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Chloride Sources

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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STAKEHOLDER WORKSHOP ON THE SECURITY AND CONTINUED

USE OF CESIUM-137 CHLORIDE SOURCES

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MONDAY

SEPTEMBER 29, 2008

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ROCKVILLE, MARYLAND

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The Workshop was held at the Bethesda  
North Marriott and Convention Center, Foyer C, 5701  
Marinelli Road, at 8:45 a.m., Lance Rakovan,  
Facilitator, presiding.

PANELISTS:

PANEL 1:

ALBERT ALOY

DAVID COPPELL

MARK MAIELLO

BRAD PATTON

JOHN SCHRADER

LYNNE FAIROBENT

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1 PANEL 1.2:  
2 LEONARD CONNELL  
3 JOHN FIKE  
4 JOSEPH KAMINSKI  
5 WILLIAM McBRIDE  
6 JOSEPH RING  
7 DAVID COPPELL  
8 GRANT NIXON  
9

10 PANEL 2:  
11 BILL FITZGERALD  
12 JED GORLI  
13 MARK SVAJGER  
14 RANDOL KIRK  
15 DEBBIE GILLEY  
16 ORHAN SULEIMAN  
17 STEPHEN WAGNER  
18 JOSEPH KAMINSKI  
19 WILLIAM McBRIDE  
20 JOSEPH RING  
21 KEVIN NELSON  
22 GRANT NIXON  
23  
24  
25

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1 ALSO PRESENT:  
2 COMMISSIONER PETER B. LYONS  
3 ROB LEWIS  
4 KEVIN CROWLEY  
5 JOHN JANKOVICH  
6 CYNTHIA JONES  
7 MICHELLE KILLIAN  
8 CHARLIE MILLER  
9 TOM MORGAN  
10 BLAIR MENNA  
11 LANCE RANKOVAN  
12 MARY SHEPHERD  
13 TOM WASIAK  
14 ORHAN SULEIMAN  
15 MOJI MOSHAASHAEE  
16 JERRY THOMAS  
17 LES JARDINE  
18 BRIAN POWELL  
19 ED GERSABECK  
20 RONALDO MINNITI  
21 PAUL MOSES  
22 MIKE RYAN  
23 GAMAL AKABANI  
24 PETER ZIMMERMAN  
25 JERRY THOMAS

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1                   STEVE ROGERS  
2                   STEVE FORASTE  
3                   BILL LIU

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P R O C E E D I N G S

(8:45 a.m.)

1  
2  
3 MR. RAKOVAN: Good morning everyone. I  
4 got a little bit of reaction there. My name is  
5 Lance Rakovan. I am a communications specialist at  
6 the Nuclear Regulatory Commission and it's my  
7 pleasure to facilitate this two-day workshop on  
8 cesium chloride. The main focus of the meeting, of  
9 course, is to have some discussions about the issue  
10 at hand. But before we start those discussions,  
11 there's a few presentations that we'd like to have,  
12 just to give a little bit of background on the  
13 subject.

14 Please note that we've extended the  
15 comment period for written comments from September  
16 30th to October 15th. The extension was published  
17 in the **Federal Register** last week. Copies of this  
18 **Federal Register** notice are also available outside  
19 on the registration table.

20 As I said, we're going to start the  
21 workshop with a few formal presentations. Following  
22 the presentations, we'll proceed to the roundtable  
23 discussions after a short break. We should be  
24 starting with the discussions around 10:15, 10:30,  
25 following Commission Lyons' address to the workshop.

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1           Again, at the registration table we had  
2           copies of the **Federal Register** notice and the  
3           agenda. There was also some copies of other  
4           materials, and a feedback form that you can fill out  
5           for us on our public meetings, if you'll just take a  
6           moment and fill that out today, or you can do it  
7           afterwards and drop it in the mail. It'll get to  
8           us, there's no postage necessary, and that gives us  
9           an idea of how we can improve these workshops.

10           So if you could take a moment to do  
11           that, that would be a great help to us. If there's  
12           not copies of all the presentations that you'll be  
13           seeing today, we plan to post them on the Cesium  
14           Chloride Workshop Web site following the meeting, so  
15           that you'll be able to see them after the workshop.

16           I'll be back again before we start the  
17           panel discussions, just to go over some ground rules  
18           and such, but at this point, the agenda for the  
19           morning, like I said, has some presentations, so I'm  
20           going to turn things over to Rob Lewis. Rob.

21           MR. LEWIS: Good morning everybody.  
22           It's always nice to have a big neutral zone between  
23           the speaker and the audience. I'm Robert Lewis.  
24           I'm the NRC's Director of the Division of Material  
25           Safety and State Agreements. Together with the

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1 Office of Nuclear Security and Incident Response,  
2 we're hosting this workshop. And welcome. It's  
3 NRC's Workshop on Security and Continued Use of  
4 Cesium Chloride Sources.

5 Now we do view those as two discrete  
6 topics as you'll see in the agenda, cause I think  
7 continued use or phaseout, or alternative  
8 technologies need to be considered, together with  
9 additional security measures that might be  
10 complementary or achieve the same end objective.

11 Thank you, first of all, from NRC, for  
12 preparing for this workshop and for your  
13 participation in this workshop, especially those  
14 roundtable participants and those that have traveled  
15 some distance, including international travelers.

16 We have collected here today, I think a  
17 wide-ranging set of expertise, and participants that  
18 can speak authoritatively on cesium chloride, its  
19 uses, and the impacts of any changes to its uses.

20 We have people from industry, the  
21 source-manufacturing industry, device manufacturing  
22 industry, the medical industry, including doctors  
23 and administrators of hospitals, research  
24 facilities, calibration licensees. We have  
25 representatives from government, from Federal

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1 Government as well as state government. Several  
2 different agencies across the Federal Government are  
3 working on cesium chloride issues.

4 We have representatives from  
5 nongovernment organizations, and I particularly want  
6 to thank the National Academies for being here  
7 today. Much of what we're doing here today is  
8 resulting from recommendations they made in a report  
9 earlier this year.

10 And we have I think also some  
11 international participants. So thank you, again,  
12 for traveling so far, and for your interest in this  
13 topic, and congressional staff interest as well.

14 The participation reflects the  
15 importance of this subject. If not approached  
16 properly, I firmly believe that this activity has  
17 the potential to impact the lives of patients in  
18 hospitals, and also the way we do business in  
19 research, in calibration.

20 I would like to use my time to talk  
21 about NRC would like to accomplish from this two-day  
22 workshop, and also describe a little bit about how  
23 we got to this point.

24 In terms of what NRC would like to  
25 accomplish, this is a workshop, it's not a seminar

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1 or a conference where we just have speakers come, a  
2 procession of speakers, very informative maybe, but  
3 this is a workshop where we are depending upon  
4 active participation to get views.

5 I think, as I mentioned earlier, this  
6 audience is very unique, and probably never been  
7 assembled before--the expertise and knowledge of the  
8 uses of cesium chloride that is in this room right  
9 now. And your participation of course is essential  
10 in all of the topical areas. We want to  
11 specifically hear what you perceive to be the  
12 impacts of phasing our cesium and replacing it in  
13 the future, for future devices, but also phasing out  
14 cesium chloride and its use for existing devices and  
15 replacing those devices with alternatives, be they  
16 different sources, different types of source such as  
17 cobalt, different form, chemical forms of cesium or  
18 different technologies such as x-ray.

19 We also want to brainstorm alternatives  
20 on security of cesium chloride. We have increased  
21 security of these sources in their settings, quite a  
22 bit in the last several years, and we're at a point  
23 where we have a great deal of experience in what the  
24 security has done, and it's time to reflect, I  
25 think, upon how to improve that, perhaps as an

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1 alternative to replacing the existing sources.

2 It's also fair game to say that the  
3 security that we have is adequate. So if that's  
4 your opinion, let us hear that.

5 Now as the regulator, we don't have all  
6 the answers here. We have been charged, I think,  
7 with looking into alternatives as a regulatory  
8 action, but we don't have the experience in the use  
9 of the material or the experience as licensees, or  
10 even as members of the public, that is necessary to  
11 bear upon what would be the impacts of phasing out  
12 such long-standing successful devices that have real  
13 impacts upon people's health and safety, and  
14 research, and the value of research.

15 No one group has those answers. In  
16 preparing for this workshop, we've talked to many of  
17 you individually, and I guess I would characterize  
18 those discussions as everybody has their own little  
19 anecdotes about whether x-rays or cesium chloride is  
20 better, better in a business sense, better in a  
21 technological sense. You know, all kinds of  
22 anecdotes. Anecdotes about research that had been  
23 done several years ago to replace them, and whatever  
24 happened to that research.

25 What we need, though, for regulatory

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1 decisions is not anecdotes but a collective  
2 consensus of the impacts. Regulatory impacts to  
3 safety, to security, and to cost, and to the  
4 environment.

5 Let me turn, briefly, now, to how we got  
6 to this point.

7 Cesium chloride is of course a salt.  
8 It's a powdery salt that is compressed and formed  
9 into sealed sources, and used in large-curie  
10 quantities, primarily in blood and research  
11 irradiators, also calibration irradiators throughout  
12 the world.

13 There is one manufacturer currently of  
14 cesium chloride in Russia, and it produces the  
15 world's supply, and then the sources are then sent,  
16 manufactured and sent to device manufacturers of  
17 various types.

18 There's three main vendors of the  
19 irradiators in the U.S., but again, it is used  
20 worldwide. Cesium chloride is a highly-dispersible  
21 salt and it's very soluble. So in a lot of ways,  
22 even putting security aside, it's not an ideal  
23 material to make sources from, and, in fact, there  
24 have been, over the years, many studies on replacing  
25 cesium chloride, especially after the incident in

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1 Goiana, Brazil, in the late '80s, when a cesium  
2 chloride source was taken apart by some local people  
3 and some very serious health effects occurred.

4 That really started the IAEA down the  
5 road of looking at source safety and security, and  
6 of course then we had the terrorism attacks of 2001,  
7 which put additional focus on the security aspect.

8 That all resulted in development of the  
9 Code of Conduct for sources, and the NRC has used  
10 the Code of Conduct with the rest of the U.S.  
11 Government to establish levels of security which  
12 need increased controls.

13 The increased controls orders were  
14 issued in 2005 to all the NRC licensees and to the  
15 Agreement State licensees around the country for  
16 large-curie quantities of cesium chloride. So blood  
17 irradiators and research irradiators essentially all  
18 got the increased controls requirements.

19 Those have substantially increased  
20 security of the material, looking mainly at the  
21 facility aspects and the personnel that use the  
22 material, and providing security features to ensure  
23 that the material is used properly and accounted  
24 for.

25 Cesium chloride is, as I said, a part of

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1 the Code of Conduct and it's one of the many  
2 nuclides listed in the Code of Conduct. The Code of  
3 Conduct and source security measures were developed  
4 using a public health and safety perspective from  
5 the point of view of avoiding prompt fatalities from  
6 radiation injury.

7           So cesium chloride, in a way, is treated  
8 like all other nuclides on that framework. There  
9 are those who believe that cesium chloride, because  
10 of its dispersibility and solubility, deserve  
11 additional treatment, additional treatment from a  
12 security perspective, not necessarily because a  
13 certain curie amount could result in some kind of  
14 fatalities from radiation industry but from costs of  
15 cleanup, or contamination spreading. And socio-  
16 economic issues associated with any terrorist using  
17 cesium chloride.

18           The chemical form of the material being  
19 very soluble and dispersible, in those people's  
20 minds, puts it on a different frame of reference  
21 than the traditional frame of reference in the Code  
22 of Conduct.

23           So that's kind of why we're here today,  
24 asking whether the increased controls which do  
25 provide security in the frame of reference of

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1 safety, health and safety and prompt fatalities,  
2 also provide adequate security from the  
3 dispersibility aspect.

4 And the Energy Policy Act of 2005  
5 established several activities to look at that very  
6 issue. The first is the task force. It's called  
7 the Energy Policy Act Task Force, which we'll hear  
8 about. One of the co-chairs of a working group of  
9 that task force, John Jankovich, is going to do a  
10 presentation on their study.

11 Basically the task force owed a report  
12 to Congress in 2006, produced that report which  
13 said, essentially, that cesium chloride needs an  
14 additional look.

15 The National Research Council of the  
16 National Academies was also chartered by the 2005  
17 Energy Policy Act to produce a study on alternative  
18 technologies to radiation sources. They did produce  
19 that study earlier this year, and Dr. Kevin Crowley  
20 from the National Academies is here, and is the next  
21 speaker, actually, to talk about what they found.

22 In their study, they zeroed in a lot on  
23 cesium chloride, and in a lot of ways, their  
24 recommendations in their study is consistent with  
25 the findings of the Energy Policy Act Task Force,

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1 which I neglected to mention, the Energy Policy Act  
2 Task Force is made up of 14 different federal  
3 agencies, plus two state organizations.

4 More recently, in the last year, the  
5 Department of Energy, and the Department of Homeland  
6 Security, in cooperation with the NRC, has started a  
7 project to look at a hardening existing cesium  
8 chloride irradiators around the country. We issued  
9 a regulatory information summary, announcing that  
10 project. We have members of the National Nuclear  
11 Security Administration which is part of DOE here  
12 today, and also the Domestic Nuclear Detection  
13 Office, which is part of DHS, here today, to talk  
14 about those studies.

15 If anybody's interested, I can identify  
16 the contacts to you. Those studies, as I said, the  
17 increased controls are focused more on the facility  
18 and the users. The hardening efforts by those two  
19 agencies are focused on hardening the actual devices  
20 to prevent a delay in the amount of time it takes to  
21 remove the sources from those devices.

22 And we are all working together as a  
23 federal agency, in the last year, more so than ever.

24 Let me conclude by quickly mentioning  
25 how we're going to go about moving forward.

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1                   We have taken several actions at NRC.  
2                   We have accelerated our inspections of the cesium  
3                   chloride blood irradiators at hospitals. We expect  
4                   to conclude all of our initial increased controls  
5                   inspections at our licensees this month.

6                   We have visited all the vendors at their  
7                   sites and talked to them about how they have  
8                   considered, in the past, alternatives to cesium  
9                   chloride sources, whether it's a ceramic form or  
10                  glass form, and if a source was produced, would it  
11                  fit, would it physically fit in their device? Could  
12                  it easily be replaced? Those kinds of questions.

13                  Those vendors are here today, so we've  
14                  kind of seeded the ideas with them of what we're  
15                  looking for in the workshop, and I hope they'll  
16                  participate in the workshop today.

17                  The Energy Policy Act Task Force, Cesium  
18                  Chloride Working Group, is delivering their product  
19                  to the task force this week, and the task force will  
20                  then take that product and the task force owes a  
21                  report to Congress in 2010, but having the Working  
22                  Group product, if the task force were to endorse it,  
23                  the NRC would take the recommendations from that  
24                  Task Force Working Group and bring those up to the  
25                  Commission where any policy issues were highlighted.

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1           The irradiator-hardening effort started  
2           in earnest in the last month or so, and we'll be  
3           working together with NMSA and DNDO to go out to the  
4           sites and to implement hardening efforts on the  
5           irradiators. In conjunction with those hardening of  
6           irradiators, which is no cost to the industry, by  
7           the way, it's all paid by the Government--in  
8           addition to the hardening efforts, while the NMSA  
9           and DNDO people are on site, they are offering  
10          security-assist visits, where some security experts  
11          can provide advice on how to improve security.  
12          Many, many different angles.

13                 One thing about this materials industry  
14          that's different from maybe the reactor industry is  
15          the amount of communication between licensees is  
16          very limited.

17                 So the reactor industry, I think they  
18          all line up behind how to do security, and materials  
19          industry, it's not conducive to that, first of all,  
20          because of the disparate types of activities that  
21          occur.

22                 But even among hospitals in a particular  
23          city, it may not be communicating how to do  
24          radioactive material security. Maybe they  
25          communicate neonatal security, or something. But we

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1 have to do some international outreach, going  
2 forward, as well. As I said, there's one producer  
3 of this material for the Free World, and that  
4 producer, any impacts, anything that we do in the  
5 U.S.--we have a session about this tomorrow--we  
6 certainly don't want to inadvertently cause security  
7 to be decreased by--for example, when teletherapy  
8 units in the U.S. became no longer economical to use  
9 in the U.S. for medical purposes, teletherapy units  
10 were shipped to developing countries.

11 In fact, Goiana, Brazil happened  
12 because of that type of situation. So we don't want  
13 to create that type of situation and we need to  
14 consider the international angle of this business sa  
15 well.

16 All of this that I've been mentioning  
17 about how we're going forward, is going to be  
18 produced in a Commission paper. In the November  
19 timeframe we owe the Commission options. The  
20 feedback from this workshop is the keystone of those  
21 options we're going to tell the Commission, because  
22 we can come up with options today, but what we can't  
23 come up with, without your help, is the impacts of  
24 all those options.

25 So we look forward to a productive two

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1 days and thank you for your attention.

2 [Applause]

3 MR. RAKOVAN: Our first presentation  
4 will be given by Kevin Crowley of the National  
5 Academy of Science.

6 DR. CROWLEY: Well, good Monday morning,  
7 everybody. I notice everybody's a bit subdued this  
8 morning. People aren't quite awake yet.

9 My name is Kevin Crowley. I'm the  
10 director of the Nuclear and Radiation Studies Board  
11 at the National Research Council of the National  
12 Academies.

13 I'm actually here today as a substitute.

14 My colleague, Dr. Micah Lowenthal, was the study  
15 director for this project, but unfortunately, he  
16 couldn't be here today. He's in Vienna because  
17 we're releasing another report on international fuel  
18 cycles.

19 So if it looks like I'm reading the  
20 notes, I am reading the notes. There are some  
21 points that Micah asked me to be sure that I made as  
22 we went through the slides, and so I will try to do  
23 that.

24 I also want to point out that, as I will  
25 tell you in a minute, the work that I'm about to

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1 describe was done by an expert committee that was  
2 appointed by the National Research Council. There  
3 are at least three members of the committee here  
4 today. I won't be with you for the full workshop  
5 but they will so. So I want to introduce them to  
6 you, and if they wouldn't mind standing up.

7 Steve Wagner from the American Red  
8 Cross. Ruth McBurney who is now the--is it the  
9 executive director of the CRCPD? Okay. And I  
10 understand that Len Connell is here. Len is from  
11 Sandia National Laboratories.

12 So if you have questions or feedback on  
13 the report, those are the three individuals that you  
14 would want to talk to during the workshop.

15 Okay. Well, let me start this by saying  
16 that what I'm about to describe was requested by the  
17 United States Congress. The study was requested by  
18 the United States Congress in the 2005 Energy Policy  
19 Act. I will show you the Statement of Task for that  
20 in a second. As we do for all requests that we get,  
21 whether they're from Congress or a federal agency,  
22 we put together an expert committee to do the study,  
23 and I will show you the roster for the committee at  
24 the end of this presentation.

25 But I wanted to let you know that the

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1 study was chaired by Dr. Ted Phillips, who is a  
2 distinguished radiation oncologist at the University  
3 of San Francisco. He's also a member of the  
4 Institute of Medicine.

5 And the other experts on the committee  
6 were from a number of different fields, including  
7 accelerator physics, radiation protection and  
8 regulation, medical physics, nuclear security, blood  
9 pathogen research, material science, nuclear  
10 engineering and public policy.

11 So we had a very broad committee that we  
12 brought together to do this study. Next slide,  
13 please.

14 Here is the study task, and I'm going to  
15 read this to make sure that we all understand what  
16 it was we were asked to do.

17 We were asked to look at current  
18 industrial research and commercial, including  
19 medical, uses of radiation sources, and identify  
20 uses for which the radiation source can be replaced  
21 with an equivalent or improved process that does not  
22 require the use of radioisotopes, or can be replaced  
23 with another radiation source that poses a lower  
24 risk to public health and safety, if it is involved  
25 in an accident or a terrorist attack.

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1           The study should explicitly consider  
2           technical and economic feasibility and risk to  
3           workers from such replacements, and I want to make a  
4           couple of important distinctions about this task.

5           We were asked to look at potential  
6           replacements. We were not asked to look at security  
7           enhancements. Now obviously that is something that  
8           the Nuclear Regulatory Commission has to do as part  
9           of its mission. That was not something that  
10          Congress asked us to do.

11          The other thing that we were asked to do  
12          was to look at high-risk radiation sources, which  
13          are the IAEA Category 1 and Category 2 sources, and  
14          in terms of cesium, because I know that's the  
15          radioisotope of interest in this workshop, a  
16          Category 2 source contains between 27 curies and  
17          2700 curies of cesium, and a Category 1 source would  
18          be anything larger than that. Next slide.

19          So what I want to do is just give you  
20          the main messages from the report and then I want to  
21          talk about the cesium because that's of interest in  
22          this workshop, and then I will backtrack and talk  
23          about some of the other recommendations.

24          So here are the main messages from the  
25          report. They're sort of a mixture of findings and

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1 recommendations. Applications of radionuclide  
2 sources are important and beneficial. Area denial  
3 and its costs must be considered in the evaluation  
4 of security risk from these sources.

5 Nonradioactive replacements exist for  
6 nearly all radionuclide sources. However, not all  
7 of these are practical or economically attractive  
8 now, but most are improving. There's a need to take  
9 actions to implement near-term replacement of cesium  
10 chloride sources, and here I want to make an  
11 important distinction.

12 Replace cesium chloride sources. It  
13 does not say replace cesium. Okay. And finally,  
14 adopt policies that provide incentives to replace  
15 other Category 1 and 2 sources. Next slide.

16 So let's now turn to some of the  
17 messages in the report about cesium chloride  
18 sources.

19 Really, two main messages. Because of  
20 its characteristics and where the sources are  
21 located, radioactive cesium chloride is a greater  
22 concern than other sources for some attack  
23 scenarios. Rob Lewis talked about some of the  
24 characteristics of cesium chloride that make it a  
25 concern--its dispersibility, solubility, penetrating

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1 radiation, the high source activity for many of the  
2 cesium chloride sources in use today, as well as its  
3 presence across the United States in facilities such  
4 as hospitals, blood banks and universities, many of  
5 which are located in large population centers.

6 This fact is made worse by a lack of a  
7 permanent avenue for disposal of these sources.

8 That is, there are some disused sources that are  
9 sitting in licensee storage facilities and there's  
10 really no pathway for disposal of these sources.

11 Next slide. So here is the recommendation that was  
12 made.

13 It says that in view of the overall  
14 liabilities of radioactive cesium chloride, the U.S.  
15 Government should implement options for eliminating  
16 Category 1 and Category 2 cesium chloride sources  
17 from use in the United States, and to the extent  
18 possible, elsewhere.

19 The committee had three options for  
20 achieving this. First, discontinue licensing of new  
21 sources. Second, put in place incentives for  
22 decommissioning existing sources, and third,  
23 prohibit the export of cesium chloride sources to  
24 other countries except for the purposes of disposal  
25 in an appropriate licensed facility.

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1 Rob Lewis mentioned to you the lessons  
2 learned from the cobalt irradiators. The committee  
3 took that lesson in making the recommendation about  
4 not exporting cesium chloride sources.

5 The committee recognized that current  
6 users and owners of cesium chloride sources might  
7 need incentives to decommission their existing  
8 sources because many of them still have value, and  
9 of course there are fairly high decommissioning  
10 costs.

11 The report provides some options for how  
12 this could be achieved. For example, buying out the  
13 remaining present value of sources, or changes to  
14 DOE's offsite source recovery project's policy.  
15 Okay. Next slide.

16 Let me now turn to some of the other  
17 messages in the report.

18 These are not necessarily directly  
19 relevant to cesium chloride. The committee noted  
20 that there are approximately 55,000 Category 1 and 2  
21 sources in 5000 devices, and that the sources have  
22 very important uses for cancer therapy,  
23 sterilization of medical devices, irradiation of  
24 blood in laboratory animals, nondestructive testing  
25 of structures and equipment, and exploration for oil

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1 and gas.

2 And so the committee's recommendation  
3 was that replacement of radionuclide sources with  
4 nonradionuclide radiation generators should be done  
5 with caution.

6 There's a bit of a, what I might call "a  
7 ying and a yang" in this report. The community is  
8 saying proceed cautiously. On the other hand, the  
9 committee is saying you really need to replace  
10 cesium chloride. So there's a certain tension in  
11 the report that I want you to be aware of.

12 I would point out that the committee is  
13 made up of experts from fields that use radiation  
14 for the benefits of society, and many of those  
15 members use radiation in their own activities, and  
16 so there was a lot of discussion within the  
17 committee about how far they really wanted to push  
18 on replacements, including replacements for cesium  
19 chloride.

20 But in the end, I think the committee  
21 felt that action was, needed to be taken on cesium  
22 chloride. Next slide.

23 And some of the reasons for that are  
24 shown in this slide. Security and safety risks  
25 motivated the request for the study, and as Rob

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1 pointed out, radiation sources, including cesium  
2 chloride sources, can pose significant risk to  
3 individuals but are unlikely to cause deterministic  
4 health effects to large numbers of people.

5 The committee concluded that the widest-  
6 ranging and most long-lasting consequences from, for  
7 example, a terrorist attack, would be economic and  
8 social disruptions, not large numbers of individuals  
9 dying, and the economic and social disruptions would  
10 come from contamination that leads to denial of  
11 areas, of land areas.

