
meter per second airflow. That's overall. But, you've got
the waste packages that are going to be in the way. So,
you're going to have at-ease and turbulent flow in the
drifts. And, likely very dusty environment.

The drip shield transport gantry is not the
biggest piece of equipment in the project. The waste
package transport package is a very large beast. This is a
very large beast, itself, though. It operates in a
radioactive environment at 60 degree--or 50 degree
Centigrade, I'm sorry; that's a typo there. Remotely controlled by operators on the surface, self-propelled by 750 volt DC electric motors on each wheel from the third rail electrical source system. Moves on steel rails, weighs 45 metric tons, almost 50 tons, and is difficult to recover if it's inoperable in the drift.

Next one, please? This shows the tight clearances. This is a drift envelope. We've got a matter of inches here in this design in this corner. Another possibility is corroded steel rails after 100 to 300 years, difficult to detect, and a dusty environment. It's going to be difficult for these optics to work in.

Okay. This has since changed, but who knows, it may come back. This is a former pin arrangement, but it's not that different than the ridges and upsets in the interlocking system now. The idea here is that this has to be done remotely in a difficult environment and the tolerances are pretty tight.

Next one, please? The connection pins are locking. It's primarily intended to lock shields together mechanically to minimize separation during shaking from major seismic events. The pin connection is conveyed by the drip shield gantry by remote control, a dusty environment, and a very tight clearance envelope. No feedback mechanism instrumentation for verifying that successful interlocking has been obtained has been described. I think there was a brief mention of it in
yesterday's presentation, but nothing has been detailed on how this is going to be verified.

This shows the mating of drip shields and the pins. Unsuccessful is a difficult problem here with the clearances we've got. This gets misaligned. It probably should be shown at an angle rather than an offset. This is a difficult problem in this environment.

The tolerance with a pin connection in my brief review of the new locking mechanism, the ridge mechanism, it's a 1.2 degree longitudinal angular tolerance of—you can be off by 1.2 degrees, no more. That's pretty tough to do in this environment and this type of equipment.

Dust, numerous studies in industrial, mining, and military environments have demonstrated the difficulty of operator visual recognition in degraded visibility environments such as dust. And, NIOSH, the former Bureau of Mines, has a major research program in this area how to have operators work in dusty environments. Dust gets in the way of sight, it blocks your vision. It gets lit up by the lights blocking what's beyond it. It coats lenses and gets into the equipment.

Here's a picture I took on October 28th last in a stone mine in Indiana and this was a--why I even bothered to bring a camera in, usually I don't even bother because you can't see anything except for when you're right up to it. This is a picture looking from about 50 feet away of a piece of equipment that is scaling the ribbon roof of the
mine. This is what my camera ended up showing because all the dust is in the way. Very typical of what we have to deal with underground in an active mine. This mine is a damp mine, but as soon as this thing started operating, it started kicking up dust everywhere.

This is from an advisory committee on nuclear waste meeting from February of 2001. They're discussing, obviously, the conditions in the repository at the closure period. Let's just continue on. They're commenting that there may be as much as 300 years worth of dust accumulated before closure. And, noted from their observations in walking around the existing facilities, they would start out clean and end up covered up with dust. This is my experience underground almost universally. The excavation operations, drilling operations all generate dust. The rock itself will generate dust with each change in temperature and humidity and air pressure. Weather systems move in, the rock kicks off a little bit of dust. One mine I worked in in Illinois, a limestone mine, had dust six inches to a foot on the floor strictly from the atmospheric effects.

This is one for retrieval. It requires innovation and equipment development for a very difficult underground environment. I worked first on retrieval about 1978-1979 for the Nuclear Regulatory Commission. I used to use this cartoon a lot at that time. It shows an alchemist, 13th or 14th century, in his workshop with a
fully modern television set explaining it to his colleague, "But then I realized in order to make it work I'd have to have a socket and God knows what else." Just because you can conceive of something doesn't mean it's going to be easy to do. And, this is from "Magazine of Fantasy & Science Fiction".

Emplacement drift retrieval environment. After it was sitting for 50 plus years, it's 50 degrees Centigrade nominally. I believe I'd probably be experienced on that. A radioactive environment, ventilated at 15 cubic meters per second which is when the airflow is going to carry dust and you need to talk about filtering this airflow. The airflow will have dust in it because of the spacing of the waste packages or configuration in the drift. There will be turbulent flow and at-ease and low spots that will drop the dust out of circulation. It's a very dusty environment. You're likely to have corroded steel or copper electric third rail. There's going to be copper in this drift at the third rail or possibly mild steel. The rails are certainly mild steel. So, we've got a potentially corroded environment, as well, for power distribution and for transport.