12 The committee noted that the IAEA source  
13 categories, like Category 1 and 2 that I told you  
14 about earlier, are based primarily on deterministic  
15 health effects, that the Nuclear Regulatory  
16 Commission and Department of Energy have looked at  
17 contamination criteria, but the committee concluded  
18 that those criteria, at their present state of  
19 development, were not adequate.

20 The USNRC and DOE looked at  
21 contamination, asked the question, Could a source  
22 contaminate a half-a-square mile kilometer area  
23 above the threshold that requires cleanup? But the  
24 committee noted that for some sources contamination  
25 could be much greater than half-a-square kilometer,

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1 and the committee recommended that the NRC and DOE  
2 take the next step, and consider the area source a  
3 radioactive source, potential to cause area denial.  
4 Next slide.

5 The committee noted that lower hazard  
6 replacements exist for nearly all applications of  
7 Category 1 and Category 2 sources. However, at this  
8 time not all of the replacements are necessarily  
9 practical or economically attractive. But most of  
10 them are improving and many of them are viable now,  
11 and there are a number of examples in the report of-  
12 -in fact there are several chapters in the report,  
13 that go into some detail about potential  
14 replacements.

15 For example, particle accelerators can  
16 be signed to operate as radiation generator  
17 replacements. In some cases, such as self-shielded  
18 radiators, which I know is a concern to this group,  
19 x-ray tubes can replace some sources.

20 Contract irradiators already use E-beam  
21 irradiation for some applications, and an x-ray  
22 facility could be a feasible replacement for cobalt  
23 60 gamma irradiation in some cases.

24 Linear accelerators for radiotherapy  
25 have already replaced cobalt-60 teletherapy devices

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1 in the United States, except for the gamma knife,  
2 and LINAC vendors are trying to penetrate that  
3 market as well.

4 The development of new technologies,  
5 especially in some areas of ultrasonics and x-ray  
6 sources, has provided alternatives to gamma  
7 radiography for nondestructive investigation.

8 Neutron well-logging tools that use  
9 americium beryllium sources are beginning to see  
10 competition from accelerator fusion sources in  
11 californium-252 sources. There are alternative  
12 radionuclides for cesium chloride. Cobalt-60 can  
13 sometimes be used in the place of cesium, and  
14 alternative material forms such as metals, oxides,  
15 and minerals, rather than salts. Specifically some  
16 alternatives to radioactive cesium chloride include  
17 radioactive cesium glass, and a mineral form of  
18 cesium, pollucite. Next slide.

19 The committee recognized that these  
20 replacements probably would not take place without  
21 some government incentives. So the committee  
22 recommended that the U.S. Government should adopt  
23 policies that provide market, regulatory, and  
24 certification type incentives to facilitate the  
25 introduction of replacements and reduce the

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1       attractiveness and availability of high-risk  
2       radiation sources. And again, there's a fairly in-  
3       depth discussion of some of the possible incentives  
4       that could be adopted.

5                 For example, making licensees bear more  
6       of the full life cycle costs of radiation sources,  
7       particularly for disposal of cesium chloride and  
8       americium-241 sources.

9                 Revising the requirements for  
10       decommissioning funds for Category 1 and 2 devices,  
11       to increase the up-front costs for higher-hazard  
12       sources.

13                I mentioned this earlier. To enhance  
14       DOE's offsite source recovery project, to include  
15       the buy-back of devices that still have use value,  
16       provided that the devices are replaced with lower  
17       hazard devices.

18                And of course the Government could  
19       impose charges on all sources, or just new sources  
20       based on hazards or risks.

21                These are options for government  
22       agencies to consider, and I want to make an  
23       important point here, which is we are a private not-  
24       for-profit congressionally-chartered organization.  
25       We are an advisory organization. We do not make

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1 public policy. The committee has made  
2 recommendations to the government. It is not up to  
3 the government to determine whether and how it  
4 should implement those recommendations. And then my  
5 final slide.

6 Just in closing, this is the committee  
7 roster. These are the committee members who carried  
8 out this study. Thank you very much for your  
9 attention.

10 [Applause]

11 MR. RAKOVAN: Thank you, sir. And we  
12 apparently have about 75 copies of the study on the  
13 registration table. So get them while they last.

14 Our final presentation before we take a  
15 quick break is by John Jankovich from the NRC, who's  
16 going to be going over the Cesium Chloride Working  
17 Group overview and general conclusions.

18 MR. JANKOVICH: Good morning. I am here  
19 to present you an overview of the report, and I will  
20 describe the relationship here of the group who  
21 prepared it, the Cesium Chloride Working Group, and  
22 they prepared it for the Radiation Source Protection  
23 Security Task Force.

24 And as you notice, I am with the Nuclear  
25 Regulatory Commission as co-chair of this Working

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1 Group. The other co-chair is Dr. Brendon Plapp from  
2 the State Department. He's also here with us today.

3 A little background, and to put things  
4 into perspective, I like to say a few words, how  
5 this Working Group came about. We all go back to as  
6 far as 2005, act of Congress established the task  
7 force, Security and Protection Task Force, and  
8 Congress also assigned the task force to write a  
9 report by 2006. That report was delivered to the  
10 president and Congress in August of 2006.

11 And one recommendation of that report is  
12 about my Cesium Chloride Working Group, specifically  
13 Recommendation 12-2, and this is a quote--important.

14 It says there should be a Working Group  
15 and the Working Group should assess feasibility and  
16 phasing out of cesium chloride in highly-dispersible  
17 form.

18 This is a clear assignment and it has  
19 three elements. I want to emphasize it because our  
20 report, what we produced, clearly addresses these  
21 assignment, specifically the--go back a second.

22 We produced a study to assess  
23 feasibility for phasing out cesium chloride in  
24 highly-dispersible form. So when I come to the  
25 conclusions, please note, that's what we are

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1 addressing here.

2 And let's go then to the next one,  
3 please. I like to point out, really, how we came  
4 about producing this report, and on this Working  
5 Group there were ten government agencies involved,  
6 because the scope of the work goes beyond the NRC.

7 And in addition, of course as you know,  
8 the NRC in the agreement states regulate nuclear  
9 material in partnership with each other. Therefore,  
10 we had a representative from the Organization of  
11 Agreement States on our Working Group. There were a  
12 total there of 33 people working on it. We began our  
13 work at the start of last year, in January, and we  
14 finish this year in August, and we worked, meeting  
15 for worktr sessions, every month on the average.  
16 That means we were not just talking. We were  
17 working on the report.

18 And we also didn't want to produce a  
19 report which comes from an ivory tower. So once we  
20 established the major issues to be addressed, we  
21 prepared a white paper to outreach to stakeholders.

22 And this white paper was presented to  
23 the government and industry sector, coordinating  
24 councils. We asked them to distribute the white  
25 paper to their members and give us comments. We did

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1 receive a number of comments, in writing, and those  
2 are collected in one appendix of our report.

3 And we submitted our report to the task  
4 force on September the 12th. I'd like to say a few  
5 words about it.

6 Our due date was the end of August. We  
7 were late only 12 days. Considering the complexity  
8 of the issues, how many agencies were involved, how  
9 many individuals were involved, I don't think it's  
10 too much of a delay. Many of us who have some home  
11 improvement projects going, we would be happy with a  
12 12 day delay only as you know.

13 However, let's go back, be serious  
14 again. This report is official use, for the  
15 official use at the moment, and the recipient of the  
16 report, the task force itself, hasn't briefed about  
17 this one. But the task force members and the NRC  
18 thinks that the work is of sufficient importance for  
19 this workshop, and also not just that the report is  
20 important. This workshop is important. That's why  
21 the decision was made to present the results here,  
22 even before the task force itself hears it.

23 One more comment, please. That this is,  
24 the report is a product of these individuals. They  
25 are technical experts in their field. They don't

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1 represent agency points of view from those ten  
2 agencies, plus the Agreement States. And this is  
3 one mosaic in the overall picture that Rob Lewis has  
4 presented earlier this morning. NRC, other  
5 government agencies, have many initiatives going on,  
6 and this is just one element, one mosaic in the  
7 overall picture. Next.

8 I want to put our report into  
9 perspective for you, and these are the caveats,  
10 these are the limiting conditions, what you should  
11 consider.

12 First of all, our assignment was  
13 primarily to address the domestic use. We have some  
14 comments on international use. You will see that  
15 later.

16 We restricted our considerations to our  
17 Category 1 and 2 sources, and dispersible and  
18 soluble form. Again, I want to add one more point  
19 of view to what we have heard from the National  
20 Academies. This form, what is used in the present  
21 time, the physical form, is like the Tic-Tac candy,  
22 compressed powder, which is dispersible and soluble.  
23 That's the issue. That's what we want to solve.

24 And as we proceeded in our work, it  
25 became clear at the beginning, that there are

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1 various applications for the use of cesium chloride  
2 sources. They differ by the purpose, how they are  
3 used. They differ by the activity level. They  
4 differ by the facilities who are using them.

5 Therefore, we made the distinction,  
6 clear distinction for research irradiators, blood  
7 irradiators, and calibrators. And when we come to  
8 our conclusions, we have this graded approach to the  
9 conclusions.

10 One resolution doesn't fit all these  
11 modes of applications, that's what I want to  
12 emphasize, there are different modes, and the  
13 solution to the problem also differs according to  
14 these modes of application.

15 In our work we of course looked at the  
16 current regulations. There are administrative and  
17 physical requirements for security at the moment.  
18 There are import/export regulations.

19 We were aware that the National  
20 Academies produced its report. I want to put again  
21 our work in perspective to the work, what the  
22 National Academy has done. They had a much broader  
23 assignment. As we have heard, they were to address  
24 all users of radioactive materials and sources.

25 Here, we are limited only to cesium

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1 chloride. Even their final conclusions had a number  
2 of suggestions about cesium chloride. We focused  
3 only on this one isotope.

4 Now here we come to the point, how we  
5 did our work. We developed a number of options. It  
6 ranged from no action to complete ban. And we  
7 reviewed and developed pros and cons, and  
8 consequences for all these options.

9 Based on that, we went through a  
10 screening process. Next slide, please.

11 Here, for using the proper word, I am  
12 showing words considerations to reach conclusions.  
13 These are the filters, the weighing factors of what  
14 we used for each of those options. And these  
15 factors are grouped into key considerations and some  
16 additional factors.

17 Of course the key considerations are  
18 focused on improving security, because that's the  
19 purpose of our work here. And we realized from the  
20 beginning, that there is competition between the  
21 beneficial use of this isotope versus the security  
22 requirements, and we had to overcome that.

23 And then let's define alternative  
24 technologies. This was also one heavy weighing  
25 factor in our analysis, and for the purpose of our

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1 report, we defined alternative technologies, you  
2 know, in different physical form. Less soluble,  
3 less dispersible, or in other isotope like cobalt,  
4 or completely new technology, just as we have heard  
5 from the Academies' presentation. That's  
6 alternative technologies.

7 And for each of those options they  
8 reviewed safe and security disposal questions. In  
9 addition, of course there are other factors. When  
10 to introduce any change. That's very important.  
11 How to apply those changes to the various modes of  
12 application, and there could be incentives by the  
13 government to facilitate the process.

14 We looked at the transportation issues.  
15 Transportation is important for a number of  
16 reasons. As we know, there are no, sufficient  
17 number of transportation packages for these large  
18 activity sources at the moment, and the costs are  
19 also very significant, and our Working Group  
20 recognized that.

21 We looked if education and information  
22 campaigns could facilitate the process. This is not  
23 just for the public but also information campaign  
24 for the professional community like us here in this  
25 room.

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1           If everybody sees the goals clearly, and  
2 sees the way to reach that, we can be much more  
3 effective than otherwise. We analyzed the role of  
4 the government for all these options, what are the  
5 consequences, what are the costs.

6           Regarding the costs, we came up with an  
7 itemized list of cost element, and we came up with  
8 some estimated dollar values for all of those.

9           Results. I'd like to sum up here the  
10 overall conclusions, and please note that this one  
11 slide expresses, in condensed form, the total  
12 findings of our Working Group.

13           So a week from now, if somebody asks you  
14 what were the findings of the Cesium Chloride  
15 Working Group, what their report contains, think of  
16 this, and I like to point out here what these  
17 results are.

18           Again, our assignment was assessment,  
19 feasibility, cesium chloride dispersibility. So we  
20 say immediate phase-out would not be feasible.  
21 That's our conclusion. Because there are so many  
22 factors involved, and timing and consequences are  
23 very crucial.

24           However, stepwise phaseout, again I say  
25 phaseout, in other form, could be feasible. Another

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1 conclusion. How we go about it. The goal here  
2 challenges would have to be overcome. Challenges in  
3 plain language, I would say are the preconditions  
4 that must be in place before stepwise phaseout or  
5 other phaseout could be implemented. And I talk a  
6 little bit about these challenges.

7           Sufficient time is needed till  
8 replacement technologies, which are well-established  
9 and broadly usable, are available. And then  
10 disposal pathways must be available. So for  
11 stepwise phaseout, or other phaseout, these things  
12 are crucial.

13           And these preconditions cannot be placed  
14 randomly, they have to be in a sequence, and then  
15 sufficient time must be given to them. And then in  
16 the meantime, the interim security measures are very  
17 important.

18           That slide presented the overall  
19 conclusions. However, we went further, and we  
20 provided step by step methods for the task force to  
21 follow up, if they choose to. We call that the  
22 Recommended Path Forward, and these six elements are  
23 the major avenues that must be implemented to  
24 achieve our goal.

25           I'd like to say a few words about each

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1 one of them.

2 One is the Working Group concluded that  
3 we need to continue the security upgrades to  
4 supplement the existing requirements, and then  
5 establish a process for determining additional  
6 upgrades and the need for them. As you know, the  
7 Department of Homeland Security and Department of  
8 Energy are implementing this voluntary initiative to  
9 have a hardening project, and we encourage that.

10 But in addition, we put here kind of  
11 administrative term. Need establish a process.  
12 that means the government should establish a process  
13 to continually evaluate the risks and take  
14 appropriate action, if needs.

15 Our recommendation two, initiate  
16 rulemaking or other processes. This is very  
17 important, because the Commission has other means to  
18 achieve the goal, and, for example, issue a policy  
19 statement or something like that. And the objective  
20 of this process should be to eliminate further  
21 licensing or ban the exports. These two functions  
22 must go together.

23 Furthermore, we recommend that there is  
24 need to develop a government-facilitated disposal  
25 pathway. This is one of the most critical elements

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1 in the overall approach, because there is no  
2 transportation package. There is no commercial side  
3 where to take these sources. And we don't recommend  
4 interim mass storage, because transportation to that  
5 site involves risk. Storing a large number of  
6 sources at a site involves risk. Further  
7 transportation creates further risks.

8 We recommend to implement incentives in  
9 a prioritized fashion, either for phasing out, or  
10 obtaining replacement technologies.

11 We also support short-term and long-term  
12 research, and because the alternative technologies  
13 are not commercially available on a large scale,  
14 they may not achieve the same purpose as the present  
15 technology.

16 And finally, we make some comments,  
17 quite a few comments about the international  
18 considerations. Most of us who are working here in  
19 the U.S. are not aware what the U.S. can do  
20 internationally, and whatever decision, rule or  
21 requirements we put in place here, will have  
22 implication on other countries.

23 And having the State Department on the  
24 Working Group was most useful, and we have a long  
25 list of considerations for the international

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1 considerations. Thank you.

2 [Applause]

3 MR. RAKOVAN: We're going to take a  
4 quick break and let you stretch your legs, probably  
5 get started here about 9:55.

6 (Whereupon, the proceedings in the  
7 foregoing matter went off the record at 9:39 a.m.  
8 and went back on the record at 9:59 a.m.)

9 FACILITATOR RAKOVAN: Welcome back.  
10 We're going to do a quick swap in the agenda real  
11 quick. I'll be going over the ground rules right  
12 before we start the discussions, but first we're  
13 going to have the address by Commissioner Lyons.

14 And to introduce him, I'd like to  
15 introduce Charlie Miller. He is the Officer  
16 Director for the Office of Federal and State  
17 Materials and Environmental Management Programs at  
18 the Nuclear Regulatory Commission. Charlie?

19 MR. MILLER: Thank you, Lance. For  
20 those of you that don't know me, I thought I'd take  
21 one moment to just identify the different roles that  
22 I play and how they're central to everything that  
23 we're doing in the workshop.

24 We heard about the Energy Policy Act  
25 Task Force this morning, which the legislation

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1 provided for the fact that the Chairman of the  
2 Nuclear Regulatory Commission would chair that task  
3 force. And I do chair the task force meetings on  
4 the Chairman's behalf, so the overall task force  
5 activities are very important to me.

6           Secondly, I'd like to point out that the  
7 increased control orders that we do have in place,  
8 that you've heard a little bit about, were done  
9 under my purview. And I signed those orders out, so  
10 I have a stake in that aspect of it also.

11           Thirdly, any rulemakings that would  
12 result from our deliberations here, or proposed  
13 rulemakings, would be done out of my office also, so  
14 how -- the path forward from here is extremely  
15 important to myself also personally.

16           And Rob had talked about the options  
17 paper. One of the important things to remember from  
18 the workshop is the fact that NRC is an independent  
19 regulator. We do not promote or deny any  
20 opportunities. We do not have a commercial interest  
21 whatsoever in what's going on. It is our job to  
22 make sure that public health and safety and the  
23 appropriate security measures are put in place.

24           Finally, I'd like to point out that  
25 because this is an issue that involves nuclear

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1 materials, our agreement state partners are  
2 extremely important. Currently, between 80 and 85  
3 percent of the nuclear materials regulation in the  
4 United States are done by our partners in the  
5 agreement states, and I'm happy to see a number of  
6 representatives from those here today, as well as  
7 our federal partners. It is important as we go  
8 forward that all our stakeholders are represented.

9           Finally, I'd like to have the pleasure  
10 of introducing the Honorable Peter B. Lyons, who was  
11 sworn in as a Commissioner of the Nuclear Regulatory  
12 Commission in January of 2005. During his tenure,  
13 Commissioner Lyons has emphasized that the NRC and  
14 its licensees must remain strong and vigilant  
15 components of our nation's integrated defenses  
16 against acts of terrorism. And in that regard, he  
17 has been a consistent voice for security matters as  
18 well as our partnerships with the agreement states,  
19 who he recognizes as our partners in this activity.

20           Commissioner Lyons has had a very  
21 distinguished career at Los Alamos Laboratory,  
22 followed by service on the Hill. He was a science  
23 advisor on the staff of U.S. Senator Peter Domenici  
24 and the Senate Committee on Energy and Natural  
25 Resources.

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1 He is a native of Nevada, and he  
2 received his Doctorate in Nuclear Astrophysics from  
3 the California Institute of Technology, and he  
4 earned his undergraduate degree in Physics and  
5 Mathematics from the University of Arizona.

6 He is a fellow of the American Physical  
7 Society and was elected to 16 years on the Los  
8 Alamos School Board, and spent six years on the  
9 University of New Mexico Los Alamos Branch Advisory  
10 Board.

11 He is a resident of Virginia currently,  
12 and without further ado I'd like to introduce  
13 Commissioner Lyons.

14 (Applause.)

15 COMMISSIONER LYONS: I am not sure which  
16 mic I'm using at the moment. Is it this one? Yes,  
17 let's just use that one.

18 Thanks, Charlie, for the kind  
19 introduction. And some of you may have noticed in  
20 what Charlie said, he mentioned 16 years on the Los  
21 Alamos School Board. I sometimes think that being  
22 on a School Board was the best preparation I could  
23 possibly have had for serving at the NRC.

24 (Laughter.)

25 I am pleased to be here today, and I

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1 very much appreciate your willingness to participate  
2 in this very, very important workshop. There can  
3 simply be no question that the uses of cesium-137  
4 chloride sources benefit the world's medical  
5 research and industrial communities and the public,  
6 and benefit them very substantially. However,  
7 preserving these benefits, coupled with achieving  
8 adequate security, is a very real challenge.

9           As I think you know, after this workshop  
10 the NRC staff will be developing recommendations for  
11 Commission deliberation. The discussions at this  
12 workshop will provide highly valuable input for this  
13 process. Because of the importance of these sources  
14 to society, it is imperative that we hear from you  
15 to help frame a strategy and a possible timeline to  
16 address this issue.

17           I want to thank the NRC staff and all of  
18 the participants who have worked so hard to make  
19 this workshop possible.

20           I need to emphasize that I am providing  
21 only my own personal views today, and certainly not  
22 necessarily those of the Commission. I will keep my  
23 remarks relatively brief, and I will be happy to  
24 take a few questions. I might even be able to  
25 provide answers, but at least I am happy to take

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1 questions, and we will see what I can do on answers.

2 I should begin by pointing out that the  
3 NRC has not made any decisions regarding the  
4 suspension of the use of high-activity cesium-137  
5 chloride sources. The information gathered at this  
6 workshop, combined with other studies, will provide  
7 useful insight for the Radiation Source Protection  
8 and Security Task Force's discussion and  
9 consideration of the continued use of cesium  
10 chloride sources. That task force is made up of 14  
11 federal agencies and representatives from the  
12 Organization of Agreement States and the Conference  
13 of Radiation Control Program Directors.

14 The security of radioactive materials  
15 has been, and continues to be, a top priority for  
16 the NRC. Applying a risk-based approach, the NRC  
17 has enhanced security of radioactive materials, and  
18 has reduced the potential threat from an RDD or RED  
19 type of attack. The security of these materials has  
20 been enhanced through additional requirements on  
21 access control, detection, trustworthiness,  
22 accounting, and other measures.

23 Nevertheless, NRC continues to work  
24 closely with its domestic and international partners  
25 to continuously assess, integrate, and improve its

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1 security programs and, when deemed necessary, to  
2 make risk-significant radioactive materials still  
3 more secure and still less vulnerable to terrorists  
4 and terrorist actions.

5 One such example of this coordination is  
6 the government-sponsored -- through DHS and DOE --  
7 voluntary program to enhance the security of high-  
8 activity cesium chloride irradiators by making  
9 design changes to further delay unauthorized access  
10 to the sealed sources. This is referred to as the  
11 hardening program. It is a voluntary program, and  
12 the NRC and agreement states have notified the user  
13 community about the program through careful  
14 communications.

15 The program, and its proposed changes to  
16 device designs, have been thoroughly vetted with the  
17 device vendors and the users, to ensure that the  
18 changes will have no impact on safety, maintenance,  
19 or operation of the devices.

20 The NRC has a number of initiatives  
21 currently underway to address security risks of  
22 cesium chloride sources, and to develop an  
23 integrated strategy towards its future use. I  
24 believe others have, and later will, cover several  
25 of these initiatives this morning, and certainly

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1 more discussion will be planned at this workshop.

2           However, I would like to briefly review  
3 a number of points that I believe have relevance at  
4 this workshop. High-activity cesium-137 chloride  
5 sources, as I think everyone in this room knows, are  
6 used for research and for industrial and medical  
7 purposes and devices regulated by the NRC and the  
8 agreement states. These devices include self-  
9 shielded irradiators, research devices, and  
10 detection and dosimetry calibrators.

11           Today, Russia's Mayak is the only  
12 manufacturer of high-activity cesium-137 sources for  
13 the international market. The commercial  
14 distributor of the Mayak sources in the U.S., as you  
15 know, is REVISS. The form of cesium-137 in such  
16 sources is the chloride form, cesium chloride, which  
17 is both very soluble and very dispersible.

18           Some research and development of  
19 alternative forms for cesium-137 has been performed  
20 and indicates that less soluble and less dispersible  
21 materials may be able to be developed for use in  
22 some cesium -- high-activity cesium sources.

23           However, Mayak will need time to develop commercial  
24 production lines for sources that would use a less  
25 dispersible form.

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1           We need your suggestions to determine,  
2           and hopefully agree, on an appropriate balance  
3           between increased control requirements and the  
4           continued use of these sources, until alternative  
5           forms can be made available or until feasible  
6           alternative technologies become widely used.

7           Prior to 9/11, regulations of the NRC  
8           and the agreement states contain both safety and  
9           security components that were appropriate for that  
10          time. After 9/11, the safety and security  
11          requirements were enhanced through the use of  
12          increased security controls that aligned the IAEA  
13          Code of Conduct recommendations.

14          Concerns about safety and security of  
15          radiation sources and devices have grown partly in  
16          response to fears that radiation sources could be  
17          used to make RDDs, or, as you know, referred to more  
18          often as a dirty bomb.

19          Congress directed the NRC, through the  
20          Energy Policy Act of 2005, to take several actions.

21          Among them, we were required to undertake a study  
22          by the National Academy of Sciences to identify the  
23          uses of high-risk radiation sources and the  
24          feasibility of replacing them with lower risk  
25          alternatives.

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1           The National Academy recommendations  
2 called for stopping the licensing of new cesium-137  
3 chloride irradiator sources, prohibiting the export  
4 of such sources, providing incentives for  
5 decommissioning of existing sources, and replacing  
6 existing sources with possibly a less dispersible  
7 form of radioactive cesium -- with cobalt-60 or with  
8 non-radioactive alternatives.

9           Others have called for the complete  
10 replacement of cesium chloride sources, including,  
11 as you are probably well aware, House Bill H.R.  
12 6816, which is entitled the Nuclear Facility and  
13 Material Security Act of 2008, and consistent with  
14 another recommendation of the National Academy study  
15 entitled Radiation Source Use and Replacement.

16           I very much agree with the National  
17 Academy that any effort to replace these radiation  
18 sources with alternative technologies should proceed  
19 with caution in order to minimize disruption in  
20 vital areas of industry, medicine, and research. To  
21 that end goal, as you know, the NRC is holding this  
22 public workshop to ensure that all stakeholders are  
23 afforded an early opportunity to provide input on  
24 any potential regulatory changes.

25           The Commission believes that a balanced

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1 consideration of stakeholder concerns is essential  
2 to inform regulatory changes, and will help quantify  
3 and possibly lessen any negative impacts of such  
4 changes.

5 The task force that I discussed earlier  
6 has formed several subgroups, including ones on  
7 cesium chloride, radiation sources, and alternative  
8 technologies. The cesium chloride subgroup has  
9 already issued its report within or to the task  
10 force. The radiation sources subgroup plans for a  
11 fall 2008 report, so pretty soon. And the  
12 alternative technology subgroup's report is due in  
13 2009.

14 These studies, as well as other input,  
15 such as, for example, the ongoing study of the  
16 Advisory Committee on the Medical Uses of Isotopes,  
17 on the efficacy of X-ray alternatives, will be used  
18 by the task force to develop recommendations in its  
19 report to the President and to U.S. Congress, and  
20 that report is due in 2010. The 2010 report will  
21 certainly include this issue, among a number of  
22 other topics.

23 As we consider these difficult issues,  
24 we need to pay very careful attention to the  
25 consequences of our actions, to avoid unintended

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1 consequences, both domestically and internationally.

2 Thus, any resolution, in my mind, would benefit  
3 from an international consensus, to avoid driving  
4 some applications offshore, and to prevent sources  
5 of concern from becoming more readily accessible in  
6 other countries.

7 It may be useful also during this  
8 workshop to discuss when security becomes  
9 sufficient. For example, should nuclear powerplants  
10 that use these sources be required to replace them,  
11 despite the enhanced security that is in place at  
12 such facilities?

13 You could also offer valuable input to  
14 two additional questions. How feasible is it to  
15 stop licensing cesium-137 chloride sources now with  
16 a goal of complete replacement within 10 years?  
17 And, second, what should be done with the replaced  
18 sources and devices? How should we solve the  
19 disposal issue? And should we prohibit export of  
20 these sources and devices, as the National Academy  
21 suggested?

22 As I noted earlier, the NRC and its  
23 federal partners need broad stakeholder input on the  
24 potential impacts of actions and the range of  
25 alternatives that can potentially address issues

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1 associated with removing high-activity cesium  
2 chloride sources from use. We clearly need your  
3 views on economic and societal costs associated with  
4 replacing these sources, including the effectiveness  
5 of replacements or in impacts-to-research programs,  
6 if they are not available.

7           Additionally, we need to understand the  
8 effect on your programs if such sources were  
9 replaced by X-ray machines or other alternatives --  
10 for example, maintenance and efficacy issues and  
11 cost issues. I, for one, very much look forward to  
12 the staff's recommendations on the issues associated  
13 with cesium chloride sources, and those  
14 recommendations are going to be informed by the  
15 dialogue of this workshop, as well as from input  
16 from previous and also ongoing studies.

17           I do appreciate your attention. I hope  
18 you have a productive, informative workshop, where a  
19 variety of different points of view can be  
20 discussed, debated, and better understood by all of  
21 you.

22           With that, I am willing to take a few  
23 questions, with the obvious caveat that I would be  
24 speaking only for myself, and that this early in the  
25 deliberations I will be fairly careful in what I

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1 say, too. If there are questions, I'll try.

2 FACILITATOR RAKOVAN: If you have a  
3 question, please come to use the microphone.

4 MR. MORGAN: Hi. I'm Tom Morgan from  
5 the University of Rochester. Most of what I have  
6 heard today is in the purview -- within the purview  
7 of the NRC. However, disposal doesn't appear to be.  
8 That's a huge political decision. How do you see  
9 this playing out -- disposal playing out -- versus  
10 all the other regulations?

11 COMMISSIONER LYONS: Well, there is  
12 certainly no question that the country now is facing  
13 a real challenge on disposal options for all  
14 sources. The closure of Barnwell certainly  
15 complicated a system that was already strained.

16 There are some possible commercial  
17 options that still may come online, but this may be  
18 something that, depending on the feedback from this  
19 workshop, depending on the success that some of  
20 these newer commercial options may have or may not  
21 have, it may be very reasonable for the Commission  
22 to entertain direct communication with our oversight  
23 committees in Congress to point out the concerns  
24 raised by the lack of disposal options, and to, you  
25 could say, ask or plead for congressional action to

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1 resolve those issues.

2 You are quite right that the NRC, per  
3 se, does not have the necessary authorities to solve  
4 this problem, but we are piece of any solution.  
5 Congress may well have to be involved before this is  
6 over.

7 Any other questions?

8 (No response.)

9 Again, I wish you great success for the  
10 conference, for the workshop. It truly is a very,  
11 very important contribution, and I appreciate your  
12 taking the time from your schedules to provide that  
13 input. So thanks very much.

14 (Applause.)

15 FACILITATOR RAKOVAN: Thank you, sir.

16 I would like to take a moment now to go  
17 over some ground rules for the discussion panels.  
18 The roundtable discussions will essentially follow  
19 the five issues detailed in the Federal Register  
20 notice, with one session devoted to each issue.  
21 We're going to have some different panel members for  
22 each discussion, and expect that those sitting at  
23 the table will be the primary participants for each  
24 session.

25 We received far more expressions of

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1 interest for serving as panel members than we could  
2 accommodate, unfortunately, as we have attempted to  
3 ensure a good balance between the various groups and  
4 perspectives sitting at the table. Therefore, we  
5 apologize that we could not put all those interested  
6 parties on the panels. However, we are going to do  
7 our best to make sure that all participants, whether  
8 they are seated at the tables or not, have an  
9 opportunity to participate in discussions.

10 Now, I have got Cyndi Jones over here,  
11 and I've got Michelle Killian over here, and they  
12 are hopefully going to help us keep honest in terms  
13 of which panel members need to be up for which  
14 discussions, and also make sure that those people  
15 have their tents designating kind of their seats,  
16 and so we know who they are when they speak as well.

17 At the start of each session we may have  
18 some initial statements made by participants. As  
19 established before the meeting, these statements  
20 should take three minutes at the most, to allow  
21 sufficient time for discussion on each issue. I  
22 would really appreciate if you would help me keep to  
23 that. If you start kind of going over the three-  
24 minute mark, I'm going to take some steps to kind of  
25 -- well, please help me keep to the three-minute

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1 mark.

2 (Laughter.)

3 If you have any PowerPoint presentations  
4 for a presentation coming up, try to get it to  
5 Michelle over here as early as possible, so that we  
6 make sure that we have it on our computer.

7 Following any initial statements, we  
8 will open up discussion for the designated issue.  
9 If you are sitting at the table and you want to make  
10 a statement, you can either raise your hand to get  
11 my attention or you can put your name tent sideways,  
12 assuming it will stay up. Again, I will try to get  
13 to everyone in the order that I see you.

14 If you are in the audience -- and I will  
15 try to go to the audience at specific times -- you  
16 can see we have got a couple of mics in the center  
17 aisle, and if you just want to approach the mic. Or  
18 I'll be looking at the crowd a couple times, if you  
19 just raise your hand, then I'll kind of give you a  
20 nod.

21 But, like I said, we're going to try to  
22 let everybody participate, but we are looking to the  
23 panel members to be the primary people who are  
24 having the discussions.

25 If things come up that aren't pertinent

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1 to the topic at hand, I'm going to put it on one of  
2 these flipcharts over here. I think you will notice  
3 on the agenda we've got some time for "parking lot  
4 issues," and hopefully we'll get to those towards  
5 the end of the day, especially if they are important  
6 topics that we want to discuss, but maybe they are  
7 just not in the flow of what's being discussed at  
8 the moment.

9 Please note that this is a public  
10 meeting, so we will be discussing only publicly-  
11 available information, asking that participants  
12 please do not -- please do not discuss specific  
13 security-related information about your facilities.

14 There also should be no discussions about specific  
15 scenarios or additional security measures that  
16 should be added to a certain device.

17 This type of discussion could  
18 potentially cross into safeguards or classified  
19 information quickly, and they are not appropriate  
20 for this workshop. So I appreciate your help in  
21 that.

22 We are transcribing today's meeting to  
23 fully document the discussions. So there is a few  
24 things that you can help us out with in terms of  
25 making sure that we get a clean transcript for the

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1 meeting. First, if you are going to participate in  
2 a discussion, please make sure you use a microphone.

3 When you do make a comment, please try to give us  
4 your name and any organization that you represent,  
5 at least the first few times that you make a  
6 comment.

7 Also, hopefully with the microphones,  
8 but let's try to keep one main conversation going at  
9 any given time. Side conversations probably won't  
10 find their way to the transcript, and they also take  
11 away from whatever the main discussion is.

12 You can also help us cut down on  
13 background noise by turning off or silencing your  
14 cell phones or other electronic devices. Heard a  
15 few of those going off already, so, if you could go  
16 ahead and do that, that will really help us out.

17 We can take written statements that we  
18 can include as part of the transcript. If you have  
19 something that you'd like to submit, you can either  
20 give it to me or any of the people that you see that  
21 have been helping out at the workshop, or at the  
22 registration table. All those will make their way  
23 officially onto the transcript.

24 Both John Jankovich and Cyndi Jones, the  
25 workshop coordinators, are going to be available

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1 throughout the meeting in order to answer any  
2 questions you might have.

3           And let's just try to remember that we  
4 are here to discuss these issues, not reach a  
5 consensus. There's a pretty good chance that we're  
6 not all going to agree 100 percent with what  
7 everybody else says. And that's all right. When  
8 someone has the floor, please give them the floor  
9 fully, and show them the respect that you yourself  
10 would like.

11           A few logistic information -- if you did  
12 park over here in the parking lot for the Convention  
13 Center, we do have free parking that we can give  
14 you. Just stop at the registration table and let  
15 them know, and you'll be able to park for free.  
16 They have got vouchers. If you haven't figured it  
17 out yet, restrooms are down here and on your right.

18           Obviously, you've probably noticed that  
19 we've got lots of food going on. There will be food  
20 out pretty much during the morning and afternoon  
21 sessions. Lunch, you're on your own. I believe  
22 they've got a restaurant down here, but there is a  
23 few restaurants that are within a quick walking  
24 distance towards Rockville Pike as well. So when we  
25 take a break for lunch, you are on your own for

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1 that.

2 We do have this room for two complete  
3 days. So if you want to leave some of your  
4 materials, like in a specific chair, it should be  
5 okay. I'm not sure that I would leave computers or  
6 anything like that, but just in case you don't feel  
7 like lugging your copy of the National Academy's  
8 report home with you, if you set it on a chair and  
9 put something with your name on it, or something, it  
10 should be fine.

11 And, again, just one more plug, if you  
12 could fill out the public meeting feedback forms. I  
13 just signed out a memo the other day that publishes  
14 the results that we had last year, and we do have  
15 specific information, trends, specific comments that  
16 were made, etcetera. So those really do help us  
17 improve on our public meetings.

18 So having said all of that, let's go  
19 ahead and move to the first panel and first topic,  
20 Issue 1.1, which is feasibility of the use of other  
21 forms of cesium-137.

22 Michelle, do you want me to go ahead and  
23 read off the participants?

24 MS. KILLIAN: That would be good.

25 FACILITATOR RAKOVAN: Okay. The

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1 participants that I have listed for this are Albert  
2 Aloy, and I apologize if I slaughter anyone's name,  
3 David Coppell, Mark Maiello, Brad Patton, John  
4 Schrader, Thadium Stirchanko, and Lynne Fairobent.  
5 If you could all go ahead and come up and take a  
6 seat. I think Michelle has specific places that she  
7 wants to put you, so if you could try to match  
8 yourself with your tent.

9 (Pause.)

10 Okay. I'm going to assume that we have  
11 everybody up here that we need.

12 I have a statement that I have been  
13 asked to read. It is from Abba Zubair, M.D., Ph.D.,  
14 from the Mayo Clinic. Unfortunately, no one from  
15 the Mayo Clinic was able to make it today, so I'd  
16 like to read the statement that he had planned to  
17 read. I've got the letter, and I'll just go through  
18 it right now.

19 "It is regrettable that I will not be  
20 able to attend the upcoming workshop that will  
21 discuss the security and continued use of devices  
22 that contain cesium-137 chloride. To supplement the  
23 letter I previously sent you" -- and this was  
24 addressed to Cynthia Jones -- "I would like to have  
25 read into the record some of the important points

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1 that were brought up by my Mayo Clinic colleagues  
2 regarding cesium blood bank irradiators.

3 "Bullet 1. Irradiation of blood is  
4 medically necessary for some patients to prevent  
5 transfusion-associated graft versus host disease.  
6 The 2005 nationwide blood collection and utilization  
7 survey reported over 2.5 million blood components  
8 were irradiated in the year 2004.

9 "Next, cesium chloride blood irradiators  
10 are the most reliable, efficient, and low  
11 maintenance blood irradiators available. All  
12 hospital blood banks are staffed 24 hours a day,  
13 seven days a week. Therefore, with the recent  
14 increased security requirements, we believe blood  
15 bank irradiators are sufficiently secured.

16 "If the decision is to allow all cesium  
17 chloride containing irradiators, then the ban should  
18 be limited to new irradiators. The cost of  
19 replacement of cesium chloride irradiators, with X-  
20 ray irradiators, would create a hardship for many  
21 hospitals and blood banks. At a minimum, the  
22 government should provide the funding for removal of  
23 existing cesium-137 blood bank irradiators.

24 "X-ray blood irradiators are the most  
25 likely alternative to cesium chloride blood

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1 irradiators, but they are not currently as efficient  
2 or reliable as cesium chloride irradiators, and may  
3 not be as efficacious based on conflicting reports  
4 in the literature. X-ray blood irradiators are  
5 associated with relatively higher maintenance costs.

6 "The current manufacturing capacity in  
7 the U.S. is not capable of replacing cesium chloride  
8 irradiators in a reasonable period of time.

9 Therefore, the waiting time to purchase an X-ray  
10 blood irradiator is over six months, and this will  
11 significantly get worse if cesium chloride  
12 irradiators are outlawed all at the same time.

13 "My assessment of opinions among  
14 colleagues in the transfusion medicine community is  
15 that existing measures taken to ensure security  
16 blood bank irradiators are adequate. Any measure  
17 that will limit their use should be enacted over a  
18 reasonable time to allow for removal and replacement  
19 of existing cesium chloride blood irradiators.

20 "Thank you for giving us this  
21 opportunity to offer our opinions and suggestions.  
22 We look forward to the outcome of the workshop and  
23 NRC's decisions."

24 And it is signed Abba Zubair, M.D.,  
25 Ph.D., Director, Transfusion Medicine and Stem Cell

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1 Therapy, Mayo Clinic.

2 All right. Did anybody time me? Was  
3 that under three minutes?

4 (Laughter.)

5 Did I hope to my own -- okay.

6 If we could go around the table and have  
7 the panelists introduce themselves briefly. To use  
8 your microphone, that's -- all you need to do is hit  
9 the center and it should come on. Lynne, do you  
10 want to start us out, please?

11 MS. FAIROBENT: Lynne Fairobent. I'm  
12 the Manager of Legislative and Regulatory Affairs  
13 for the American Association of Physicists in  
14 Medicine.

15 MR. SCHRADER: I'm John Schrader, REVISS  
16 Services, and Vice President of North American  
17 Operations, and also Radiation Safety Officer.

18 MR. PATTON: I am Brad Patton from Oak  
19 Ridge National Laboratory, involved in cesium source  
20 fabrication work.

21 MR. MAIELLO: Mark Maiello, Radiation  
22 Safety Officer for the Pearl River, New York  
23 facility for Wyeth Pharmaceuticals.

24 MR. COPPELL: And I'm David Coppel.  
25 I'm Manufacturing and Technical Director for REVISS

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1 Services.

2 MR. ALOY: I am Albert Aloy from St.  
3 Petersburg Institute.

4 FACILITATOR RAKOVAN: Thank you,  
5 everyone.

6 Just switched to the lapel mic, so  
7 hopefully you can all hear me. It sounds like I'm  
8 coming through okay.

9 Why don't we go ahead and start with our  
10 discussion of 1.1. Michelle, do you want to put up  
11 the first question, then, please?

12 (Pause.)

13 Something go wrong?

14 MS. KILLIAN: Yes.

15 FACILITATOR RAKOVAN: Of course. Do we  
16 have a paper copy that I could read it from? Do you  
17 have another copy?

18 (Pause.)

19 As we are waiting to do that, does  
20 anyone have an opening statement that they wanted to  
21 go through? Please.

22 MR. PATTON: I have some viewgraphs.

23 FACILITATOR RAKOVAN: Into the  
24 microphone, please.

25 MR. PATTON: I have some viewgraphs --

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1 FACILITATOR RAKOVAN: If you could  
2 introduce yourself.

3 MR. PATTON: -- if you could put them  
4 up, please.

5 FACILITATOR RAKOVAN: Could you  
6 introduce yourself, please, the first couple of  
7 times that you speak?

8 MR. PATTON: Brad Patton from Oak Ridge  
9 National Laboratory.

10 FACILITATOR RAKOVAN: Thank you. Do you  
11 have some viewgraphs?

12 MR. PATTON: Yes, sir, I do.

13 FACILITATOR RAKOVAN: Okay. Do we --  
14 does Michelle have them in the computer already?

15 MR. PATTON: Yes, she does.

16 FACILITATOR RAKOVAN: Okay. Well,  
17 unfortunately, that might be -- we're experiencing  
18 technical difficulties. Please stand by.

19 (Laughter.)

20 Thanks, Lynne.

21 All right. Question 1.1, are  
22 manufacturers -- this is feasibility of the use of  
23 other forms of cesium-137. The question is: are  
24 manufacturers currently considering the use of other  
25 forms of cesium, other than cesium chloride? If

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1 yes, what are such considerations?

2 Hey, look at that. Okay. Michelle, do  
3 you have the charts? Can you put those up, please?

4 MS. KILLIAN: Is this for Lynne?

5 FACILITATOR RAKOVAN: No. This is for  
6 Brad Patton.

7 (Pause.)

8 MR. PATTON: Can I get up here where I  
9 can see?

10 FACILITATOR RAKOVAN: Yes. You can use  
11 the podium if you'd like to while you're giving your  
12 presentation. Certainly. Thanks.

13 MR. PATTON: I am Brad Patton from Oak  
14 Ridge National Laboratory, and I would like to give  
15 you some history of cesium chloride production at  
16 Oak Ridge, which hopefully will put some of the  
17 discussion in perspective later on in the day.

18 Next viewgraph, please.

19 ORNL produced cesium chloride from 1950  
20 until 1989. Approximately 56 million curies of  
21 cesium chloride were distributed over that  
22 timeframe. And the specific activity of material  
23 that we produced was always greater than 18 curies  
24 per gram, and many times as high as 25 curies per  
25 gram. And that is important as we go through the

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1 discussion I think, and getting a concentrated  
2 source is very important to the discussion we are  
3 having.

4           The cesium chloride we produced was  
5 produced both in bulk material, breast pellets and  
6 powders, which were distributed to other  
7 manufacturers to produce sources, and we also  
8 produced sources ourselves. And you see in this  
9 photograph we had a different -- a number of  
10 different source types that were produced at ORNL.

11           Next viewgraph, please.

12           Our process was very simple, and I think  
13 that is why we are using cesium chloride. The  
14 material -- the bulk material was separated at the  
15 Hanford facility, the DOE Hanford facility. It was  
16 shipped to ORNL, and the process simply was to  
17 dissolve the material, to filter it, and then  
18 solidify the material again into the cesium chloride  
19 form, and then those were cold-pressed into pellets.

20           Again, this is a hot cell operation, and  
21 this is the simplest way to produce the material,  
22 and that is why cesium chloride I guess was chosen  
23 as the source form of interest, plus the fact that  
24 you get some very high specific activities  
25 associated with the material.

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1 Next viewgraph, please.

2 During that period in the early 1980s,  
3 ORNL did experiment with other source forms. And  
4 pollucite, which has already been discussed today,  
5 was one of those source forms. And we actually  
6 produced cesium-137 material with pollucite.  
7 Unfortunately, the specific activity is more like 10  
8 curies a gram that we -- that we -- resulted from  
9 this process, roughly half the specific activity  
10 that we had in general in our cesium chloride.

11 Another source form that we make at ORNL  
12 is californium sources, and this is a cermet, which  
13 is a ceramic encapsulating a metal matrix, and it's  
14 used commonly from ORNL now. It's a palladium and  
15 cesium oxide cermet, and ORNL is experimenting with  
16 cermets for spent fuel and proposes cesium-type  
17 cermet, which both would be insoluble and also non-  
18 dispersible.

19 As I put in the box here, these are all  
20 more difficult processes, and all have to be done in  
21 a hot cell environment.

22 Next viewgraph?

23 In summary, ORNL has a lot of experience  
24 in handling cesium chloride, also experience in  
25 other source forms. We have no plans to be in the

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1 cesium production business, but we are interested in  
2 developing new source forms and reviewing source  
3 forms developed by other agencies.

4 And based on our experience with how  
5 easy cesium chloride is to produce, and the specific  
6 activity that you get with cesium chloride,  
7 alternate forms will be more difficult with lower  
8 specific activities, and we believe the phaseout  
9 would need to be driven by some sort of regulatory  
10 requirement.

11 FACILITATOR RAKOVAN: Thank you, sir.

12 Did we have any other opening points for  
13 this particular issue?

14 (No response.)

15 Okay. So let's just go ahead and open  
16 to discussion, then. Anybody have a point that  
17 they'd like to make on this particular issue, work  
18 towards -- sir, please, if you could introduce  
19 yourself, at least for the first few times.

20 MR. COPPELL: Yes, thank you. It's  
21 David Coppel here again from REVISS Services. I  
22 think many of you will know that REVISS works  
23 closely with Mayak in a partnership for  
24 manufacturing and distribution of radioactive  
25 sources, including large cesium sources.

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1           And I just wanted to respond to the  
2 first question, question 1.1, are manufacturers  
3 currently considering the use of other forms of  
4 cesium? Well, the answer is, quite simply, yes. In  
5 fact, I think it is probably common knowledge that  
6 other forms of cesium have been available for some  
7 decades, not for this type of product.

8           And I think what has been explored at  
9 the moment is the potential to extend and probably  
10 modify the manufacturing technologies for those  
11 alternate forms, so that they could be applied to  
12 the manufacture of large cesium sources for the  
13 applications that we are discussing.

14           The only thing I would say is that these  
15 development programs are not very quick or very  
16 easy. I think as Brad pointed out in his  
17 presentation just now there are some technology  
18 challenges that we need to go through, and so at  
19 this precise stage we are not quite in a position to  
20 be able to make some firm proposals. But I think  
21 our expectation would be that within a very few  
22 months that would be possible.

23           FACILITATOR RAKOVAN: Okay. Anyone want  
24 to piggyback on that, or make a different discussion  
25 point? Sir, yes, if you could introduce yourself,

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1 please.

2 MR. MENNA: My name is Blair Menna. I'm  
3 from Best Theratronics. A question for Brad, I  
4 guess, and it's probably just a yes or no question.

5 I gather from your presentation that it is very  
6 feasible technically. We -- we have the technology  
7 to develop a non-dispersible form of cesium.

8 MR. PATTON: Yes, we do have the  
9 technology to produce those forms. But I guess the  
10 question is whether we can get the specific  
11 activities high enough to serve the uses that you  
12 now have for the source materials. But, yes, I  
13 think the source could be developed that are non-  
14 leachable and non-dispersible, but you are going to  
15 have to add -- have some additives there, and the  
16 specific activity will be necessarily lower.

17 MR. COPPELL: Dave Coppel again here  
18 from REVISS. Just to add a couple of points to  
19 that. I agree with what Brad says. That's  
20 certainly a challenge. It is not the only  
21 challenge. I think in developing the alternative  
22 forms we will need to understand more clearly what  
23 the target is going to be in terms of solubility and  
24 leachability, and also what the target is going to  
25 be in terms of dispersibility.

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1                   And then, having gone through the  
2                   technology development program, there will be a  
3                   matter of cost as well. We will need to come to  
4                   that at some stage.

5                   MS. FAIROBENT: To both of you, what  
6                   sort of timeframe are we realistically talking  
7                   about? If we had an alternative form today that was  
8                   readily available, what timeframe could it be  
9                   brought into market to substitute out the cesium  
10                  chloride form?

11                  MR. PATTON: Since we are really not in  
12                  the business right now --

13                  FACILITATOR RAKOVAN: Sir, I don't think  
14                  your microphone is on. Yes, red light is on when  
15                  it's on.

16                  MR. PATTON: I would refer to REVISS on  
17                  that. Since we are really not the producers at this  
18                  time, that would be their -- their statement,  
19                  please.

20                  MR. COPPELL: Okay. Thanks, yes. The  
21                  simple answer is I am not exactly sure. It will be  
22                  a few years. It is going to depend I think on --  
23                  well, a number of factors, but particularly the  
24                  commercial viability. Obviously, this is going to  
25                  go faster if there is more funding available to

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1 support it, so there are a lot of factors involved  
2 in making an assessment of time scale, but let's say  
3 a few years.