This is the emplacement gantry and retrieval gantry, dual function. Remotely controlled, operates in a radioactive environment, in a 60 degree heating temperature environment, self-propelled by 750 volt DC electric motors on each wheel on steel rails.
This shows a problem similar to the drip shield gantry, very tight clearance system in the envelope of the drift. One thing I have not had a chance to fully investigate is the creep closure of the rock mass surrounding the drift that proposes the drift. Those 300 years, that's going to deform. I don't know whether it's been considered if it's going to deform sufficient to allow these clearances or the modification of equipment or the internal environment is going to have to be made.

I made a flow chart up, just too busy to put in here. But, at least, 23 distinct steps starting with drift inspection, verification conditions through getting the waste package out to the surface in order to achieve retrieval.

It's a pretty complicated situation.

Okay. The project, meaning Yucca Mountain Project, has identified abnormal scenarios; derailment of an emplacement gantry in an emplacement drift or a retrieval gantry, rockfall or emplacement drift major ground failure. I just don't want it to happen on a Monday morning.

Remember, these scenarios have to be dealt with and successfully accomplished in a very difficult environment of long time periods intervening since the last series of people living there. High temperature radioactive ventilation with dust coming in, tight clearances, dusty, settled in the ground, probably corroded
the ventilation. There's a very serious problem with hydroelectric tunnels and it blocks your ventilation and your water flow.

Next one, please? Okay. Here's the consequences of a major ground failure. Buried waste packages or gantries, blocked air flow, your heat is no longer dissipating, dangerous radioactive environment, rising temperatures. Tunneling in from adjacent drift or raised boring up from the ventilation level will be slow and difficult and final connection will have to be done remotely. Almost all of this has to be done remotely. This is where that cartoon comes in. If you invent the equipment to do all this, it doesn't exist.

Okay. Common problems to both the drip shield emplacement and retrieval. They're repository locomotives. This is not a show-stopper. They're constantly read in the project documents that the 50-ton class electric locomotives are what's going to be used. And, Improvement Equipment Corporation is cited as a source of these. They have never made a 50-ton locomotive. And, also, they no longer exist. They were liquidated and went out-of-business about five years ago. There's no non-coal rail-haulage mines in the United States that we can find. All operators have switched to continued belt haulage or trackless haulage. Even Henderson Molybdenum Mine in Colorado which had an 11 mile long haulage tunnel under the Continental Divide switched out to a belt conveyor a few
years ago. Pretty awesome to think about, an 11 mile long belt conveyor, but that's what everybody is going to.

Next one, please? Mining locomotives. The Yucca Mountain Project is probably the last market for heavy-duty mining locomotives. The only place to get them is Sweden by special order. That doesn't mean you can't get it. Like most equipment, it's all special order, special design, but it's not an off-the-shelf product. It never was an off-the-shelf product. Goodman has never made a 50-ton locomotive, another chief engineer now retired.

Next one, please? The retrieval locomotive, is has to go beyond the doors, the sealed doors, shielded doors, is hinted at being a 750 volt wet cell battery locomotive. 750 volt wet cell batteries don't exist. Above 300 volts, cell-to-cell arcing and creep occur. I tried to find a greater than 360 volt DC wet cell battery and you can't. The fuel cells and other technologies of these power levels are still in the very developmental stage. In Canada, I think, there's an 8-ton locomotive that works on fuel cells. You can run a 750 volt locomotive with a 350 volt battery which operates slow and with much less power. It won't be able to achieve its cycle times inner-plant. A wet cell battery discharges rapidly above 60 degrees Centigrade due to the lead-to-lead oxide chemical reaction that creates the power for the battery. That rapidly accelerates and the battery would completely discharge in a very short time.
Okay. Drip shield issues wraps us up. Titanium supply, achieving the drip shield interlock.

Next one? Retrieval issues. Retrieval under realistic expected environments needs to be looked into. Manipulating derailed gantries and other vehicles in tight clearances. Recovering waste packages from ground failures in tight clearances. Clearing ground failures remotely. Blocked ventilation causing heat rise before recovery and retrieval. Once that (inaudible) is blocked, the clock is running.

Common issues are the availability of locomotives, availability and performance of locomotive and batteries in this environment, steel rail corrosion, third rail corrosion and remote controlled optics and equipment operation in a dusty environment.

Okay. If these operations are integral to safety and licensing, there must be an up-front and credible plan and design using currently available technologies for how they are to be accomplished. We do not see such plans and designs in the project documents.

Okay, thank you.

GARRICK: Thank you very much, Frank. I think that the Board benefits a great deal from presentations such as this. I think on of the pieces of information that we don't get enough of is operational information and we'd like to very much see similar kinds of discussions and presentations having to do, for example, with the surface
facilities. I'm sure we would run into some of the same kinds of problems.

Are there questions from the Board? Andy, do you have a question?

KADAK: It was good. It was certainly good.

GARRICK: All right. Thank you.