4 FACILITATOR RAKOVAN: Please, if you  
5 could go ahead and step to a microphone and  
6 introduce yourself.

7 MS. SHEPHERD: Mary Shepherd, J.L.  
8 Shepherd and Associates. With the having of the --  
9 of the output by going to a more indispersible form,  
10 there would have to be consideration for either the  
11 placement of the device because of the size of the  
12 sources would be either double to replace the source  
13 or to look at the technology. Is half a curie  
14 output -- half a curie output feasible for the --  
15 replacing into existing devices? There is not the  
16 physical size to put double -- a capsule that is  
17 twice the size inside an irradiator.

18 And the question for REVISS would be:  
19 would there be a means of replicating the current  
20 curie output in the same size?

21 MR. COPPELL: Well, the simple answer  
22 is, no, not really. The specific activity and  
23 volume-specific activity of the replacement product  
24 would be lower. There is no doubt of that. And  
25 there are some other effects as well, such as self-

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1 absorption of the radiation in a larger and more  
2 dense material.

3           Having said that, it may be that the  
4 physical size of the sealed source is not -- not  
5 immensely larger than a current one of the same  
6 activity. We've got a few estimates. I don't have  
7 some figures with me at the moment, but I guess that  
8 what we believe is that for many instruments it is  
9 possible to make relatively minor modifications to  
10 the instrument in order to accommodate a slightly  
11 larger sealed source. But we really need to discuss  
12 that with equipment manufacturers and the industry  
13 more generally.

14           FACILITATOR RAKOVAN: Does anyone want  
15 to expand upon that or -- please, if you could  
16 introduce yourself.

17           MR. MAIELLO: Sure. Mark Maiello again  
18 from Wyeth Research in New York. There was the  
19 representative from Best, I believe. This would be  
20 a question for you on this issue. Forgive me if  
21 this is anecdotal information, but is it true that  
22 the existing irradiators would not be subject to  
23 reloading, but, in fact, would have to be totally  
24 replaced? We had heard that that was a real  
25 possibility.

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1 MR. WASIAK: Obviously -- Tom Wasiak  
2 from Best Theratronics. We haven't done very  
3 extensive analysis of that situation, but we looked  
4 at it briefly. And I think the entire -- doing it  
5 in the field would be probably prohibitive and  
6 likely impossible. There might be an option of  
7 doing something in the facility, kind of swapping  
8 the radioactive shielding component. That might be  
9 an option.

10 I also would like to say -- kind of  
11 follow up on the previous comment that the impact of  
12 using different form of cesium varies, obviously,  
13 with the design of the equipment. And it's not the  
14 same for all kind of equipment and all applications.

15 So in our case it might be easier in case of blood  
16 irradiators -- obviously, you have to compensate in  
17 some way for a loss of specific activity and  
18 possibly, you know, increased volume or increased  
19 number of sources.

20 But it might be possible, with some, you  
21 know, medium size design changes. In other case,  
22 more significant changes to the design of equipment  
23 would be required, and probably loading these type  
24 of sources to the existing pieces of equipment might  
25 be impossible.

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1 FACILITATOR RAKOVAN: I've got a few  
2 panelists who haven't made any comments yet. I'd  
3 just like to open the floor, if they would like to  
4 go ahead and step up and say something at this  
5 point, after this gentleman speaks, of course. Sir,  
6 if you could introduce yourself.

7 MR. SULEIMAN: Orhan Suleiman with the  
8 Food and Drug Administration. You talk about reduce  
9 specific activity. Twenty percent, 50 percent?  
10 Give me a ballpark figure. And how would that have  
11 -- what sort of an impact would that have in terms  
12 of irradiation time for commonly-used applications?  
13 Are we going to go from five-minute times to five  
14 hours? Or are we going to go from five minutes to  
15 10 minutes? That has a lot to do with the  
16 practicability and the applicability of such  
17 changes.

18 MR. PATTON: Well, you saw my  
19 viewgraphs. In the pollucite, we really --  
20 basically was half what the cesium chloride was.  
21 And I don't know if there's other experience there,  
22 but I think half or lower may be -- depending on how  
23 much -- again, we don't know what the requirements  
24 are for dispersibility or leachability. I mean,  
25 depending on what those requirements are, how much

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1 better is good enough, it would drive that specific  
2 activity reduction.

3 MR. SULEIMAN: I know, but I can only  
4 think one thing at a time, so I want to -- I want to  
5 understand the reduced --

6 (Laughter.)

7 -- activity and intensity, and then I  
8 could worry about the other issues. But I think --  
9 is reducing the activity going to be so bad that it  
10 can't be -- it won't be practical in the working  
11 environment? And what are the average times for  
12 using these irradiators for applications?

13 MR. COPPELL: Well, I'm not sure I can  
14 add much to what Brad just said. If you're looking  
15 for a typical number, think of half. Whether that's  
16 still -- is still viable from an applications  
17 perspective is really a question more for the  
18 equipment manufacturers.

19 And I think we're all a little concerned  
20 about getting numbers set in concrete too early, but  
21 just for order of magnitude think of maybe half.

22 MR. SULEIMAN: Thank you.

23 FACILITATOR RAKOVAN: Sir, if you could  
24 introduce yourself, please.

25 MR. MOSHAASHAEE: Moji Moshaashae,

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1 Schering Corporation. I just had a question. When  
2 you change the constituency of the cesium chloride  
3 itself, you have additives. Does that change in any  
4 way the gammas that are -- you know, the basically  
5 beautiful gamma that we get from the cesium sources  
6 that we get right now? Do we get uniform --  
7 uniform, actually, gammas?

8 MR. COPPELL: Provided you design the  
9 material that you incorporate -- matrix material  
10 that you incorporate this in correctly, the answer  
11 is no.

12 MR. THOMAS: I'm Jerry Thomas of Via  
13 Christi Regional Medical Center in Wichita, Kansas.

14 FACILITATOR RAKOVAN: If you could turn  
15 the mic up a little bit, please.

16 MR. THOMAS: Oh, absolutely. Excuse me.

17 FACILITATOR RAKOVAN: Thank you.

18 MR. THOMAS: I'd like to give Orhan a  
19 direct answer to your question, and that is how long  
20 of the irradiation time. We currently are  
21 irradiating at about 12 to 15 minutes for a source  
22 -- pardon me, for a blood sample. Consequently, if  
23 we double that time, the throughput is going to be  
24 24 to 30 minutes per sample.

25 Consequently, to meet the workload that

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1 we currently have, we are going to have to have an  
2 additional irradiator capability. I think that is  
3 going to be the case in many large blood banks is  
4 that the current irradiator capacity is not going to  
5 be sufficient with the lower specific activity  
6 source in the irradiator.

7 MR. MOSES: Paul Moses, Best  
8 Theratronics. If you look at the different models  
9 that we have in the gamma cell line, which holds the  
10 cesium source, you are looking at the higher loaded  
11 units to be in compliance with the AABB and the FDA.

12 You would be looking at little over a minute to be  
13 in compliance with a fully loaded unit, GammaCell  
14 1000.

15 The GammaCell 3000, which holds multiple  
16 blood bags, you are looking at a cycle time of  
17 around two and a half minutes on a new unit fully  
18 loaded. So after you've had a unit for it sounds  
19 like -- in the gentleman's case here -- for maybe 20  
20 years --

21 PARTICIPANT: Fifteen.

22 MR. MOSES: -- 15 years --

23 (Laughter.)

24 -- yes, you are obviously -- your cycle  
25 time is going to drop a little. But that just

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1 speaks to the reliability and the longevity of this  
2 kind of product in the marketplace.

3 FACILITATOR RAKOVAN: Do you want to --  
4 okay. Rob, do you want to go first?

5 MR. LEWIS: Rob Lewis from NRC. I would  
6 like to hear, if I could, some additional words from  
7 the panel about creating a market. And, in  
8 particular, the panel seemed to indicate that there  
9 wasn't a technological obstacle to a new form, but  
10 there wasn't a market-driver. And, you know, a  
11 regulatory action could create a market, of course,  
12 to drive a new form for the U.S.

13 But, as we all said, this is a worldwide  
14 business, and there is only one producer in the  
15 world, which is Mayak. And would the regulatory  
16 action in the U.S. also create a market for the rest  
17 of the world, or -- or, you know, how can we do this  
18 in isolation? Even -- is there enough market force  
19 to sustain two different forms -- a cesium chloride  
20 form for the rest of the world and a different form  
21 for the U.S.?

22 MR. SCHRADER: John Schrader, REVISS  
23 Services. We have had this discussion internally  
24 quite a bit. It is going to depend on what the  
25 costs are to make the changes, whether they are

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1 going to be able to pass a lot of costs on,  
2 obviously.

3 We are looking at probably having to  
4 develop a new process line to be able to develop the  
5 new source material. Whether there is a sufficient  
6 market out there right now to be able to maintain  
7 two lines where you have cesium chloride on one and  
8 where you have this new material on another --  
9 again, it's going to all depend on what the  
10 development costs are and what the sales costs will  
11 be.

12 FACILITATOR RAKOVAN: Please.

13 MR. ALOY: Excuse me. Because I am not  
14 very fluent in excuse, maybe I speak in Russian and  
15 use the --

16 FACILITATOR RAKOVAN: No, that's fine.  
17 That's fine.

18 MR. ALOY: I can -- I would like to  
19 stress only that we have no technology for a new  
20 alternative form. We have only the scientific  
21 results and scientific resources and scientific  
22 bases of different alternative materials, like  
23 pollucite or glasses.

24 But technology means that equipment,  
25 operational personnel, and hot cell installation.

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1 And so just only the first approach to the change  
2 for a new alternative materials we have.

3 And also, in Russia we have the testing  
4 in the -- with surrogate materials, not with the  
5 real initial form. Initial form is cesium nitrate  
6 is initial form to transform into the ceramics or  
7 into the glasses. So we have no technology for  
8 pollucite or alternate forms. We have only  
9 scientific approach, and we need enough time to  
10 implement the scientific approach into real  
11 technology.

12 And also, we need to understand that the  
13 cesium chloride, due to crystalline form properties  
14 and physical property, has free volume into the real  
15 sources. This is free volume in the design sources,  
16 about 25 volume percent.

17 So we can use this additional volume to  
18 receive the volume activity, specific volume  
19 activity, equal approximately -- it's about 90  
20 percent to the activity of the cesium chloride.  
21 This is only -- just my remarks to the discussion.

22 FACILITATOR RAKOVAN: Thank you, sir.

23 MR. COPPELL: Yes. Can I just add my  
24 support to that comment on behalf of the  
25 manufacturers? I am trying to be careful to say

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1 that we believe that we can develop the technology.

2 But I support what Mr. Aloy says. We don't have  
3 that technology right now. We have a track record  
4 of use of non-dispersible versions for forms of  
5 cesium going back some time, which leads us to  
6 believe that it is feasible.

7 But, really, we need some more months,  
8 as I said at the outset, maybe six to nine more  
9 months, to -- to assure ourselves, and then be able  
10 to make a proposal. And thereafter, then actually  
11 industrializing that technology, bringing it to  
12 market, assuming that the commercial environment  
13 existed to justify it, would take a few years.

14 FACILITATOR RAKOVAN: If I could -- I'm  
15 sorry, I had a gentleman who stood up earlier. If  
16 you want to -- please. I cut you off earlier, and I  
17 wanted to give you a chance. I'll get to you next,  
18 sir, I promise.

19 MR. WASIAK: Just a brief comment. I  
20 guess it -- some of the questions earlier it was  
21 assumed that a 50 percent drop in specific activity  
22 automatically means that the irradiation time would  
23 have to be doubled.

24 It is true in some cases, but I think  
25 by, you know, installing more sources where you have

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1 that capability, or in other means, this can be  
2 compensated to some extent, and may not necessarily  
3 mean drop of -- or extension of irradiation time  
4 twice the previous value, right? So partial  
5 compensation, if not full compensation, may be  
6 accomplished by certain design changes.

7 FACILITATOR RAKOVAN: Yes. Sir?

8 MR. MAIELLO: Mark Maiello again from  
9 Wyeth Research. You know, we are starting to touch  
10 on the money issue now a little bit. And I'd like  
11 to remind everyone here that even pharmaceutical  
12 companies have budgets and --

13 (Laughter.)

14 -- we are -- we are starting to hear  
15 rumors. You know, again, I hate to bring up  
16 anecdotal information, but, you know, we are hearing  
17 rumors that new irradiators may cost, you know,  
18 hundreds of thousands of dollars.

19 In the present economic atmosphere, even  
20 companies like my own are struggling. And prior to  
21 this, they were struggling on their own without the  
22 present economic burdens, research lines and  
23 research avenues in most pharmaceutical companies.

24 And I know there are some of my  
25 colleagues here, so correct me if I'm wrong, there

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1 are -- those research avenues were drying up. So,  
2 you know, budgets are rather tight. Unless these  
3 new -- and with all due respect to the panel  
4 members, unless these new sources are competitively  
5 priced, with the non-isotopic versions, for  
6 companies like mine that do not need a mono-  
7 energetic photon beam, they will switch over.  
8 That's what I'm hearing from my management and the  
9 scientists that use these devices. They will switch  
10 over to X-ray type devices.

11           Again, it is probably too early to  
12 determine what the cost of these things will be, but  
13 it is something to keep in mind.

14           MR. JARDINE: Let's see, Les Jardine, a  
15 consultant. And I have worked the last 12 years in  
16 Russia, including the Mayak site.

17           Just I want to add what is missing --  
18 and everybody should bear in mind -- the cesium  
19 comes from an operating reprocessing plant. There  
20 is one at Mayak. There is none in the U.S.

21           That plant purposely designed a process  
22 to recover cesium nitrate. That doesn't exist in  
23 France, where there is another operating plant. To  
24 take that product, as Albert Aloy said, to another  
25 form requires the scientific basis, which the

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1 institute has developed. But what's required are  
2 the engineering study to decide how to fit that in  
3 an operating reprocessing plant in their hot cells.

4 And that is where this time comes in.

5 And it's my personal judgment, having  
6 worked feasibility studies and others in Russia,  
7 it's a five-year process to take it to another form  
8 in an operating plant at Mayak. That's why I'm  
9 supporting the notion of three years, but it's not  
10 -- and just bear in mind, in Oak Ridge, what could  
11 they do? They don't have any cesium nitrate. We  
12 don't have the reprocessing plant.

13 So somehow, you know, as an operating  
14 reprocessing plant you have to develop a whole  
15 remote operated production line and continue the  
16 scientific work. And it's a five-year timeline, is  
17 my experience in Russia.

18 And I should just add, because I may not  
19 comment again, and there has to be the cooperative  
20 agreement between the governments to allow that work  
21 to take place. That's missing. The U.S.-Russian  
22 government to allow that work to happen is missing.

23 FACILITATOR RAKOVAN: Orhan? If you  
24 could introduce yourself again, please.

25 MR. SULEIMAN: Yes. Orhan Suleiman with

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1 FDA, but these are clearly my professional  
2 questions. I have accepted the fact that the  
3 activity, although reduced, could probably be -- you  
4 can use more of it, and it will probably be  
5 feasible. It sounds like industry is up to the  
6 challenge.

7 The more fundamental issue is the  
8 chemical, non-dispersibility form, and how that  
9 works out economically I have no idea. But,  
10 obviously, it is feasible. I just wanted to get  
11 that clarified in my mind.

12 So it sounds like it is very, very much  
13 possible to come up with a solid, non-dispersible  
14 form of cesium, and it's -- probably with sufficient  
15 activity, in larger amounts, that would fulfill the  
16 tasks necessary. How that plays out economically,  
17 as I said, I'm not going to participate in that  
18 decision, because who is going to manufacture it,  
19 who is going to put it together is a different  
20 issue.

21 But the scientific issues, the technical  
22 challenges, sound like they're soluble. I mean,  
23 they're -- they can be resolved.

24 (Laughter.)

25 They can be resolved.

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1 Am I correct on those two points? We  
2 probably could get a forum that would be adequate,  
3 and we probably could get insufficient activity. I  
4 mean, that's what I'm hearing. I don't really need  
5 your answer. That's what I've come to the  
6 conclusion myself.

7 FACILITATOR RAKOVAN: Anybody want to go  
8 into that territory?

9 MR. SCHRADER: I was just going to say I  
10 think it's a correct conclusion that it is a  
11 solvable issue. I wouldn't go so far as to say,  
12 yes, it's -- the money is -- you know, how much is  
13 it going to cost? Is it -- we can solve the  
14 problem, but can people afford it when we get it  
15 solved?

16 Secondly, I would just kind of add that  
17 everything is dispersible with enough exposure  
18 behind it.

19 MR. PATTON: I guess I might make one  
20 more comment. I guess it was mentioned that there  
21 is some void volume in these sources, so there is --  
22 we could reduce the void volume in the cell -- I  
23 mean, into the -- in the source and also decrease --  
24 or increase, I guess -- the amount of material in a  
25 given volume.

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1           But I would like to caution that we do  
2 want to keep safety in mind as well. And barium  
3 grows into these materials. It has different forms.

4           So we need to look at the thermal expansion and  
5 make sure we don't develop a source that is not safe  
6 in the process of changing the source form. So all  
7 of the testing, and so forth, needs to be done to  
8 make sure that the source form is safe as well.

9           FACILITATOR RAKOVAN: Dr. Aloy, you had  
10 --

11           MR. ALOY: We need to find not only the  
12 physical forms, but also to provide the results --  
13 positive results after the testing of these forms in  
14 optimal design, because we have after the studies  
15 some ceramics or glasses, we provide the test for  
16 compatibility, for fire, and for some additional  
17 tests for specificity.

18           And not -- we have good results after  
19 this testing. So it's not only the problem to find  
20 the alternative forms and produce. It also needs  
21 along the way for testing purposes alternative forms  
22 and the design of sources for specificity. We have  
23 standards and -- followed by these vendors in all  
24 the testing.

25           MR. COPPELL: Well, I think I'm at risk

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1 of repeating what a number of other people have  
2 said. I agree with the point that Brad made about  
3 the -- we do need to take care of the question of  
4 safety and allowing sufficient void volume in  
5 cesium. But in estimating, maybe a half the content  
6 activity in a source made to a new format, I think  
7 we are making allowance for that. I don't really  
8 want to complicate the issue by going into the  
9 detail of what that means.

10 And I also agree with the comments that  
11 Mr. Aloy made about, in terms of the performance of  
12 these sources, there is a long road to go down to  
13 convince ourselves that the improvement that is  
14 delivered from a change in physical and chemical  
15 form is adequate to meet everybody's needs and  
16 expectations. And that is particularly true in  
17 terms of dispersibility.

18 I think we have had a couple of  
19 conversations and discussions about leachability or  
20 solubility, if you want to call it that, and that's  
21 a relatively simple term to understand. And it's a  
22 relatively simple concept to measure and validate.

23 But when it comes to discussion about  
24 dispersibility, which of course is another concern,  
25 then I don't know that there is any very clear

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1 guidelines right now. And I think part of the  
2 process of developing the technology will be to  
3 develop an understanding of what is acceptable in  
4 terms of dispersibility.

5 FACILITATOR RAKOVAN: Anyone care to  
6 piggyback on that, or make another point? Please  
7 introduce yourself, sir.

8 MR. POWELL: I am Brian Powell. I am  
9 from Constellation Energy, nuclear power. And I  
10 guess I am trying to get an understanding of this  
11 from a practical perspective. So what I'm  
12 understanding is that to calibrate our instruments,  
13 for example, we are going to need twice the  
14 material. We'll basically have to replace our  
15 calibrators, and that -- there is going to be some  
16 increased cost with this new solid type of source.

17 I don't know if there's a ballpark  
18 number that it's going to be 10 times as much per  
19 curie, or 1,000 times more per curie, or a million  
20 times more per curie, but that would be something  
21 that I'd like to know.

22 And the other thing is, which I'm  
23 hearing some things being touched on, is industrial  
24 safety issues. You know, does making these new  
25 sources introduce other things that we are going to

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1 need to be able to monitor for besides just  
2 radiation? Chemicals leaching out, things like  
3 that?

4 FACILITATOR RAKOVAN: Just wanted to  
5 interject from that question. Just keep in mind  
6 that, you know, we are having this workshop because  
7 it's part of the process. We haven't made any  
8 decisions on how we're moving forward on this at  
9 this point. So just kind of wanted to throw that  
10 out there. We're -- you know, we're just discussing  
11 these issues.

12 Did anybody want to react to the  
13 gentlemen's statements?

14 MR. COPPELL: On the subject of cost, I  
15 mean, I think it's obvious to the industry that this  
16 isn't going to work if the cost of the new  
17 technology is that significantly greater, or, more  
18 particularly, if the cost of the new technology is  
19 more than alternate technologies. Then, clearly, it  
20 is not going to be very attractive.

21 So that has got to be borne in mind, and  
22 it is being borne in mind in terms of our  
23 development activities.

24 I think, though, that you need to recall  
25 that the costs will be split into two parts, really.

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1       The first part is a development cost, and that  
2       could be quite significant to the industry, and, of  
3       course, the risk is that that development cost will  
4       have to be incurred before there is any revenue or,  
5       indeed, any guarantee of any revenue. And that is  
6       part of the discussion we need to have.

7                   And then, there will be a manufacturing  
8       cost once the technology is developed and installed  
9       and considered operational. And that is not yet  
10      assessed, but we understand that it needs to be  
11      realistic in terms of market accessibility.

12                   FACILITATOR RAKOVAN: I am going to use  
13      a pause, since I see no hands. Lynne, do you want  
14      to go ahead and give your presentation?

15                   Michelle, if you could bring Lynne's  
16      presentation up? She has just got some general  
17      information from the medical perspective that she  
18      wanted to share.

19                   MS. FAIROBENT: Thank you, Michelle.

20                   As I introduced myself earlier, I am  
21      Lynne Fairobent with the American Association of  
22      Physicists in Medicine (AAPM). And since this issue  
23      surfaced and the NAS panel had been charged with  
24      their task, AAPM and the medical community has been  
25      looking at this issue.

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1 Next slide, Michelle.

2 AAPM's mission, just for those who may  
3 not be as familiar with us as others in the  
4 audience, is to promote the highest quality medical  
5 services for patients while advancing the practice  
6 of physics in medicine and biology by encouraging  
7 innovative research and development, disseminating  
8 scientific and technical information, fostering the  
9 education and professional development of medical  
10 physicists. And we currently represent about 6,000  
11 medical physicists, primarily in the U.S., but we  
12 also do have international members.

13 Next?

14 The use of radioactive materials in  
15 medicine I think can easily be stated and not  
16 disputed, that it has resulted in many lives being  
17 saved that otherwise would not be. Cesium chloride  
18 irradiators are just one example of the way in which  
19 this occurs.

20 AAPM is concerned that the prohibition  
21 or elimination of the use of cesium irradiators  
22 could result in a decrease in the standard of care  
23 that currently exists in this country. As a result  
24 of that -- next slide -- AAPM conducted a survey in  
25 August of this year to assess our members'

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1 experience with irradiators across the board.

2 The results of the survey are skewed  
3 toward hospital-base or university-base irradiators,  
4 but it should not affect the general overall  
5 conclusions and trends.

6 Next slide.

7 The survey was distributed to all AAPM  
8 members, as well as members of the RSO, the  
9 Radiation Safety Officers' listserv, and other  
10 medical organizations had access to this.

11 We received 363 respondents, 297 had  
12 irradiators. 84.6 of those used cesium-137 as the  
13 source. 9.3 percent used conventional X-ray units.

14 Six percent used medical LINAC accelerators or  
15 LINACs.

16 The cesium units represented all of the  
17 major vendors. Only 10 percent were purchased  
18 within the last two years, and seven percent planned  
19 on replacing the units within the next five years.

20 Next slide.

21 Twenty-five percent of the cesium units  
22 had some malfunction, but most were repaired in less  
23 than seven days. This is an issue that keeps coming  
24 up as we discuss and debate the difference between  
25 the cesium chloride irradiators and transitioning to

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1 the X-ray units.

2 Of the X-ray units, 35 percent had  
3 malfunctions, with 44 percent being repaired in  
4 seven days.

5 Next slide.

6 Of the cesium units, only 40 percent are  
7 used for blood irradiation, and I think this is key  
8 to keep in mind -- is the other irradiation uses of  
9 these irradiators. With 25 percent used for  
10 material, 25 percent for animal irradiations, and 10  
11 percent was unspecified as other uses.

12 Of the X-ray units, 50 percent were used  
13 for blood irradiation, 19 percent for material, and  
14 32 percent for animals. Of the medical LINACs that  
15 were used in this modality or use, 40 percent were  
16 for blood irradiation, and 11 for animals, versus  
17 the primary use of LINACs, of course, is to treat  
18 patients -- human patients and veterinary patients  
19 -- for the treatment of cancer.

20 Next slide.

21 In conclusion, we feel that both types  
22 are usable. The conventional X-ray irradiators seem  
23 to be fairly reliable. However, they represent only  
24 a small minority of the irradiators currently in the  
25 field, and they have slightly more down time than

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1 the cesium units.

2 The cesium units, on the other hand, we  
3 know to be extremely reliable. Their users, in  
4 general, have no plans to replace them unless there  
5 is an external factor that is going to drive them to  
6 that.

7 Next slide.

8 We believe that the forced removal of  
9 cesium irradiators would result in a large loss of  
10 resources, both radiation sources and funds, not  
11 only from medical facilities but research  
12 institutions as well.

13 Next slide.

14 In considering the cost of alternative  
15 technologies, one needs to include not only the cost  
16 of the replacement, but the calibration and  
17 maintenance of the equipment, the cost of downtime  
18 for the critical use equipment, such as the blood  
19 irradiators. And a quantifiable cost for the  
20 alternative blood sterilization during equipment  
21 down time needs to be assessed and needs to be  
22 possible, as well as the human cost for patients who  
23 need blood.

24 In many cases, the comments we receive  
25 from the survey, if an X-ray unit is being used for

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1 blood irradiation, and it is down, oftentimes the  
2 backup is the cesium irradiator at someone else's  
3 facility if they do not have one at their own  
4 institution.

5 Next slide.

6 It is easily demonstrable that cesium  
7 chloride sources utilized in blood irradiators have  
8 a much more reliable performance record than  
9 machine-produced technologies. And both the cost  
10 and continuity of operation or failure should be  
11 considered financially, and then the possible impact  
12 on human life.

13 Over the course of the rest of today and  
14 tomorrow, we actually will be sharing more data as a  
15 result of a couple of the other questions that are  
16 being asked. But there is a huge increase in  
17 concern in the research community on the viability  
18 of transitioning, for clinical trials work, from  
19 using a cesium irradiator now to -- if one has to  
20 transition to the X-ray unit, can one in fact  
21 demonstrate the equivalency to FDA in order not to  
22 jeopardize the clinical trials work that has been  
23 done currently, and not have to go back and start at  
24 square one.

25 Thank you.

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1 FACILITATOR RAKOVAN: Thanks, Ms.

2 Fairobent.

3 Michelle, if you could go ahead and  
4 bring up the question again.

5 Anyone have any reaction to the  
6 presentation that Ms. Fairobent just gave, or any  
7 other issues that they'd like to throw around in  
8 terms of question 1.1? Please.

9 MR. MAIELLO: Mark again from Wyeth  
10 Research. Lynne, that was very good. The -- again,  
11 the anecdotal information I will give you from my  
12 institution. And, again, if my colleagues find that  
13 this is inaccurate, please go to the microphone.

14 I'll step back a little bit about what  
15 -- you know, about what I commented on earlier. The  
16 pharmaceutical companies are a little strange. They  
17 do things with research lines in mind, and that  
18 research often changes.

19 In my own institution, the use of the  
20 irradiators is basically two different types, one  
21 for irradiating small animals, the other for  
22 irradiating cells. The group that irradiates the  
23 cells would agree with the equivalency issue that  
24 you brought up, because when asked directly by me  
25 they said, yes, it would be potentially troublesome,

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1 because the literature has used the -- the  
2 literature shows that researchers have used the  
3 cesium sources most frequently for irradiating  
4 cells. And perhaps research that was conducted with  
5 an X-ray machine, with its broad spectrum, would be  
6 questioned.

7           On the other hand -- and this was part  
8 of my comment before -- the group that irradiates  
9 with animals -- irradiates the animal lines would  
10 probably not care. However, I will say this. The  
11 researcher who I questioned, who was in charge of  
12 the irradiator, said to me a few days ago it would  
13 be potentially feasible, if the money is there, to  
14 purchase -- to keep the irradiator, assuming no  
15 regulatory issues arise, and buy an X-ray machine at  
16 the same time, and use it exactly the way you  
17 described it -- as a potential backup for the X-ray  
18 machine if the X-ray machine fails, and we have  
19 heard about the higher maintenance and potentially  
20 higher breakdowns. And so the irradiator would  
21 still be there, assuming, of course, that no  
22 regulatory issues arose to force us out.

23           So the situation is never quite clear.  
24 It is always gray. And when given a choice, people  
25 will often take the choice, especially if -- I have

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1 to say it -- if the money is there, they will take  
2 the choice.

3 FACILITATOR RAKOVAN: Okay. A few more  
4 comments, and then we're going to move on, please.

5 MR. McBRIDE: I'm Bill McBride from  
6 UCLA. I'm a radiobiologist. I'm representing ASTRO  
7 here. It's the American Society of Therapeutic  
8 Radiation Oncology.

9 Yes, I'd like to say that there are  
10 actually -- you know, from a radiobiological point  
11 of view, I'll state the obvious. An X-ray is not a  
12 gamma ray. There is a big difference between them.

13 I think the -- you know, whenever it  
14 comes to the usage of these machines, they are all  
15 used for different purposes. And, actually,  
16 switching -- I mean, I disagree entirely that small  
17 animal users could switch easily to X-rays. That  
18 just isn't true. I think that it would take a lot  
19 of effort. Most of the work that has been done with  
20 small animals have used cesium.

21 I think that in particular for things  
22 like whole body radiation setups cesium is a much  
23 better kind of -- for all kinds of technical  
24 reasons. I think making that change is going to be  
25 expensive, it's going to use more animals, you are

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1 going to get into a whole new recalibration system.

2 And I think it is not just a simple matter of, you  
3 know, taking the animals and saying, "Okay. Let's  
4 use X-rays." I don't think it's going to be that  
5 easy at all.

6 So I think there are disadvantages,  
7 certainly, to using X-rays for many studies, not all  
8 certainly. There are some situations where the  
9 transition can be made without a great deal of  
10 difficulty, but they are other situations where it  
11 is just going to be very difficult indeed.

12 FACILITATOR RAKOVAN: One more hand,  
13 please?

14 MR. NIXON: Grant Nixon with Best  
15 Theratronics. As the world's leading manufacturer  
16 of self-contained irradiators, in both the X-ray  
17 technology form and in the cesium form, I would  
18 agree wholeheartedly with that comment. The use of  
19 X-ray technology does not port well to the research  
20 irradiator applications, specifically with regards  
21 to irradiating animals. There is a big difference  
22 between the mode of dose deposition.

23 When you're dealing with low-energy  
24 photons that are inevitably part of the X-ray  
25 spectrum, you will end up with a lot of photo-

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1 electric differentiation in terms of the absorbed  
2 dose. So unless you can genetically engineer a  
3 mouse not to have any bones --

4 (Laughter.)

5 -- you are going to be -- you are going  
6 to be stuck with using a high-energy gamma research  
7 irradiator for the foreseeable future.

8 Thank you.

9 MR. KAMINSKI: Hi. Joe Kaminski, NIH,  
10 but I'm not speaking on behalf of the NIH. I'm a  
11 radiation oncologist. Again, we treat with X-rays,  
12 high-energy X-rays, and, of course, you know, a  
13 mono-energetic 660KeV gamma -- that's cesium -- is  
14 useful. But certainly other sources, such as  
15 cobalt, could be used, which would more mimic the  
16 high-energy X-rays which we used clinically.

17 So to disregard X-rays -- and, again, we  
18 can use LINACs for some animal use, although it is  
19 expensive. But there are alternatives, such as  
20 high-energy X-rays. So --

21 MR. SVAJGER: Hi. I'm Mark Svajger with  
22 Fluke Biomedical. We are a large calibration  
23 facility. I just have a statement and a question.  
24 First of all, the statement. Any changes will cause  
25 the price of calibration to go up. And we are

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1 already probably one of the most costly facilities  
2 right now, at, let's say, \$200 an instrument.

3           So when we're talking about, like the  
4 gentleman from Constellation Energy, is it going to  
5 be 100 times more, a million times more? That will  
6 all impact us as we use our equipment to survey our  
7 facilities.

8           Number two, my question is, if we change  
9 -- this is more or less for Brad, I guess. If we  
10 change from a powder form to more of a ceramic form,  
11 are there any more inherent errors or variables with  
12 that?

13           MR. PATTON: Maybe others can -- I think  
14 there might be some self-shielding, but I think  
15 someone mentioned earlier that the energy of the  
16 gamma is going to be the same in these different  
17 forms. And there might be some self-shielding if  
18 you bring in some cermats, you bring metals or other  
19 things into it. But I think you will get the same  
20 type energies, which I would think would be of  
21 interest to you.

22           MR. ALOY: I can say that because the  
23 ceramics or glasses contained only elements with the  
24 atomic weight, the self-absorption is not -- will  
25 not change very sharply from the cesium chloride.

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1 So the properties will be very close to cesium  
2 chloride.

3 MR. MAIELLO: If I might just get back  
4 to that issue briefly about the use of both machines  
5 at a facility. First, let me say, don't shoot the  
6 messenger. I'm only repeating what the scientists  
7 tell me.

8 And maybe the confusion bespeaks more to  
9 the -- where we are about this than anything else.  
10 And if they haven't researched it very well, then  
11 they are making statements about using both kinds of  
12 machines, you know, with one as a backup. On the  
13 other hand, the end point that we used the machine  
14 for is simply the knocking down of the immune system  
15 of the animal. It is not to do anything else.

16 Now, whether that -- you know, certainly  
17 a mono-energetic photon is not needed for that, but  
18 the -- it is true that the broad spectrum of the X-  
19 ray machine may induce some secondary effects that  
20 scientists have not considered. But, again, that is  
21 because of where we are in this entire issue. They  
22 are hearing these things, that these cesium sources  
23 may go away and they are beginning to explore  
24 whether or not the alternatives are available.

25 Now, I do know -- I have made contact

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1 with a few other scientists at other institutions,  
2 and they use the machine -- the X-ray machine for  
3 exactly the same reason we do -- to knock down the  
4 immune system of the animal, so that oncological  
5 compounds can be tested on the tumors that the nude  
6 mice grow rather quickly.

7 FACILITATOR RAKOVAN: Sir, I'm sorry.  
8 I'm going to interrupt real quick. Right now, I'm  
9 just trying to bring us all in. We're focusing on  
10 feasibility of the use of other forms of cesium-137.

11 If you'd like, I can't put like in a parking lot  
12 kind of the X-ray stuff, because we are going to hit  
13 on that later. Do you want me to put it up there,  
14 or do -- to --

15 MR. MAIELLO: As I understand, that is  
16 going to be another question.

17 FACILITATOR RAKOVAN: Yes, yes. We're  
18 going to get to that.

19 MR. MAIELLO: We can hold that off until  
20 then.

21 FACILITATOR RAKOVAN: Okay. I just  
22 wanted to kind of bring us back.

23 Lynne, I saw you had your tent up  
24 earlier?

25 MS. FAIROBENT: I think the only comment

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1 I wanted to make on -- with regard to a LINAC being  
2 used instead of cesium chloride, while we are  
3 awaiting development of an alternative form of  
4 cesium perhaps, is that in many of the medical  
5 institutions where they may use the LINACs for blood  
6 irradiation, they have to schedule the blood as if  
7 they were scheduling a patient for treatment. And  
8 oftentimes the LINAC may not be available, because  
9 patient treatment tends to take priority, as I think  
10 most of us would agree it probably should.

11 So if there is -- if the X-rays are  
12 being used and there is down time on that, and the  
13 LINAC is the backup, it may not be available due to  
14 patient treatment schedules.

15 FACILITATOR RAKOVAN: As you've noticed,  
16 we've put the other -- the next question up, which I  
17 think we've been covering anyhow. It's question  
18 1.12, is the use of other forms of cesium feasible?

19 If so, please describe desired methods, and discuss  
20 any benefits or obstacles. Again, I think we have  
21 been covering this, unless -- if someone has a  
22 specific additional topic.

23 Sir, if you can introduce yourself one  
24 more time.

25 MR. MENNA: Yes, Blair Menna again from

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1 Best Theratronics.

2 I just want to key in on the word  
3 "benefits" there. And one of the things that I  
4 think potentially may be feasible and would  
5 certainly be extremely beneficial is, if we went  
6 into reprocessing cesium, wouldn't it be wonderful  
7 if we were reprocessing the existing cesium  
8 chloride? So the benefit would be that we -- we  
9 would essentially defer the disposal problem. We  
10 wouldn't have to find an immediate storage solution  
11 for that.

12 Assuming that the specific activity  
13 drops off, and assuming that there is a switch to  
14 alternative technologies all together, I am  
15 wondering whether or not we couldn't essentially  
16 reprocess cesium, have enough return from the field  
17 that then would be returned for applications in a  
18 less dispersible form.

19 So I see it being a benefit. I don't  
20 know whether any of the source manufacturers could  
21 comment on the feasibility of doing that.

22 FACILITATOR RAKOVAN: If you'd like to.

23 MR. COPPELL: Okay. Well, just briefly.

24 Yes, I understand, Blair, what your proposal is  
25 there, and it does sound attractive, doesn't it?

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1           There are one or two obstacles that we  
2 may have to overcome before we could recycle cesium  
3 that is currently in circulation, not least the fact  
4 that a lot of that material is quite old already.  
5 Cesium has a half-life of around 30 years. And so  
6 material which is well into one half-life may be 15  
7 or 20 years old. It is really questionable whether  
8 that would be reusable anyway.

9           We are already looking, as we have  
10 described, at the potential reduction in specific  
11 activity of an alternate form of maybe a factor of  
12 two. If you make that worse by using 15-year old  
13 cesium, or 20-year old cesium, I'm just not sure it  
14 is practical. But it is -- it is something that is  
15 being considered.

16           MR. ALOY: Excuse me. It's -- maybe I  
17 do not speak in good English, but I would like to  
18 say that besides cesium-137 we have this table. I  
19 support cesium-133. And when we use the decay of  
20 cesium-137, the ratio between stable isotope and  
21 radioactive isotope changed, and the stable isotope  
22 equivalence in the -- for the second review of this  
23 radioactive isotope. So this is not feasible to --  
24 to process the spent sources to separate cesium-137,  
25 because the ratio will be not good for the -- using

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1 their radiation sources.

2 MR. COPPELL: At the risk of getting  
3 into too much detail, I agree with that. But, of  
4 course, the cesium-137 decays to barium. The barium  
5 is -- can be separated after the cesium, so it -- in  
6 effect, the effective specific activity of the  
7 material doesn't decay with the same 30-year half-  
8 life as the cesium-137 does. You can recover some  
9 of this lost activity by removing the barrier.

10 FACILITATOR RAKOVAN: Please introduce  
11 yourself.

12 MR. JONES. Yes. Rick Jones, just  
13 private citizen. I represent myself.

14 (Laughter.)

15 Just hearing the dialogue, it -- what  
16 I'm hearing is the users are expressing criteria  
17 that has to be met. Manufacturers are kind of  
18 responding to that, and these are kind of drivers  
19 from both sides to inform the decision.

20 As a path forward, something to  
21 consider, not making more work for federal agencies,  
22 but it would seem a getting together of the users to  
23 create the criteria that they need in the different  
24 uses of these sources, and then compiling that, and  
25 then communicating that to the manufacturers, gee,

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1 how would you meet these criteria, would really go  
2 to help inform what can and can't be done and in  
3 what timeframe, how much money would it take, how  
4 many years of development.

5 If it's five years just to create the  
6 product line, how many years of testing would it  
7 require to accept the product in the different users  
8 for blood irradiators, for your radiation of  
9 animals, cells? You know, how many years of just  
10 testing of the new product to make it acceptable to  
11 the user community?

12 But I just -- in listening to this, it  
13 seems like a collection of user needs communicated  
14 to the manufacturers to then respond to see what  
15 they could do. And perhaps that could be something  
16 the federal agencies could do in informing the  
17 answers to these questions over time.

18 Thank you.

19 FACILITATOR RAKOVAN: Thank you, Mr.  
20 Citizen.

21 (Laughter.)

22 I'm going to go ahead and try to get  
23 through a few of the questions. 1.13 I believe we  
24 have up already. Would the affect of density  
25 loading, with different forms of cesium, preclude

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1 the use -- their use in existing devices? And also,  
2 would it require modification of existing devices?  
3 If anyone has any specific points that haven't been  
4 made on this topic, now would be a good time to  
5 interject.

6 Sir, please, step in.

7 MR. ALOY: Just only from the scientific  
8 point of view, not as a producer, because  
9 unfortunately I represent a different Mayak site.  
10 And as the people from Radio Institute note, I had  
11 an opportunity to participate in this very important  
12 meeting.

13 But from a scientific point of view, I  
14 can say that -- that feasibility study, we need to  
15 have in at once to change the technology. And this  
16 is a task for optimization. From one point of view,  
17 this is a safety, then cost, then technology  
18 availability, and the physical and allegation  
19 properties, and all together we need to combine --  
20 have good initial data based on the scientific  
21 research and development technology, and then  
22 calculate all of this in the optimization option --  
23 for optimization option.

24 And, of course, we need to move to each  
25 -- from one site, the users from other sites,

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1 distributors and producers and scientists and  
2 technology specialists. So we need to understand  
3 also about the secondary risk when we use the new  
4 technology, which accompanies a new process.

5 And this is -- will be a more  
6 complicated process, but from -- very simple answer  
7 for this question. I think -- this is my private  
8 opinion -- that, yes, we can develop a very good new  
9 ceramic or glass forms, with good density of cesium-  
10 137, which will satisfy the user's needs.

11 But we need to move to each -- okay.

12 FACILITATOR RAKOVAN: Thank you, sir.

13 Anyone else want to build off of those  
14 comments, or give another perspective? Sir, if you  
15 could introduce yourself again, please.

16 MR. WASIAK: Tom Wasiak from Best  
17 Theratronics. I guess I may repeat the previous  
18 comment, but I guess this question specifically asks  
19 -- so speaking about our family of irradiators,  
20 GammaCells, if you read the question as, would it  
21 preclude their use in existing devices, without  
22 absolutely any changes? I think the answer would be  
23 yes.

24 But if you look at it, you know, with  
25 some small to medium to large design changes, the

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1 answer would be it would be possible, and different  
2 forms of cesium would not be precluded in this  
3 application.

4 FACILITATOR RAKOVAN: Thank you.

5 MS. SHEPHERD: Mary Shepherd, J.L.

6 Shepherd and Associates.

7 FACILITATOR RAKOVAN: Could you bring --  
8 just go ahead and bring the microphone down. There  
9 you go.

10 MS. SHEPHERD: Okay. Better?

11 FACILITATOR RAKOVAN: Much better.

12 Thank you.

13 MS. SHEPHERD: Mary Shepherd, J.L.

14 Shepherd and Associates. I think it would have to  
15 be a cooperative effort with the source  
16 manufacturers and the irradiator manufacturers to  
17 develop sizes that would be interchangeable or  
18 requiring different kinds of modifications. I think  
19 it's way too soon to say a yes or a no at this point  
20 in time, because we don't know what the new forms  
21 are going to be, what the sizes will be, or if they  
22 would be interchangeable.

23 FACILITATOR RAKOVAN: Very good point.

24 Please introduce yourself, sir.

25 MR. GERSABECK: My name is Edward

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1 Gersabeck. I'm with U.S. Department of Agriculture.

2 We currently own and operate nine Huseman Category  
3 1 irradiators that we use primarily for sterilizing  
4 insects. And in our line of work we simply can't  
5 tolerate too much of an increase in time, which  
6 you're sort of implying if you had increased --  
7 decreased your activity by about a half, because in  
8 our line of work the time is critical because we try  
9 to destroy the gonadotropic tissue in the insects.  
10 But if they are in those irradiators too long, we  
11 start getting secondary damage to the insect.

12 So -- and I'm not sure if -- maybe if  
13 there is someone from NRC here, if we had to  
14 redesign the Huseman to accept a higher amount of  
15 material, would that imply having to get a new  
16 license as well for those? Because we also own the  
17 license to the Huseman irradiator.

18 Thank you.

19 FACILITATOR RAKOVAN: Any further  
20 discussion on this particular question before we  
21 move on to the next?

22 (No response.)

23 Okay. Michelle, 1.14. Is it feasible  
24 that high activity, e.g. IAEA Category 1 and  
25 Category 2, cesium sources will be available in

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1 alternative material forms? If so, what is the  
2 estimated timeframe for manufacturing?

3 Please, go ahead.

4 MR. COPPELL: Well, I think to some  
5 extent we have covered that already. I think the  
6 answer is probably, though we need a few more months  
7 to come up with a firm proposal. And with regard to  
8 timeframe, well, a few years. Don't know quite what  
9 that means, somewhere between two and five I guess,  
10 probably nearer five.

11 FACILITATOR RAKOVAN: Okay. Please.

12 MS. SHEPHERD: Mary Shepherd from J.L.  
13 Shepherd and Associates.

14 FACILITATOR RAKOVAN: If you could speak  
15 up just a little bit. Do your best.

16 MS. SHEPHERD: I'm freezing.

17 (Laughter.)

18 Mary Shepherd from J.L. Shepherd and  
19 Associates. One thing we haven't discussed is what  
20 we did with the chloride sources, that the DOE did  
21 -- was a 100-year accelerated aging test, and I  
22 don't know what the timeframe would be on that  
23 before, you know, any licensing could be performed.

24 I just -- I didn't know what -- if we had even  
25 thought about those yet.

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1 FACILITATOR RAKOVAN: Want to take a  
2 stab? You seem to be a very popular guy at this  
3 panel, so --

4 (Laughter.)

5 -- maybe I should just assume that you  
6 are going to be addressing the questions.

7 MR. COPPELL: It's a good point, Mary,  
8 and you -- it is one of the issues that we need to  
9 consider, as well as the question of  
10 solubility/dispersibility, the third element that I  
11 would probably cite as being a technology issue,  
12 which we need to include in the development program,  
13 is to work out how stable these materials are over a  
14 period of time in the matrices that we developed for  
15 them.

16 It's easy enough to say, well, they  
17 should be okay, because we've had -- we've had a lot  
18 of ceramic and glass materials with cesium in them  
19 around for 30 or 40 years. But I'm not sure how  
20 much evidence or data there is about how they  
21 perform once they are 20 or more years old. So it's  
22 an issue. We do need to do some accelerated  
23 lifetime trials on them, but it's assumed to be part  
24 of the program. We have not forgotten it.

25 FACILITATOR RAKOVAN: Further discussion

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1 on these issues? Please. If you could introduce  
2 yourself, sir.

3 MR. MINNITI: Yes. I am Ronnie Minniti  
4 from the National Institute of Standards and  
5 Technology. I have a question. When --

6 FACILITATOR RAKOVAN: Could you turn up  
7 the mic?

8 MR. MINNITI: Yes.

9 FACILITATOR RAKOVAN: Just bring it up  
10 closer to you. You can just turn -- you can move  
11 it. There you go.

12 MR. MINNITI: Okay.

13 FACILITATOR RAKOVAN: Don't be afraid.

14 MR. MINNITI: Yes. The summary that was  
15 made at the beginning classified the different  
16 applications in three basically, right? Research  
17 irradiators, blood irradiators, and calibration. So  
18 I think I speak on behalf of the people that need  
19 calibration of instruments.

20 So the question is -- we are talking  
21 about here about periods of time, a few years,  
22 right? And I think I heard this morning saying that  
23 it will depend on the market and how many  
24 irradiators will be needed. So, hypothetically, if  
25 some of the -- for these -- for some of these

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1 applications, like blood irradiators, it's decided  
2 that other forms -- other alternatives are going to  
3 be used.

4 And then, the only people who would need  
5 another form of cesium would be the calibration  
6 facilities. This is approximately something between  
7 10 and 20 percent of the current irradiators in use.

8 So in that case, would the manufacturers be  
9 interested in pursuing this? I guess that's the  
10 question, because then that would increase cost of  
11 making sources, right? As opposed to -- do you  
12 understand the question or --

13 (Laughter.)

14 Yes. Well, it looks like you are going  
15 to --

16 (Laughter.)

17 MR. COPPELL: I think if I -- can I  
18 reinterpret the question? I think what you're  
19 saying is that if a number of the applications for  
20 cesium sources dropped off the list --

21 MR. MINNITI: Yes.

22 MR. COPPELL: -- and other technologies  
23 were used for them, would that increase the cost of  
24 the remaining --

25 MR. MINNITI: Yes.

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1 MR. COPPELL: -- smaller volume of  
2 cesium sources?

3 MR. MINNITI: Yes.

4 (Laughter.)

5 Well, no, that's obvious, but what  
6 concerns me is that, okay, well, if this is not -- I  
7 guess it's a comment more than a question. But if  
8 that's the case, then will there be a replacement --  
9 a possible replacement for calibration of  
10 instruments? If it's decided that, okay, we cannot  
11 pursue -- the manufacturers of sources are not going  
12 to pursue another form of cesium, because then the  
13 cost is too high for just a few users, right? Which  
14 is maybe 100 out of currently 1,500 calibrators out  
15 there. Then, that would become a problem, right,  
16 for those -- for that particular application. So I  
17 guess it was just a comment.

18 FACILITATOR RAKOVAN: I think we are  
19 going to get into some of those issues later in the  
20 panel.

21 One last comment before we move on to  
22 the next question? Sir, if you could introduce  
23 yourself again, please.

24 MR. POWELL: Yes, Brian Powell,  
25 Constellation Energy. So I'm representing nuclear

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1 power.

2 And just looking at this question up  
3 here, is it feasible that high activity, IAEA  
4 Category 1 and 2 cesium sources will be available in  
5 alternate material forms? And it's just a comment.

6 In the current cesium-137 form, cesium chloride, we  
7 are already covered, as far as safety and security  
8 and these sources. We have taken all our steps to  
9 make sure that those are protected.

10 And that wouldn't change if those  
11 sources were in a different form. So I'm kind of  
12 looking for the benefit of spending all this time  
13 and energy to follow this path when we already have  
14 things in place to protect them. And we are going  
15 to do the same thing, regardless of the form that  
16 this source is in.

17 FACILITATOR RAKOVAN: Okay.

18 MR. KAMINSKI: Joe Kaminski. To address  
19 that question, I guess, is -- the concern is the  
20 solubility of the cesium-137 chloride. Just I'm  
21 also on the emergency preparedness side, and  
22 dispersibility, and the ability to leach into  
23 concrete, and so forth. So if it gets released, for  
24 example, in the City of New York, let's say, while  
25 you're talking about economic impact, that could be

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1 billions of dollars. That could be underestimating  
2 it.

3 So, I mean, it is a real potential, and  
4 that's why there is concern. And, again, I don't  
5 speak on behalf of NIH. So --

6 FACILITATOR RAKOVAN: Okay. Any further  
7 discussion before we move on to the next question?  
8 Okay.

9 MR. ALOY: Unfortunately, we have not  
10 the standards for dispersibility properties of these  
11 materials. We have standards for leachability, we  
12 have standards for the mechanical properties study,  
13 for fire testing, but we have not -- IAEA regulation  
14 hasn't standards for dispersibility. What does it  
15 mean?

16 Because any materials may be dispersed  
17 in small particles with action from explosion, for  
18 example, or from other mechanical forces. So maybe  
19 we need to develop these standards or testing --  
20 testing procedure for dispersibility, to meet these  
21 requirements. It's my opinion.

22 FACILITATOR RAKOVAN: Okay. Yes,  
23 please.

24 MR. COPPELL: Yes, I agree. Maybe I --  
25 I think we all understand that the risk is that this

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1 -- this gets close to the security issue. But I  
2 think we -- we are going to have to work out what we  
3 mean by "dispersibility," how exactly are you going  
4 to try to disperse it before you can do anything to  
5 assess its performance in those circumstances and  
6 compare it with other options. It's tricky. I  
7 don't know how we go about that, but we need to find  
8 a way.

9 FACILITATOR RAKOVAN: Okay. We've got  
10 two more questions I'd like to get through before we  
11 go out for lunch. Question 1.15, since all of the  
12 cesium chloride is manufactured in Mayak, Russia, is  
13 it known if the cesium source producer can modify  
14 its production processes? I think I know kind of  
15 who this question might be focused on.

16 (Laughter.)

17 Are you okay with addressing it, sir,  
18 or --

19 MR. COPPELL: Yes, okay. I mean, but I  
20 think we have more or less addressed it a couple of  
21 times. It is -- the answer is, in principle, we  
22 think so. It depends on just what the technology  
23 involves. As Dr. Aloy has said, you know, it -- the  
24 technology development must include development of  
25 facilities for production, must ensure that we have

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1 validated the product to make sure it does what we  
2 think it does, as well as just the scientific  
3 element of, can we make this material in a less  
4 soluble, less dispersible form.

5 I think, you know, that the view within  
6 the industry is the answer is probably. We need a  
7 few more months to come up with some firm proposals,  
8 and then we need to look at whether it is  
9 commercially viable.

10 FACILITATOR RAKOVAN: Dr. Aloy?

11 MR. ALOY: It is well known that new  
12 forms, like the pollucite or glasses, you need to  
13 use a higher temperature. It is a high temperature  
14 process. During this high temperature process, the  
15 cesium alterations have made -- will be higher, and  
16 we will have more secondary waste in comparison with  
17 cesium chloride production.

18 So this is the task for optimization of  
19 the process. And, of course, we need -- this is my  
20 own opinion. Mayak all the time go ahead and  
21 develop a new technology, but we support this study  
22 by R&D in the institute. And so I think that in the  
23 near future they can do new forms.

24 MR. PATTON: This is Brad Patton again.  
25 It was pointed out earlier that we, in this

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1 country, aren't doing reprocessing, but there is a  
2 lot of research going on about reprocessing now.  
3 And some of those flow sheets include separation of  
4 fission products.

5 I think we need to consider looking in  
6 the long term, if we are separating cesium-137 and  
7 developing waste forms for cesium, we need to think  
8 about the applications here for irradiators, and  
9 perhaps some waste forms that we might develop could  
10 also be used for irradiation sources.

11 So I think as we begin to develop new  
12 waste forms and look at reprocessing in this country  
13 we need to consider the use of some of those  
14 materials for irradiation sources.

15 FACILITATOR RAKOVAN: Any additional  
16 points before we go ahead and move on to the final  
17 question on this topic?

18 (No response.)

19 Okay. I think it's already up there  
20 already, but question 1.16, would other entities in  
21 the U.S. or worldwide engage in manufacturing  
22 sources with alternative forms of cesium-137?  
23 Anyone have any thoughts that they'd like to share  
24 on this particular issue? Stab in the dark? Lynne?

25 MS. FAIROBENT: Brad, I have a question

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1 for you. You said Oak Ridge was not interested in  
2 getting into the production mode for cesium. But  
3 has there been discussion among the broader DOE  
4 community as to one of the other labs stepping up  
5 into this role?

6 MR. PATTON: Of course, we all work for  
7 the Department of Energy, so it's up to the  
8 Department of Energy to task us with production  
9 material. But I guess, again, as rightly discussed  
10 earlier, we aren't doing reprocessing in this  
11 country. The cesium we have, which is significant,  
12 is older. And we could remove the barium, but we  
13 still have the inert cesium that's in the material.

14 And so it's a lower specific activity, which would  
15 be lowered further by some of these source forms.

16 So it would be up to DOE to decide that,  
17 and I don't see anyone, you know, discussing it at  
18 this time.

19 FACILITATOR RAKOVAN: Please.

20 MR. COPPELL: Yes. I guess the issue is  
21 that a lot of the costs involved in this,  
22 effectively entry costs for establishing a facility  
23 or a plant to manufacture these products. And for  
24 somebody who doesn't manufacture them right now, the  
25 entry costs are higher than extending the capability

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1 for somebody who does. I guess that's the issue.

2 FACILITATOR RAKOVAN: Okay. Any further  
3 discussion on any of the topics involved with  
4 Issue 1.1, feasibility of the use of other forms of  
5 cesium-137, before we take a break for lunch?

6 (No response.)

7 I know, it's very encouraging for  
8 everyone to rush up with a comment, isn't it?

9 (Laughter.)

10 Okay. Let's try to get started promptly  
11 at 1:00. The next panel will be feasibility of the  
12 use of isotopes other than cesium-137. If you are a  
13 panelist, please just come right up and take your  
14 seat at the table. We'll start again promptly at  
15 1:00.

16 (Whereupon, at 11:54 a.m., the proceedings in the  
17 foregoing matter recessed for lunch.)

18 FACILITATOR RAKOVAN: Why don't we go  
19 ahead and get started.

20 ISSUE 1.2: FEASIBILITY OF THE USE OF ISOTOPES OTHER  
21 THAN CESIUM 137

22 The next topic that we will be  
23 discussing is Issue 1.2, Feasibility of the Use of  
24 Isotopes Other Than Cesium 137. Why don't we start  
25 by going ahead and having our panelists introduce

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1 themselves if we could start over here on the left  
2 please.

3 MR. CONNELL: My name is Leonard  
4 Connell. I study radiological and nuclear terrorism  
5 at Sandia Labs and I was the lead on the Red Teaming  
6 Analysis, the attack videos which some of you may  
7 have seen on looking at the vulnerability of the  
8 cesium chloride machines and also led the team that  
9 designed the upgrade kits for those cesium chloride  
10 irradiators.

11 MR. FIKE: I am John Fike, the  
12 University of California at San Francisco. I'm a  
13 radiobiologist. I'm here on behalf of the Radiation  
14 Research Society.

15 MR. KAMINSKI: Joe Kaminski, National  
16 Institutes of Health. I'm a radiation oncologist  
17 and previously in my other life also head of a  
18 laboratory and I'm involved also in the emergency  
19 preparedness side.

20 MR. McBRIDE: I'm Bill McBride, UCLA,  
21 Radiobiologist. I'm representing the American  
22 Society for Therapeutic Radiation Oncology and I  
23 also lead a CMCR which is one of the center for  
24 countermeasures at UCLA.

25 MR. RING: I'm Joe Ring, Harvard

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1 University Radiation Safety Officer. I am  
2 presenting a summary of my faculty's comments.

3 MR. COPPELL: I'm David Coppel. I  
4 didn't get any calls over lunch. So I'm still  
5 technically Manufacturing Director for REVISS  
6 Services.

7 (Laughter.)

8 MR. NIXON: I am Grant Nixon. I'm a  
9 Senior Radiation Physicist for Best Theratronics and  
10 in a former life NDS Nordion. We are the largest  
11 manufacturer of self-contained irradiators both in  
12 terms of x-ray, technology and cesium chloride.

13 FACILITATOR RAKOVAN: Thank you,  
14 gentlemen. Before we dive into the questions, I  
15 believe a few of you had statements or presentations  
16 that you wanted to go through. So if you would like  
17 to go first, that would be fine.

18 MR. FIKE: John Fike, representing the  
19 Radiation Research Society. I'd like to make a very  
20 brief statement primarily regarding the scientific  
21 impact and potential consequences of banning, in  
22 particular, cesium sources.

23 As I said, I represent the Radiation  
24 Research Society which is about 1500 members. It's  
25 a multidisciplinary group of biologists, physicists,

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1 chemists and clinicians and while there are multi-  
2 faceted and extensive interests across these people,  
3 there's a common goal of advancing the understanding  
4 of radiation effects and advanced of radiation  
5 medicine.

6 The work by these individuals is  
7 supported in a big way, hundreds of millions of  
8 dollars, by a variety of governmental sources and  
9 nongovernmental sources, NIH, DOD, DOE, NASA, DHS,  
10 NSF and others. So it's a big component of  
11 federally-sponsored research and I'd like to just  
12 summarize the concerns of the Radiation Research  
13 Society in just three major points.

14 We did a poll a couple months ago and  
15 about 80 percent of the members indicated the cesium  
16 irradiators were used by them and over half of them  
17 were critically dependent on it and when I say this,  
18 80 percent of the people said that the loss of these  
19 irradiators would be either major or catastrophic to  
20 their research efforts.

21 The second point is, and may Bill  
22 McBride will speak more to this in a moment,  
23 Radiation Research members play in a central role in  
24 the development of medical countermeasures to meet  
25 the threat of radiological nuclear terrorism. If

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1 cesium irradiators were eliminated, this development  
2 would suffer a serious setback and made our country  
3 more vulnerable and I mean that in the context of  
4 the timely development of effective countermeasures.

5 And, lastly, Radiation Research members  
6 are actively involved in the development of  
7 innovative cancer treatments involving all types of  
8 radiations. Cesium irradiators are critical to much  
9 of this work and if they are eliminated, this could  
10 have a very significant impact on the advancement of  
11 radiation medicine.

12 That's my statement.

13 FACILITATOR RAKOVAN: Thank you, sir.

14 MR. McBRIDE: Just on behalf of ASTRO  
15 (American Society for Therapeutic Radiology and  
16 Oncology) I would like to echo John's comments and  
17 expand on a little bit of that. I mean, I think  
18 there really is in terms of the countermeasures  
19 program the majority of the eight centers of which  
20 UCLA is one use cesium sources as the main kind of  
21 workhorse for all of this activity and this is a  
22 major program which has been undertaken by the  
23 government to try and counteract exactly the kind of  
24 terrorists' acts that we're really thinking of in  
25 this forum.

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1 I think that we should also realize that  
2 there's a lot of radiation research which has been  
3 done which is not totally directed towards a kind of  
4 terrorist attack, but from the point of radiation  
5 protection for the population as a whole since  
6 really the last war and before even. And also in  
7 the medical kind of sphere using radiation in a  
8 therapeutic sense really has saved many, many lives  
9 and it's a major cancer modality. Over 50 percent  
10 of patients with cancer get treated with radiation  
11 and are cured. So limiting our sources, limiting  
12 our availability of these sources, really is going  
13 to have a major impact upon the research which goes  
14 on.

15 I'd like to just kind of stress that  
16 there are lots of user groups out here and we hear  
17 from blood bank users which are an important group.  
18 We've also heard someone talking this morning about  
19 zapping mice to knock down the immune system. The  
20 radiation research is a lot more sophisticated than  
21 that. We're dealing with the effects of radiation  
22 on many different organ systems and tumor systems  
23 and this requires a lot of different kind of  
24 approaches, the uses of radiation, and cesium is one  
25 of the major ways in which we do this kind of

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1 research.

2 We have a record of well over half a  
3 century if not a century of research using these  
4 kind of sources and it's the transition to any other  
5 kind of modality, whether it be x-ray or cobalt, is  
6 not going to be trivial.

7 MR. KAMINSKI: Again, this represents  
8 only my professional opinion and I'll just pose a  
9 question first and it's obvious. But should we  
10 pursue safer forms of cesium-137 or technologies  
11 assuming they exist and are economically viable to  
12 the enduser and I think all of you would agree that  
13 we should because if we don't the potential impact  
14 of not doing so could be substantial as already  
15 mentioned.

16 I'm certainly not arguing for any one  
17 single solution. We need alternative forms of  
18 cesium-137. If they are currently available, then  
19 we should look into that and x-rays obviously are  
20 another potential form, another potential source,  
21 and potentially even other radionuclides. Of  
22 course, this should be done over many years and it  
23 needs to be carefully orchestrated so it doesn't  
24 interrupt research in blood banks, for instance.

25 Thank you.

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1 MR. RING: Could I have Joe Ring's  
2 slides please?

3 I've attempted to collect a wide variety  
4 of input from my faculty and it's very important for  
5 us to stress that much of the work that we do is  
6 basic scientific research and it is used to develop  
7 therapeutic interventions for disease among other  
8 things.

9 We work in primary areas. Next slide  
10 please. I was trying to get going. Cancer therapy,  
11 blood transfusions, DNA damage studies, space  
12 travel, molecular biology, immunology, stem cell and  
13 radiological terrorism effects, a very wide range.  
14 We're using it for a very wide range of research and  
15 that means that many of things that we're  
16 identifying may be slightly different.

17 One thing I did come to find out is I'm  
18 not going to argue with a Harvard faculty member  
19 when he tells me or she tells me that there are  
20 differences. Cesium-137 is the instrument of choice  
21 for much of the research. It is the standard. It  
22 is the standard because it has uniform irradiation  
23 effects. It has very unique cell interactions.

24 This is one of the areas where I got  
25 very clear guidance from my faculty. They want me

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1 to show you this book. This book documents, it's a  
2 long-standing reference, the unique effects from  
3 cesium and from radiation. The cell damage ends  
4 when the irradiation ends and it's very important to  
5 most of our faculty. It has very well characterized  
6 interactions.

7 If you go into PubMed and you look for  
8 DNA damage since 1998, you will find that there's  
9 almost 7500 references or studies that used cesium  
10 radiation in the last ten years. That's only  
11 looking at DNA damage. You can look at many of  
12 these other studies and you can get similar numbers.

13 Generally I found when I did it and I gave up  
14 overload there were 3,000 on most of the subjects at  
15 the minimum. So it was extensively used. Next  
16 slide please.

17 There's been lots of discussion about  
18 potential alternatives. That raises an awful lot of  
19 angst and concern for my faculty. They say there is  
20 very different biological mechanisms which mean a  
21 lot to them when they work at basic science.  
22 They're working at very small levels in the cells  
23 and there's a picture that shows you there. Just  
24 graphically, you can see that it's different  
25 response mechanisms. I don't want to go into the

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1 details. But the alternative sources give different  
2 effects because their effects vary with the energy  
3 of the sources. They see very strong differences  
4 in the irradiations done between x-rays and strong  
5 differences between cobalt and cesium irradiations.

6 The chemical agents really react by a  
7 very different methodology that presents them a fair  
8 number of problems. Chemical reagents react by  
9 diffusion. Therefore, they see a gradient across  
10 whatever they're trying to study in reactions and,  
11 even more, there is no clear endpoint. That  
12 endpoint continues after a period until the chemical  
13 agent wears down and that chemical agent has  
14 different effects in the cells. So they see very  
15 different reactions from chemical agents that are  
16 different by substantial means from other  
17 irradiation sources and radiation sources in general  
18 vary amongst the energies.

19 The faculty really is looking for a way  
20 to move forward. They're very concerned about the  
21 grants and contracts which are federal money and the  
22 impact on that and the ability to continue  
23 competitive science research. They are very  
24 concerned that this will drastically impact science  
25 and that we need to look at alternative studies and

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1 whether or not they can be correlated. There is a  
2 huge dataset out there of studies that have been  
3 done over the last 40 or 50 years that cannot be  
4 correlated with new studies done by another  
5 mechanism. So we have a validate or cross validate  
6 that historical dataset.

7 We should investigate alternative  
8 physical forms to cesium so that we can minimize  
9 that risk. One of the things that they recommend  
10 very strong in the short term is to look at  
11 hardening of the sources. I know there is some  
12 discussion with that.

13 I got an awful lot of interest from my  
14 faculty and I will tell you that they really made a  
15 point. Harvard faculty don't usually get involved.

16 They demanded that I have a meeting and they  
17 demanded that I show up to talk to them and they  
18 presented significant volumes of scientific data to  
19 show this is different and it is of importance to  
20 them.

21 Thank you.

22 FACILITATOR RAKOVAN: Before we move to  
23 the questions, any further statements by the  
24 panelists? I have one on the far side. Are you  
25 going to use the podium?

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1 (Off the record discussion.)

2 MR. CONNELL: Again, I'm Len Connell  
3 from Sandia Labs and my role has been on the  
4 National Academies to really help inform the  
5 committee on the differences in the risk, the  
6 radiological terrorism risk, between the different  
7 radionuclides. So I brought this. I don't have a  
8 presentation.

9 But this is cesium chloride and if we  
10 filled up to about this level, that's about 1,000  
11 curies of cesium chloride. As was mentioned in most  
12 sources, it's a packed powder, but packing it into  
13 pellets doesn't really effect the dispersability  
14 very much. This is about 1,000 curies of cobalt and  
15 since we're talking cobalt-60 I thought this was  
16 kind of to frame the debate between two, about 7  
17 grams of cobalt.

18 Now we have two very interesting  
19 accidents that have occurred with both of these  
20 types of material. The one was mentioned before was  
21 in Goiania in `87 and it involved about 1400 curies  
22 of the cesium chloride. We know from that accident  
23 that because of the solubility of the cesium when it  
24 got onto the ground it went into solution, it mixed  
25 with dust particles, the dust went onto the tops of

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1 those nice Spanish tiles and, as was mentioned  
2 before, you can't just rub it off. It actually  
3 chemically bonds with these building surfaces. So a  
4 huge expense in clean-up. A large difference  
5 between that and cobalt. Seventy grams of the  
6 cesium chloride in that teletherapy unit in Goiania  
7 produced roughly 70 tons of rad waste that had to be  
8 disposed.

9 About a year later, a cobalt teletherapy  
10 machine in Juarez, again similar problem. It was  
11 abandoned and people stole the material and sold it  
12 to a junkyard for scrap metal.

13 Now the cobalt in the teletherapy  
14 machines, it's not this slug. It's actually little  
15 BBs about a millimeter in size. Some of those also  
16 got dispersed in the city. In that case, it was a  
17 matter of the responders going around with the  
18 radiation detector, finding the pellets, picking it  
19 up, putting it in a pig and the problem was solved,  
20 a huge difference in the consequence. Not even  
21 looking at the radiological terrorism and all the  
22 different mechanisms of dispersal, we know from  
23 those two datapoints there's a very significant  
24 difference in the consequence.

25 So that's what has driven my concern

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1 about the cesium chloride. By switching to cobalt,  
2 we don't completely solve the problem as was  
3 mentioned by others. Anything can be dispersed if  
4 you work hard enough at it. The difference with the  
5 cobalt of course is there's much more work that has  
6 to be done.

7 I hope that that frames the debate a  
8 little bit. Thank you.

9 FACILITATOR RAKOVAN: Thank you.

10 MR. KAMINSKI: I just want to make one  
11 comment that I didn't totally agree with. I  
12 certainly don't agree with the mechanism of action  
13 being different between x-rays and cesium.  
14 Certainly, the depth dose profiles are different in  
15 small animals and so forth. It might be more ideal  
16 to use a cesium source than, for instance, like  
17 cobalt source where it d-maxes that 0.5 centimeters  
18 where you might need to use bolus. But certainly  
19 the mechanisms are the same.

20 MR. NIXON: I'll show you if I could  
21 make a comment on your comment. In terms of dose  
22 deposition, even though the depth dose profiles even  
23 if you were to find similar profiles in water, it's  
24 very different in terms of the way it interacts with  
25 the matter. X-ray tubes generally produce a broad

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1 spectrum. A significant portion of that spectrum is  
2 in the low energy sector and that's up to and  
3 including say up to 150 kilovolts, KeV.

4 Most of these photons interact  
5 differently when they come into contact with atomic  
6 constituents that are of higher atomic number. They  
7 react via the photoelectric effect and that's why  
8 when you get an x-ray radiograph you get this  
9 contrast that appears between bone and tissue. Even  
10 though you get a similar depth dose profile in terms  
11 of the total attenuation of the beam throughout the  
12 sample, the actual deposition in the individual  
13 constituents inside that ensemble is quite  
14 different. In fact, if you're going to go below 320  
15 kilovolts it could be as high as two to one.

16 FACILITATOR RAKOVAN: All right. Hold  
17 on. The topic at hand is feasibility of the use of  
18 isotopes other than cesium-137. We are doing  
19 opening statements. If you'd like we can put this  
20 topic in the parking lot. You just have to tell me  
21 what I'm supposed to put up there. I'm all right  
22 with that. Do you guys want me to put it in the  
23 parking lot?

24 MR. NIXON: I think that would be for  
25 the next session.

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1 FACILITATOR RAKOVAN: Okay. Can you  
2 hold on to discuss it until then?

3 MR. NIXON: Okay.

4 FACILITATOR RAKOVAN: Okay. I thought  
5 we had one more opening statement here to do.  
6 Correct?

7 MR. NIXON: Yes.

8 FACILITATOR RAKOVAN: If you could wait  
9 until you get to the podium to make sure that we  
10 have you on the transcript.

11 MR. NIXON: Presentation Number one.  
12 So, as I said earlier, we are the -- My name is  
13 Grant Nixon. I'm a radiation physicist with Best  
14 Theratronics and formerly NDS Nordion. So as such  
15 we are the largest manufacturer of blood  
16 irradiators, both x-ray and cesium based, in the  
17 world. Next slide please.

18 In terms of a quick summary of some of  
19 the questions and our position, as a manufacturer,  
20 we would say that for most of our applications that  
21 we sell units for cesium chloride could possibly be  
22 replaced with cobalt-60 energies or sources for most  
23 applications from a radiation physics perspective.  
24 Unfortunately, for current designs of self-contained  
25 irradiators this is not always easy because of the

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1 shielding requirements of cobalt are much greater.

2 Next slide please.

3 As such, we can look to other isotopes  
4 that differ from cobalt-60 such as europium-152.  
5 This isotope has received considerable press as a  
6 possible substitute for cobalt-60 due to the cost of  
7 cobalt-60. The problem with europium is it's a  
8 fairly broad spectrum radioisotope and although it  
9 has a good long half-life there are issues  
10 associated with its handling, manufacturing, the  
11 availability in terms of manufacturing as well, and  
12 more difficulties in terms of the filtering of the  
13 low energy components.

14 Cobalt-60 is the only isotope as a  
15 manufacturer that we would consider as a possible  
16 substitute for cesium chloride in self-contained  
17 irradiators. But as a simple hand-waving argument  
18 or scaling argument can demonstrate, the shielding  
19 requirements are approximately two to one and the  
20 use of tungsten or depleted uranium which nobody  
21 wants to touch anymore will not alleviate that basic  
22 fact by very much.

23 Now in terms of attendant risks  
24 associated with the transport of cobalt sources,  
25 because cobalt has a 5.27 year half-life versus a 30

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1 year half-life of cesium-137 most units will have to  
2 be resourced over a period of five to ten years if  
3 they are to meet the requirements that they are put  
4 to initially. So with that transport comes other  
5 issues, security of the transport, possible  
6 accidents, etc., and, of course, all the ALARA-  
7 associated risks that health physicists like to jump  
8 all over.

9 Thank you.

10 FACILITATOR RAKOVAN: Thank you, sir.

11 Okay. I think we might as well go ahead  
12 and go to the questions. We could do this similar  
13 to the way we did the discussions this morning. For  
14 those of you at the table, if you just want to give  
15 me one of these (Indicating) or put your tent up,  
16 then I'll try to go to you. For those of you in the  
17 audience, the same kind of thing. If you give me a  
18 wave or if you want to approach the mike, I'll try  
19 to go to people in the order that I see them.

20 I thought that this morning went very  
21 well in terms of a back and forth and we had very  
22 good participation. So I'm hoping to keep that  
23 going.

24 As we have 1.1 up there or 1.21(a), can  
25 cobalt-60 be substituted for a radioactive cesium

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1 chlorine for any applications, (b) if so, what types  
2 of applications, and (c) if not, why not? And there  
3 are only three questions for this panel. So we'll  
4 see how much time we need to discuss each. So don't  
5 be shy.

6 MR. KAMINSKI: The answer is yes. It  
7 could be substituted. Whether it's better, it could  
8 be in certain situations such as if it's a large  
9 animal where a 660 KeV may not be penetrating enough  
10 to give a homogenous dose if you're radiating a  
11 monkey or something like that. But in those cases  
12 probably most academic facilities have LINACs that  
13 could be used on the weekends or potentially at  
14 night.

15 MR. McBRIDE: Yes. I mean, the answer  
16 is yes. You can use cobalt. Do we have the  
17 facilities in most academic places? Probably not.  
18 I think also there are issues. Certainly if you're  
19 doing a monkey, I think cobalt is fine. If you're  
20 doing mice, there are other kind of issues in terms  
21 of set-ups and things like build-up that you  
22 mentioned in terms of depth doses and so on.

23 One of the great things about cesium is  
24 that non-radiation physicists and biologists can use  
25 it without any problem at all. It's a very simple

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1 machine, a very reliable machine. Whenever you  
2 start moving into cobalt machine for doing the same  
3 kind of things, you need a lot more back-up. You  
4 need better dosimetry. You need just a different  
5 kind of set-up completely from what we have at the  
6 moment with cesium.

7           And so actually putting that in place is  
8 as I said not trivial. I mean, in radiation  
9 oncology, they got rid of most of our cobalt  
10 machines. There are not all that many left. There  
11 are a few of the old kind of style of DOE kind of  
12 panoramic cobalt machines around the place. But  
13 really overall, I really don't think that we have  
14 the facilities to replace cesium in almost all of  
15 the academic centers certainly and I can't talk  
16 outside of that.

17           MR. FIKE: I'd like to expand on that a  
18 little bit. For those of you who don't do animal  
19 research like Bill and I do, I'm talking now about  
20 small animals, rodents mainly, and most universities  
21 now are going to transgenic facilities within their  
22 institutions which are behind the barrier. These  
23 are specialized secure areas. People have to gown  
24 up and so forth.

25           The point is that, and all I can speak

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1 is for the University of California, San Francisco  
2 (UCSF) and I'm not on their space committee, but  
3 nevertheless the idea of putting in a much bigger  
4 room heavily shielded that would be required for  
5 cobalt would be very problematic. A) There's not  
6 space there and B) just the idea of renovating a  
7 whole room and getting a very heavy, big, shielded  
8 cobalt unit behind a barrier like that I think would  
9 be very problematic, not only economically but  
10 practically, and I think that has to be considered,  
11 at least, from the research perspective. I can't  
12 speak for blood irradiators. Maybe it's the same  
13 issue. I don't know.

14 MR. CONNELL: Can we hear from JL  
15 Shepherd? Mary, can you talk about whether there  
16 are cobalt-60 mouse irradiators existing and how  
17 feasible that is? I spent several years working  
18 with the manufacturers on all these different  
19 applications. So I just wanted to hear from them.

20 MS. SHEPHERD: Mary Shepherd, JL  
21 Shepherd and Associates. Not a lot of people using  
22 cobalt are using them for small animal research.  
23 It's mostly large animal research. When you go to  
24 large animal research, you need to have a shielded  
25 room like the teletherapy rooms. Most of those have

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1 disappeared from this country. So the cost for  
2 doing a completely shielded facility to do large  
3 animals is quite expensive.

4 Cobalt primarily is used now for  
5 biologicals, CDC research, all the real nasty  
6 biologics that are dose rate dependent. I'm not  
7 going to go any further than that.

8 The weight of a cobalt machine is not  
9 such that a replacement cobalt machine could not go  
10 into an animal facility that is not on the ground  
11 floor because buildings cannot take the weight.  
12 You're talking a replacement for like a Mark I that  
13 can go anywhere from 4,000 to 6,000 pounds. You're  
14 talking 14,000 pounds on a little bit larger  
15 footprint and therefore the entire animal facility  
16 would need to be relocated. Most of them are not on  
17 the ground floor for security reasons and for other  
18 like PETA and other issues like that. So the whole  
19 institution would have to change the whole facility  
20 plan or build a whole new secure facility just for  
21 the replacement.

22 MR. KAMINSKI: And again, this is my  
23 professional opinion that I would not switch from a  
24 cesium-137 source for small animals to a cobalt. I  
25 think that would be a mistake because again the

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1 cobalt-60 d-maxes at 0.5 centimeters. So certainly  
2 you wouldn't be getting a homogenous dose through  
3 the animal.

4 MS. MOSES: Paul Moses, Best  
5 Theratronics. Formerly, we used to be Atomic Energy  
6 of Canada and then we turned into MDS Nordion and  
7 very recently we became Best Theratronics. Going  
8 back to even Atomic Energy of Canada, we had access  
9 to probably more cobalt than anybody in the planet  
10 just based on our nuclear reactors.

11 We looked at both cobalt for research  
12 applications and, of course, for the blood  
13 community. It would have been very easy for us to  
14 use cobalt. It was easier for us to get and less  
15 expensive. But the thing is when you actually look  
16 where blood banks are located and we did that.  
17 Being in marketing, you sit and say where is it  
18 going to go, how is it going to get there, how much  
19 is it going to cost and you look the money  
20 associated with that.

21 So if you look at most blood banks,  
22 they're on a 3<sup>rd</sup> or 4<sup>th</sup> level. You have to go up in  
23 an elevator. So you go to the elevator and you say,  
24 "Okay. How much can this accommodate" and you very  
25 quickly realize that cobalt's not going to fit into

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1 the blood bank communities partly because they're  
2 huge. It has a half-life of 5.2 years. Cesium is  
3 30.2. So you're looking at constant replacement.

4 There's a lot of issues like that,  
5 business issues, that are a concern when you start  
6 looking at cobalt to replace a cesium unit. But,  
7 once again, weight is a big concern as to where they  
8 would go and you can't get a cobalt unit up on a  
9 third or fourth floor when they weigh 6,000 or 7,000  
10 pounds.

11 MR. MORGAN: Tom Morgan, University of  
12 Rochester. I just wanted to put an underlying  
13 exclamation point. Not all irradiators that are  
14 being used in research are self-shielded  
15 irradiators. A number of us have irradiators that  
16 are in shielded rooms because we need to be able to  
17 irradiate parts of animals. So if I had to change  
18 out the source to cobalt-60, that room isn't  
19 shielded for cobalt-60.

20 PARTICIPANT: I must say joke. All  
21 irradiators are not created equal. We all know  
22 that.

23 (Laughter.)

24 I had actually a scientist who came to  
25 me and he said, "I want to irradiate just the head

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1 of the mouse." So being an engineer and being a  
2 health physicist, I designed a real good shield  
3 around the body and left the head exposed to cesium-  
4 137. Can you do that with cobalt-60? Absolutely  
5 with the high energy that's cobalt-60 and I could  
6 accomplish that.

7 MR. SVAJGER: Just to add to I'm  
8 sorry. Mark Svayger of Fluke Biomedical. Just to  
9 add to the open air exposures and not a shielded  
10 device, 11 meters, 2,000 curies of cesium requires a  
11 meter of high density concrete walls and that's on  
12 the ground level. So if a hospital has three  
13 levels, you have your floor and your ceiling to  
14 account for. So that's an added expense.

15 Also to put it in perspective, it costs  
16 us \$250,000 in 1999 to design this new facility and  
17 at that time it was going to cost us just \$500,000  
18 just to tear it down. That's just the concrete and  
19 the structures themselves. Thank you.

20 MR. POWELL: I am Brian Powell again.  
21 Constellation Energy. Looking at nuclear power and  
22 what I'm thinking about is the radiation protection  
23 aspects of the cesium versus the cobalt or an  
24 alternative source. And from my perspective or from  
25 our industry's perspective, we use cesium to

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1 calibrate our instruments for a reason because we  
2 have cesium being produced in the reactor. We need  
3 to have a way to see what kind of dose our workers  
4 are getting so we can give them good reports at the  
5 end of the year that this is how much exposure that  
6 you received.

7           So all our instruments are calibrated  
8 towards cesium for that reason because we produce  
9 it. It also has the lower energy which is more  
10 representative of the range of isotopes that we have  
11 in the power plants and obviously the 30 year half-  
12 life lends itself to what I would call a stable  
13 study. So the cesium is our base source, a thing  
14 that all of our documentation and all our research  
15 is based on from the instruments that we use to go  
16 out and try to find the radiation to the instruments  
17 that we use to check people when they're exiting the  
18 radiologically-controlled area.

19           I'm looking to hear how the NRC, for  
20 example, who is looking at our application of our  
21 instruments and our research and all that towards  
22 the cesium would -- We would have to potentially  
23 change our entire radiation protection program to go  
24 after something else.

25           MR. COPPELL: Yes, Dave Coppel here

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1 from REVISS Services again. This may be a statement  
2 to the obvious I suppose, but the incentive for  
3 considering cobalt as an alternate to cesium  
4 chloride really goes back to the presentation that  
5 Len Connell made about the potential dispersability,  
6 solubility, clean-up costs and so on.

7 The question in the *Federal Register*  
8 specifically refers to a comparison between cobalt-  
9 60 and cesium chloride. I guess the question we  
10 ought to ask ourselves is how do you stack up the  
11 comparison between cobalt-60 as one option and a  
12 less dispersable form of cesium-137 as another  
13 option.

14 MR. McBRIDE: If nobody is going to  
15 answer that, I'll say the latter.

16 (Laughter.)

17 FACILITATOR RAKOVAN: Anyone? Please.

18 MR. CONNELL: I'll make a comment about  
19 that. That's a very good point and I've talked a  
20 little bit with John Schrader and David about the  
21 dispersability issue and whether if we were to start  
22 with pollucite form whether we could design it in  
23 such a way that it minimized certain dispersable  
24 effects. So one good thing about designing it from  
25 scratch is we could try to build some of those

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1 aspects into it.

2 But as was mentioned I think before,  
3 there really are two properties we're looking at  
4 here. One is the solubility issue which is what you  
5 really are solving when you go from the chloride to  
6 the pollucite or if you go to cobalt.

7 And the other one is dispersability and  
8 that's a much more difficult aspect because the  
9 question is what do you mean, like was discussed in  
10 the earlier session, by dispersability. How  
11 dispersable? What kind of a particle size are you  
12 trying to prevent? And we end up quickly getting  
13 into classified information. But that is something  
14 that we have to consider. And by going to  
15 pollucite, you really do solve mainly the solubility  
16 issue and a pollucite behaves in terms of an  
17 explosive dispersal similar to ceramics and that  
18 really doesn't completely solve our dispersal  
19 problem.

20 As we're looking through these different  
21 alternatives, again as I mentioned in the  
22 introduction, if we go to a radionuclide alternative  
23 to cesium we are reducing the risk because we're  
24 actually making it more difficult to disperse, but  
25 we're not eliminating the risk. The only way to

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1 eliminate the risk is to go to an non-radionuclide  
2 alternative like the x-ray machine. And being from  
3 my perspective, not being a user, but being a  
4 student of radiological terrorism, that would be my  
5 preferred option.

6 As we look through these things, I'd  
7 like to really understand much better where we could  
8 use x-ray machines, where we couldn't. If it's a  
9 cost issue, that's something the government can  
10 balance. Because the other thing we need to look at  
11 as we talk about cost is we need to look at the cost  
12 of maintaining cesium chloride in the U.S. and  
13 that's an additional cost for security as most users  
14 probably already realize.

15 But it also involves an increased cost  
16 to try to train the police department in trying to  
17 respond to a terrorist incident and it involves the  
18 cost of if a terrorist actually does acquire this  
19 source and disperses it. What is the cost of a  
20 terrorist incident using that material? And you  
21 have to weight that based on the probability of that  
22 and nobody really knows what the probability of that  
23 is.

24 But after 9/11 we got a lot of  
25 complaints that the government didn't connect the

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1 dots. So here's a case where we're really trying to  
2 connect the dots and look where the holes are in our  
3 security, where our gaps are, and trying to plug  
4 them and that's one of the reasons why we're trying  
5 to look at other options for cesium chloride.

6 MR. SULEIMAN: Orhan Suleiman from FDA.

7 Limiting myself to the question, the feasibility of  
8 the use of isotopes other than cesium-137, you're  
9 obviously talking about other energies and if you're  
10 talking about calibration, cesium is ideal for some  
11 applications. It's absolutely terrible for others.

12 So you limit yourself by taking cesium.

13 Are you talking about eliminating cesium  
14 from all commerce for all calibration applications  
15 just because of its chemical and mechanistic form? I  
16 think you would be doing the scientific community a  
17 disservice by taking this specific nuclide out of  
18 the picture completely. If you're talking about  
19 terrorism and being afraid of things, I deal with  
20 explaining risk to people every single day. And so  
21 at some point, when do you block yourself up in a  
22 corner with a wall and just not expose yourself to  
23 anything?

24 The NRC has a tough task here. There  
25 are societal benefits of cesium. There are

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1 scientific benefits of cesium with its unique  
2 energy. It's used as the nuclide for many, many  
3 calibration applications. But then again, in its  
4 current form, it also raises some risks. But I  
5 think in terms of the specific question, isotopes  
6 other than cesium-137, you're going to create a hole  
7 if you eliminate cesium-137.

8 MS. DANIELS: Sameera Daniels, Ramsey  
9 Decision Theoretics. This is addressed to Dr.  
10 Connell. I read through NA's, National Academy,  
11 report. What confused me a little bit, maybe it was  
12 because of the way it was presented, from, let's  
13 say, a period from 1999 to 2003, I think, or 2005,  
14 that was a time range where incidents occurred and I  
15 was wondering if you could just summarize the number  
16 and what kinds of incidents that you have been  
17 concerned about.

18 MR. CONNELL: Do you mean terrorists  
19 incidents?

20 MS. DANIELS: Yes.

21 MR. CONNELL: This is not a very good  
22 venue for discussing that, but what we've learned is  
23 that terrorists are getting more knowledge about  
24 these radionuclides and what's important. I mean  
25 you can go to the Jihadi websites and read about it

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1 and they've read the same things that you've all  
2 read in the papers that come out of *USA Today* and  
3 *The Washington Post* and NGO type reports that have  
4 discussed these things and so we are concerned.

5 Then we see incidents in London with  
6 doctors being terrorists and that kind of raises the  
7 flag again about what's the vulnerability at  
8 hospitals and universities for these things. These  
9 aren't places that typically have a real strong  
10 security culture. So that raises our concern about  
11 risk.

12 When we talk about calibration machines  
13 that are at nuclear power plants, again that's not  
14 the same kind of a risk factor.

15 FACILITATOR RAKOVAN: Ma'am, if you're  
16 going to speak, I'm going to have to ask you to use  
17 the microphone.

18 MR. CONNELL: I hope I answered your  
19 question, but there's not much more I can say about  
20 that. I'm not trying to scare people, but when we  
21 look and do these studies we look at all the  
22 different radionuclides out there and we try to find  
23 out where are the risks and that's what we did with  
24 the National Academy study and that's why we ended  
25 up with the bigger concern with cesium chloride

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1 because of the past experiences with accidents that  
2 involved cesium.

3 MR. MINNITI: I am Ronaldo Minniti from  
4 National Institute of Standards and Technology.  
5 Anyway, to answer that question, I guess I talk on  
6 behalf of all calibration facilities and I think  
7 most of the people will agree with me that for  
8 calibration purposes and when I say "calibration" I  
9 mean calibrating the radiation detector instrument,  
10 cesium cannot be replaced by cobalt because we rely  
11 on the energy. Energy of cesium is 662 keV and  
12 energy of cobalt is much higher. So the answer to  
13 that is no, it cannot be replaced and then it's B.  
14 If so, what type of applications of calibration of  
15 instruments. If not, why? I think I answered that.

16 I guess I had a comment for Len about  
17 the security. So I'm done with the question and  
18 this is the comment or question. If we would  
19 increase the security in the facilities that have  
20 cesium chloride, then as you say there would be a  
21 terrorist which would like to get a hold of cesium.

22 Now if he has increase security, would he prefer to  
23 get something else, cobalt for example? I  
24 understand that because the cost to clean up cobalt  
25 would be much less, but still do you have still the

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1 psychological or social impact? Thank you.

2 MR. CONNELL: Well, that's a concern  
3 that you want to have a risk balanced across the  
4 spectrum. But again from my perspective, I'm  
5 looking at where the long pole is in the tent right  
6 now. Where are the high risk factors right now?  
7 What do we need to do in the near term to try to  
8 reduce that?

9 The stop gap was one of the things that  
10 was discussed earlier that Commissioner Lyons  
11 mentioned, this hardening program, where we're  
12 trying to go back in and retrofit these machines and  
13 we've done the Red teaming assessment. We know  
14 where we would attack them and so we're trying to  
15 cover up those zones that are vulnerable and make it  
16 more difficult for someone to gain access to the  
17 machine and that actually enhances the increased  
18 controls which it kind of fits together well with  
19 that in that we want time delay. We want time for  
20 the police departments to be able to get there and  
21 prevent that kind of a thing.

22 If that forces the terrorists to move to  
23 cobalt, well, we already have the increased controls  
24 with cobalt and, as I mentioned, cobalt, anything  
25 can be made dispersable, but it takes more skill.

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1 It takes a larger team, more equipment, more money  
2 and more time and the time is of the essence.  
3 That's the critical factor here. If you steal it  
4 and then you have to use it, that takes time.  
5 That's why cobalt is less risk.

6 MS. MOSES: Just a quick one. In a  
7 comparison between cesium and a biological disaster,  
8 biological terrorism, how you would relate or what  
9 would be worse?

10 FACILITATOR RAKOVAN: I think we should  
11 just maybe move on from this. Remember we're here  
12 to talk about the feasibility of the isotopes other  
13 than cesium-137. I have one person I need to go to  
14 first.

15 Ms. Shepherd, please.

16 MS. SHEPHERD: Mary Shepherd, JL  
17 Shepherd and Associates. One area we haven't talked  
18 about is non-proliferation and tracking of plumes  
19 like Chernobyl-type power plant accidents. Cesium  
20 is your recognizable peak and the Cesium technology  
21 I don't think will be replaceable with cobalt or  
22 other methods. It's non-proliferation power plant  
23 accidents and we would lose a significant tool.

24 MR. KAMINSKI: Just one remark. Again,  
25 it's my professional opinion. I won't say that

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1 again, but I agree. I think we definitely need  
2 cesium-137, just alternative forms.

3 MR. MINNITI: One thing I forgot to  
4 mention, regarding replacements I think for  
5 calibration purposes again, in the case of a  
6 radiological incident, we count on emergency  
7 responders, police, firefighters, police personnel,  
8 walking into this incident with a calibrated  
9 detector. They rely on that to know that they're  
10 going to ensure safety for them and for the public.

11 So I guess my point is again cesium has  
12 been established as the workhorse for 40 years and  
13 if we would look for an alternative, it would have  
14 to be something that has similar energy. So maybe  
15 another form of cesium could be a possible solution.

16 Cobalt as I said before no. I guess what I'm  
17 trying to say now imagine if we are not careful  
18 about the replacement. If we remove cesium away, I  
19 guess the impact for this particular case is you  
20 would have emergency responders walking into a  
21 radiological incident with non-calibrated  
22 instruments and we would be creating a new risk. So  
23 it would defeat the purpose of this whole ruling  
24 anyway.

25 MR. CONNELL: Ronnie, can I ask you a

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1 question about calibration?

2 MR. MINNITI: Yes.

3 MR. CONNELL: Because we really didn't  
4 pay it as much attention in the National Academy  
5 study because again we only have 100 of these out  
6 there and they are usually much lower curie  
7 quantity.

8 But can you explain to me? Do we really  
9 need 100 of these outside in the commercial  
10 facilities? Can we draw them back in to maybe just  
11 a few labs and have smaller quantity? Do we really  
12 need 400 curies or more to do your calibrations?

13 MR. MINNITI: The reason high activities  
14 are used is again there are three manufacturers here  
15 that can correct me if I'm worry, but I think that  
16 most of the sources that are used for calibrating  
17 instruments go all the way up to most of them 400,  
18 500 curies and there are a couple for the nuclear  
19 power plants that go up to 1200 curies.

20 The reason, you can ask why is it so  
21 high. These detectors are measuring a broad range  
22 of exposure rates. So this is why you need these  
23 high activities because you want to calibrate at the  
24 low end of the scale. But also you want to reach  
25 rates of 100 R per hour for example or in the case

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1 of the nuclear power plants, they put these  
2 teletectors very close to the source and they want  
3 to shoot over that range.

4 I think if someone would ask me  
5 personally if we can live with what activities we  
6 could live in the instrument calibration community,  
7 I would say that probably with 1200 curies and below  
8 would be fine. So that would limit the Category 2  
9 range. Right? I don't know if that answers your  
10 question.

11 MR. CONNELL: I had one more hand and  
12 then I'm hoping to move onto the next question.

13 MR. SVAJGER: Mark Svajger with Fluke  
14 Biomedical. To answer your question, we calibrated  
15 in the range of up to 100 R per hour so that it will  
16 exceed your 400 curies statement. Plus we also  
17 calibrated in hour per second for, for example,  
18 nuclear power plants.

19 MR. CONNELL: Okay. So let me ask you.  
20 If I'm interested in doing a very high dose rate,  
21 could I use cobalt for that and just use cesium,  
22 cobalt and a lower energy nuclide to kind of give  
23 you the spectrum, the response function?

24 MR. SVAJGER: Once again, cobalt-60 is  
25 about 1.1-1.3 MeV and cesium is 0.6 MeV. So many of

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1 the detectors are also energy dependent. But  
2 certain things can be done with cobalt-60. But most  
3 everything we do is cesium-137. And to take an  
4 account most radiation measurement instruments, they  
5 have a wide range from low keVs in the 10s and 20s  
6 to upper 1.4 to 1.3. Thank you.

7 FACILITATOR RAKOVAN: Okay. One more  
8 comment from someone who promised he'd be brief.

9 (Laughter.)

10 MR. MINNITI: To answer your question,  
11 the detectors are TLDs. These are thermal-  
12 luminescent dosimeters and people use this, I don't  
13 know, probably most of the people are familiar, but  
14 for radiation protection and there are hundreds of  
15 thousands of those in the U.S., probably more than  
16 one million. I came up with this number just by  
17 talking to only a few of our people we interact  
18 with. That's basically the Navy, Air Force, Army  
19 and a couple other private sectors.

20 But anyway TLDs are -- The readers that  
21 are used for TLDs are calibrated with cesium and I  
22 just thought you were asking why and these are  
23 calibrated at doses of 5 gray. This is the highest  
24 dose. We're talking 100 Roentgen (R).

25 The reason why you used the high

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1 activities which was your question is you want to  
2 irradiate these TLDs in a reasonable amount of time.

3 I mean you could irradiate these doses per days,  
4 but you have to do this. These are large amounts.

5 FACILITATOR RAKOVAN: I'm sorry. I  
6 think we're going to have to move onto the next  
7 question.

8 1.2-2 and I think we've gone into this a  
9 little bit, but can the shielding challenges for  
10 cobalt-60 be addressed by switching from lead  
11 shields to more effective tungsten or depleted  
12 uranium shielding? And there was a note. Consider  
13 that tungsten shielding is more expensive than lead  
14 and manufacturing depleted uranium shielding is a  
15 very specialized, expensive operation that requires  
16 NRC or agreement state licensing for its entire life  
17 cycle.

18 Shielding discussion. No one in the  
19 mood to discuss shielding. All right. We have a  
20 couple people.

21 MR. MENNA: Blair Menna from Best  
22 Theratronics. I'll just take a quick stab at it.  
23 Tungsten is very expensive. The metals market  
24 recently has just been going crazy. The subject of  
25 home renovations came up earlier in the morning.

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1 You know if you're been pulling wire in your house  
2 extension that it's gone up. Copper has gone up  
3 hugely. Tungsten, we've seen huge leaps in the  
4 price.

5 We are worried about the cost of  
6 redesigning an irradiator to accommodate a larger  
7 cesium source. Thinking out loud, I would suggest  
8 that it would be cheaper to redesign a lead unit to  
9 accommodate a larger non-dispersable source  
10 than it would be to make one of the irradiators out  
11 of tungsten. The cost would be prohibitive.

12 MR. AKABANI: Depleted uranium by itself  
13 --

14 FACILITATOR RAKOVAN: I'm sorry. Could  
15 you identify yourself?

16 MR. AKABANI: I'm My name is Gamal  
17 Akabani. I used to work at Battelle Pacific  
18 Northwest and one of my main projects was depleted  
19 uranium and the depleted uranium by itself does  
20 carry out a confounding factor because of the fact  
21 that it produces lots of x-rays and therefore it  
22 will be something that has to be taken into  
23 consideration when you irradiate either animal  
24 experiments or things like that. I know it's very  
25 heavy, contains some of titanium. However, it's by

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1       itself, I would consider it to be probably not cost  
2       effective.

3                   MS. SHEPHERD:   Mary Shepherd, JL  
4       Shepherd and Associates.   Tungsten is a very long  
5       lead time item now.   If you go to a manufacturer  
6       trying to obtain it, it's sometimes six to nine  
7       months out for large quantities and depleted uranium  
8       besides the licensing problems has a bad reputation  
9       with a lot of countries around the world and at one  
10      point there was much more restriction towards its  
11      use as a lead alternative for shielding and so there  
12      would have to be some kind of regulatory interface  
13      to be able to use depleted uranium.   But it is very  
14      expensive and it's also still a strategic material  
15      in the Unites States.   It used to be up to a couple  
16      years ago.

17                   FACILITATOR RAKOVAN:   Anyone want to  
18      expand upon those comments or make a new point?

19                   (No verbal comment.)

20                   Okay.   Let's go ahead and move onto the  
21      third question then, 1.2-3.   What are the attendant  
22      risks associated with cobalt-60 source  
23      transportation?   The note:   Consider the shorter  
24      half-life of 5.27 years of cobalt-60 radiation  
25      sources.   It would require that they would be

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1 replaced more frequently than cesium-137 which  
2 entails the transportation of both fresh and used  
3 sources. I think this was brought up someone  
4 previously, but transportation.

5 MS. SHEPHERD: Mary Shepherd, JL  
6 Shepherd and Associates. You exponentially increase  
7 your risk for a transportation accident with the  
8 more shipments you have on the road.

9 I don't think we have time to go into  
10 all the transportation issues now, but tomorrow 99.9  
11 percent of all U.S. transport containers are no  
12 longer useable.

13 There are two basically nuclear waste  
14 containers, two models, that are certified in the  
15 U.S. market. Some of the international containers  
16 are in applicable for U.S. domestic use with the  
17 NRC, but that's not granted yet. We filed  
18 extensions for special permits and we have a new  
19 container in testing. That's a very long and  
20 expensive process.

21 So right now, as of tomorrow, there is  
22 very little domestic options for any kind of source  
23 transport for Type B quantity of radioactive  
24 materials.

25 MR. RING: Joe Ring, Harvard. If you

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1       tried to replace the sources in transgenic  
2       facilities with ones that are shorter, you have a  
3       significant issue with changing the source out and  
4       bringing it in and out of the transgenic facility.  
5       It's very important that those facilities stay  
6       biologically clean for the purposes of the residents  
7       and that certainly is against what we need in the  
8       transgenic facility.

9                   MR. JARDINE: I'm Les Jardine,  
10       Consultant. I just add to our memory here. This  
11       will add to the waste disposal problem for which  
12       there is no answer. Yes, it's five years half-life,  
13       but it generates a lot more waste all these  
14       operations for where there is no endpoint.

15                   FACILITATOR RAKOVAN: Further discussion  
16       on transportation issues or for that matter any  
17       issues associated with feasibility and the use of  
18       isotopes other than cesium-137?

19                   Charlie, I'll get to you in a second.  
20       I'm sorry. I had a hand back there first.

21                   MR. WASIAK: I would like to go back for  
22       the moment to the comment that I think Len made  
23       regarding different forms of cesium that the  
24       pollucite or ceramic would only address part of the  
25       problem meaning the solubility, not necessarily the

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1 dispersability. Could you give us an idea or your  
2 opinion? If addressing both aspects would it fix  
3 100 percent of our problems. Addressing the  
4 solubility problem only, how much of an improvement  
5 would that be if we only address that part with  
6 alternate forms of cesium?

7 MR. CONNELL: That's a real tough  
8 question to answer, Tom. Again, if you look at the  
9 Goiania incident, the solubility was a big factor in  
10 the way the material spread itself around and got  
11 bonded to surfaces. So I think it's a big  
12 improvement. How I would quantify that, I mean,  
13 that's just -- Because there are so many different --  
14 - I mean, what we really need to go through and  
15 maybe this will come up tomorrow when we talk about  
16 risk is we need to look at all the different  
17 pathways by which a terrorist can use this material  
18 and think through all those different paths and try  
19 to look at the relative probabilities of those and  
20 then see what the impact is of changing the  
21 dispersability.

22 It's a complicated process, but I would  
23 relate it to like a PRA-type analysis. You look at  
24 the different, you know, a thought tree and then try  
25 to assign probabilities and look at the different

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1 progression. But I think there's a way to do it. I  
2 don't know if you can come up with an exact number.

3 But I do believe that the solubility  
4 issue is a big issue and if we remove that it takes  
5 a big chunk out of the risk. It doesn't remove the  
6 fact that you have to go around and -- Now if you  
7 have an oxide that's not soluble and if you still  
8 have very, very tiny, you know, 100 micron particles  
9 of oxide, you have to go around and pick them up.  
10 But, at least, it's not chemically bonded to the  
11 concrete. So that makes it feasible to mechanically  
12 remove it. It still would be expensive, but it  
13 won't be impossible to clean up in a nondestructive  
14 way.

15 MR. WASIAK: I guess the reason for that  
16 question was primarily to kind of assess the  
17 viability of the alternate form of cesium. Because  
18 if it doesn't really help us that much, then it's  
19 really maybe not worth doing. But my expectation  
20 was that addressing the solubility problems  
21 significantly and dispersability to some extent  
22 would get us quite a significant part of the way  
23 there.

24 MR. CONNELL: I think it does a good  
25 job. I don't think the government has really sorted

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1 through the complete effect of that yet. I think  
2 that a lot more analysis needs to be done to look at  
3 the impact of having a material that's not soluble,  
4 but it's still dispersable.

5 MR. MILLER: Thanks, Lance. This is  
6 Charlie Miller from the NRC. Lance, I would like  
7 you to get a couple of things in the parking lot.

8 FACILITATOR RAKOVAN: Can you speak a  
9 little bit more into the mike.

10 MR. MILLER: As I listen to the  
11 discussion thus far, there's a number of things I  
12 would just like to throw out for consideration for  
13 the rest of the workshop. One is that we've had a  
14 lot of good discussion over the course of the day  
15 concerning cesium chloride, various forms of cesium  
16 chloride alternatives, some alternatives, cobalt so  
17 far or x-rays.

18 One of the things that the NRC has to  
19 ponder when formulating our decision makings is to  
20 where we go with this is how far do we go as a  
21 regulator. Okay. Nothing that we're going to do is  
22 going to give zero risk except complete elimination  
23 of radionuclides. I think that's recognized. So  
24 the question becomes what is an acceptable risk and  
25 that's something we should be thinking about as we

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1 go through and formulate our comments.

2 Some stakeholders here are coming at it  
3 from a security perspective. Like Lance, some are  
4 coming at it from the manufacturing perspective.  
5 Some are coming at it from a research perspective.  
6 Some are coming at it from a medical perspective.  
7 Some are coming at it from an industrial calibration  
8 perspective.

9 The other piece that I'd like to get a  
10 little bit better handle on, we've kind of talked  
11 around it some, so if anybody has any insights to  
12 this especially the manufacturers and distributors,  
13 is it's obvious from the discussion so far based  
14 upon the stakeholders' input that one size doesn't  
15 fit all. So therefore if we were to look for  
16 alternatives, what percentage, for example, of the  
17 cesium chloride would be eliminated if we went to  
18 alternatives for various utilization, in other  
19 words, for blood irradiators versus calibration  
20 versus research aspects of it so that if we do make  
21 decisions that are different for each how much are  
22 we really reducing the risk by the actions that  
23 we're taking?

24 And I guess finally I would just like to  
25 -- We don't live in a zero risk society. We're not

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1 going to get there as I said. So therefore if we  
2 are to promulgate, if we were to go forward and  
3 promulgate, some kind of ruling-making on this  
4 activity, part of our rule-making activity requires  
5 a regulatory analysis which has to factor in  
6 cost/benefit of the actions that were taken. It's  
7 important for us to have that information so that we  
8 make informed decisions as we go forward.

9 Those are some things that I would just  
10 like to put in the parking lot and hope that we can  
11 get better information on as the workshop goes on  
12 and is concluded or anyone who wants to issue  
13 written comments or supply comments to us after the  
14 workshop these are important considerations for us  
15 as we go forward and make recommendations to the  
16 Commission as the NRC staff.

17 Thank you.

18 MR. McBRIDE: Can I just ask you a  
19 question before you go away?

20 MR. MILLER: Absolutely.

21 MR. MENNA: You said getting rid of  
22 radionuclides. Are you talking only about the high  
23 level or what level or --

24 MR. MILLER: Yes, if you're going to  
25 talk about complete, if you were removing the risk

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1 completely of using cesium chloride or cobalt or any  
2 radionuclide, the only way you eliminate that risk  
3 completely is not to use it at all from a  
4 radionuclide perspective. So there's a recognition  
5 --

6 MR. MENNA: But get rid of low level  
7 radionuclides as well?

8 MR. MILLER: That's all it's going to  
9 take. Yes, any utilization of it at all in any form  
10 is going to give some form of risk. The question  
11 becomes what's that accepted level which I think is  
12 the point that we're trying to ponder.

13 MR. RYAN: Mike Ryan. I'm a member of  
14 the ACRS, Advisory Committee on Reactor Safeguards.  
15 Charlie, I couldn't applaud you more for bringing  
16 up the issue of risk. On the one hand, we've talked  
17 a lot today about how cobalt-60 can be used to  
18 replace cesium in an irradiator which kind of  
19 presumes the question we've decided cesium doesn't  
20 work. How about we ask the other question? What  
21 would it take to make a cesium irradiator have a  
22 risk profile that was acceptable by whatever metric  
23 you wanted to use?

24 Asking the alternate question is a way  
25 to analyze how do you make it better rather than

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1 what can we substitute and I think when you do that  
2 in a risk-informed way and think about all the  
3 risks, the risk of a terrorist, the risk of them  
4 getting to the material, the risk of them getting it  
5 and doing something bad with it and all those things  
6 which is the event side and then thinking carefully  
7 and systematically about protections that you have  
8 or don't have now or should have or might have, we  
9 can really kind of sort it out.

10 This last question on transportation to  
11 me comes in from left field. What does this have to  
12 do with irradiators? Transporting cobalt or cesium  
13 on its own merit has a risk and I'm sure you're  
14 concerned about Type B casks sort of going away.  
15 Three of my favorites expire tomorrow. So that's a  
16 whole different question.

17 But I would just urge that we focus on  
18 the risks. What are the risks we're trying to  
19 mitigate and how can we systematically mitigate them  
20 and then how do we ask the questions? Instead of  
21 presuming cesium has to go away, we can say if we  
22 really want to keep cesium, what does it take to  
23 give it the risk profile that would be acceptable  
24 from a risk-informed regulatory view?

25 MR. KAMINSKI: I haven't heard anybody

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1 including the NRC or NAS advocating elimination of  
2 cesium-137, but I think at least according to the  
3 NAS report they do suggest eliminate of cesium-137  
4 chloride, at least, category 1 and 2 and just one  
5 reason is just due to the solubility and that's a  
6 significant economic impact it would have on society  
7 if a terrorist event happened.

8 MR. RYAN: It is true it is soluble. I  
9 agree 100 percent. It is salt. But where is the  
10 evidence that says on a risk metric that that's the  
11 most important thing about cesium-137? If it's  
12 properly secured, properly confined, properly  
13 contained, by whatever mechanism you want to think  
14 up so that it prevents that action, that solubility  
15 may become less significant from a risk point of  
16 view and I think we're giving that up too quickly.

17 MR. KAMINSKI: I agree with you, but can  
18 we mitigate the risk and is it still economically  
19 viable?

20 MR. RYAN: That's exactly the question  
21 we're posing.

22 MR. KAMINSKI: That's our question.

23 MR. RYAN: Exactly the question. I  
24 think we need to systematically think that through  
25 before we throw it away.

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1 MR. CONNELL: I thought Charlie brought  
2 up some points about the different modalities here.

3 If you look at calibration machines and they're at  
4 nuclear power plants, you have one security risk.  
5 If you have cesium chloride at a university with  
6 graduate students that are foreign, you have another  
7 kind of risk. Hospital, blood banks, a different  
8 whole spectrum. So you look at each one differently  
9 and maybe you can come up with different solutions.

10 Maybe for the blood banks for those that  
11 are not using a very high through-put, an x-ray  
12 machine is a good option. For United Blood Services  
13 or the Red Cross where they have a lot of through-  
14 put, maybe you consolidate your cesium chloride  
15 there and you increase the security and really beef  
16 it up at those facilities. There are different ways  
17 of dealing with this problem in terms of risk  
18 reduction.

19 MS. SHEPHERD: Mary Shepherd, JL  
20 Shepherd and Associates. I think the risk  
21 associated with transport is probably when  
22 radionuclides are at their most vulnerable that's  
23 why it should be looked at significantly, much more  
24 so than in a secured facility and that's being  
25 addressed through other modalities. But I think

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1 it's a reason why that was brought up here.

2 And regarding the solubility and  
3 dispersability, ever since we've had above-ground  
4 testing we've had cesium all over the world and I  
5 don't think we've cleaned up everything we've done  
6 from our own above ground tests, much less everybody  
7 else's besides Bikini Atolls and different areas  
8 like that. It's there. It's part of the  
9 environment.

10 FACILITATOR RAKOVAN: Any further  
11 discussion on feasibility of the use of isotopes  
12 other than cesium-137? Mr. Suleiman.

13 MR. SULEIMAN: I think I want to sort of  
14 second the previous comments because if cesium-137  
15 is so long-lived you just don't change it out very  
16 frequently. So it's transported less frequently.  
17 It's accessed less frequently. That has to figure  
18 into the risk probability paradigm somehow. So, in  
19 some ways, you could make an argument that cesium-  
20 137 is actually more secure because it doesn't have  
21 to be handled or it doesn't have to be changed out  
22 or replaced as often.

23 You really have to look at this thing  
24 from the total life cycle from manufacturing to  
25 eventual storage or elimination. If you phase them

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1 out, then you have to get rid of all these all over  
2 the country or you'll just let them decay away. So  
3 you just have to identify all the variables and  
4 assign some guesstimates into the risk.

5 MR. KAMINSKI: Just one comment. Having  
6 worked with a cesium irradiator a few years ago and,  
7 of course, measures have been implemented to  
8 increase security and so forth since then, it's not  
9 too difficult and if I wanted to I could have gotten  
10 a hold of it back then.

11 FACILITATOR RAKOVAN: Go ahead.

12 MR. COPPELL: Sorry. David Coppel from  
13 REVISS Services again. I guess I'm not sure what to  
14 contribute to this discussion from a manufacturer's  
15 perspective. We, of course, make both cobalt  
16 sources and cesium sources.

17 This is inevitably about balance and  
18 risk. Of course, it is and I guess everybody  
19 understands that. I hope we're not going to ban  
20 cars in order to reduce road accidents. What we're  
21 looking at is whether or not here there's an  
22 opportunity to fit air bags or whatever and I guess  
23 for me with one set of demands which is reduce the  
24 risks associated with how a terrorist might handle  
25 cesium-137, but another set of demands from users

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1 who say it's really not very easy to substitute  
2 cesium-137 with any other isotope. Then I guess that  
3 we are trying to plan a furrow of finding a way of  
4 manufacturing cesium sources that meet both sets of  
5 requirements and that's just what we hope to come  
6 back with in a few months.

7 MR. POWELL: Brian Powell, Constellation  
8 Energy. As far as I understand, the sources of  
9 concern already, Category 1 and 2 sources of  
10 concern, already, are required to have a  
11 transportation security plan. So I guess I'm asking  
12 the panel what is the difference between the -- Is  
13 there a new proposed transportation security plan  
14 for cobalt-60 that's different than the cesium-137  
15 one or any of the other isotopes are concerned or  
16 are we already covered sufficiently by the existing  
17 plans that we've implemented?

18 MR. RING: Joe Ring, Harvard. I would  
19 like to respond to that in the general security. I  
20 think the real issue with cobalt-60 is that you have  
21 to replace it much more frequently. Therefore, it's  
22 on the road an awful lot more. Cobalt irradiators  
23 can last a comparatively short time as compared to  
24 cesium.

25 And I would like to make a comment about

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1 the security of the current irradiators. I've gone  
2 from a few thousand people having access to them to  
3 400 people who now coordinate the access and I will  
4 tell you that those 400 people think it is extremely  
5 difficult to get access to an irradiator these days  
6 and when they go through the process and they have  
7 to have an escort by a security guard through  
8 multiple systems, it is difficult for them and it  
9 really has greatly impacted their research.

10 MR. KAMINSKI: Just to make one comment  
11 about cobalt and, of course, I think cesium needs to  
12 be used in certain cases for animal research also.  
13 But the specific activity tends to be higher with  
14 the cobalt source and you can load more also at the  
15 time. So at least according to an NAS report, they  
16 estimate replacement about every 15 years instead of  
17 every 30.

18 FACILITATOR RAKOVAN: Okay. Another  
19 one. Maybe we should just get you a lapel mike like  
20 the one I have.

21 (Laughter.)

22 MS. SHEPHERD: I'm sorry. In regard to  
23 shipment security, Mary Shepherd, Shepherd and  
24 Associates. In regard to shipment security, there  
25 was a *Federal Register* announcement that did not go

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1 into the safeguarded areas, but there will be more  
2 security for all kinds of aspects starting out with  
3 manufacture and distribution licensees that will  
4 probably filter down through the whole licensing  
5 community and I think it's -- I don't remember the  
6 number, but it came out in August.

7 FACILITATOR RAKOVAN: Any further  
8 discussion or should we go ahead and take a half  
9 hour break?

10 (No verbal response.)

11 Okay. We'll come back in a half an hour  
12 and start promptly a few minutes before 3:00 p.m.  
13 with Panel 2. Off the record.

14 (Whereupon, at 2:26 p.m., the above-  
15 entitled matter recessed and reconvened at 3:00 p.m.  
16 the same day.)

17 MR. RAKOVAN: Okay. Let's go ahead and  
18 get started again.

19 We're going to move on to Issue No. 2,  
20 which is use of alternative technologies. If we  
21 could really quick just go and have the new panel  
22 members at the table or we might as well go ahead  
23 and ask everybody who's at the table regardless of  
24 whether you're new or not to introduce yourselves,  
25 starting on the left there.

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1 MR. FITZGERALD: Yes, I'm Bill  
2 Fitzgerald. I'm from the National Institute of  
3 Environmental Health Sciences. I'm the Radiation  
4 Safety Officer there.

5 MR. GORLI: Jed Gorli, Medical Director,  
6 Memorial Blood Center, speaking on behalf of the  
7 American Association of Blood Banks, or AABB.

8 MR. SVAJGER: I'm Mark Svajger,  
9 Radiation Safety Officer and calibration service  
10 manager for Fluke Biomedical, and I hope this is  
11 employed. It's really just nonactive here.

12 (Laughter.)

13 MR. SVAJGER: Yeah, we're hurting right  
14 now. Thanks.

15 MR. KIRK: Yes, I'm Randol Kirk from Rad  
16 Source Technologies.

17 MS. GILLEY: Good afternoon. My name is  
18 Debbie Gilley, and I'm with the Advisory Council for  
19 the Use of Medical Isotopes for the NRC.

20 MR. SULEIMAN: I'm Orhan Suleiman. I'm  
21 with the Food and Drug Administration's Center for  
22 Drug Evaluation and Research. I also wear a dual  
23 hat because I also participate with the Medical Use  
24 Advisory Committee for the NRC.

25 MR. WAGNER: Hi. Good afternoon. My

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1 name is Steve Wagner. I'm with the American Red  
2 Cross. I'm a scientist at the Holland Laboratory.

3 MR. KAMINSKI: Joe Kaminski, NIH.  
4 Again, I only represent myself.

5 MR. McBRIDE: Bill McBride, again,  
6 representing Astro.

7 MR. RING: Joe Ring, Harvard,  
8 representing the summary of our faculty.

9 MR. NIXON: Grant Nixon, radiation  
10 physicist, representing Best Theratronics.

11 MR. RAKOVAN: Thank you all.

12 As usual, I think we might have a few  
13 statements to start the panel out with. So if  
14 anyone has a statement they'd like to make now.  
15 Okay. Start at the end there.

16 MR. FITZGERALD: Again, I'm Bill  
17 Fitzgerald. I'm the Radiation Safety Officer at the  
18 National Institute of Environmental Health Sciences,  
19 and I'm representing the researchers at the NIHS.

20 You can go on to the next slide.

21 The NIEHS is one of the 27 institutes  
22 and centers of the National Institute of Health. We  
23 also are home of the National Toxicology Program.  
24 We focus on environmental influences in the  
25 development and progression of human disease. We

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1 are located in Research Triangle Park, North  
2 Carolina.

3 Next slide.

4 We have a J.L. Shepherd Mark-431. This  
5 is kind of a model, or Mark-168(a). It has about  
6 22,000 curies of cesium in it when it was purchased.

7 It has been in service for more than 30 years. The  
8 dose rates we were able to achieve when we first  
9 purchased this were greater than 113 gray per  
10 minute, and we have more than 40 ongoing research  
11 projects.

12 There's been hundreds of research  
13 projects using this irradiator over the last 30  
14 years, but ongoing right now we have about 40.

15 Next slide.

16 So I spoke to each of the researchers  
17 who used the irradiator and then tried to break down  
18 their uses of it into classification, and I have  
19 five classes here to let you know how to use it.

20 And then I also asked them for some  
21 alternatives. What would you do if you lost the use  
22 of the irradiator? What would you do as a means of  
23 getting your work done or your research done?

24 So I broke it up into these five  
25 classes: feeder cell, oxidation of proteins, loss

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1 of bone marrow viability, chromosome aberration, and  
2 DNA study and repair states.

3 The first one with the feeder cells, the  
4 doses range usually from about 30 to 80 gray. This  
5 research has been going on for about 30 years.

6 The alternatives to that is you can use  
7 X-ray. Some of the researchers said that this may  
8 be an issue and that there's such a spectrum with  
9 the X-rays, but they thought that they can overcome  
10 that by hardening up the beam a little bit.

11 You can also use chemical treatments.  
12 It is widely known that you can use chemical  
13 treatments to stop the production of these cells.  
14 The problem though is that when you're doing basic  
15 cell research, some of this is genotoxic and so it  
16 kind of nullifies what you're trying to accomplish,  
17 and so in some cases you may be able to use some  
18 chemicals, but in most of the cases where we're  
19 looking at basic research, you're not going to be  
20 able to.

21 But this is an alternative that they  
22 brought forward and said in some areas they would be  
23 able to do that.

24 The next slide, please.

25 The oxidation of proteins is something

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1 that has come out recently. We've been doing this  
2 for about five years. The thing with this is that  
3 you're trying to form hydroxyl radicals and  
4 concentrations enough to oxidate the proteins, and  
5 these dose rates that you need are really large.  
6 They're around 23 gray per minute.

7 And, again, this research is only about  
8 five years ongoing. You need ranges from about 100  
9 to 2,800 gray, which are just really long doses, but  
10 the researcher really kind of reached in and said,  
11 well, he might be able to use some laser flash  
12 photolysis to do this kind of work, but he said it  
13 may change the type of work they're doing, but if he  
14 lost the irradiator he may be able to do that.

15 Next slide, please.

16 The bone marrow viability, this is  
17 something, again, that has been going on for a long  
18 time. You're talking about doses five to ten gray.

19 It has been going on for about ten years. Again,  
20 they thought you could use X-rays to take care of  
21 this. There are chemicals that you could also use,  
22 but again, here we go. When you're using a  
23 chemical, it is also toxic to other organs in the  
24 mouse or the animal that you're working with, and so  
25 that may be a problem.

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1           So it may work for some research, but  
2 not for others.

3           Next slide.

4           And in the chromosome aberration, again,  
5 five to 40 gray here, about 30 years of research.  
6 Again, even before the radiator that we had on site  
7 that used X-rays for some of this work, most of what  
8 we're doing this in is lower forms of animals. So  
9 we're using flies, nematodes, and things like that.

10           The nematode people said that they  
11 thought they could use a UV cross-linker. There's  
12 some research that says that might work. It may  
13 not, depending on the thing, but that's mainly  
14 limited to the worm community. And, again, the  
15 chemicals is also limited to the worm community.

16           The next slide, please.

17           With regard to our DNA repair studies,  
18 this is what this research is about. We're looking  
19 at research that's specific to direct ionization of  
20 direct effects of low ionizing radiation. It deals  
21 with double strand breaks and resection of randomly  
22 broken DNA.

23           We use yeast to model that because yeast  
24 has about 500 fewer times less DNA than on a human  
25 cell. So we knew more about yeast a long time ago,

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1 but that means you have to have a higher dose to do  
2 that. So that's been ongoing.

3 The high dose rates are needed for a  
4 short time because the repair starts, and just a  
5 point about the animal studies. The animal strains  
6 that we use are specific. We make it specific to  
7 the radiation dose. We know what the outcome is.  
8 If we had to go to another form of radiation, we'd  
9 have to recharacterize that, and that would take  
10 many years of research.

11 And then finally, the last slide,  
12 please.

13 And it's basically our clinical points  
14 are that for some researchers we feel that there are  
15 alternatives to gamma radiation, but for most of the  
16 research we're looking at direct effects of  
17 ionization, and we don't think there is any  
18 alternatives to gamma radiation because that's what  
19 we're studying. So I just want to make that point.

20 Thank you.

21 MR. RAKOVAN: Thank you.

22 MR. GORLI: Next slide.

23 I'm speaking for the American  
24 Association of Blood Banks (AABB), and I just wanted  
25 to make some over arching comments at first.

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1           AABB is not tied to any specific single  
2           technology. That said, the details do matter. We  
3           need to use irradiation to achieve a specific end.  
4           That end is to prevent transfusion associated graft  
5           versus host disease, which once it happens in a  
6           patient is generally fatal and not treatable.

7           Irradiation consistent with AABB  
8           standards has shown to be 100 percent effective in  
9           the prevention of this complication.

10          Next slide.

11          Leaving X-rays to the subsequent slides,  
12          cobalt is less desirable in that you've already  
13          heard about its increased shielding requirements.  
14          At least in half of our applications they're in  
15          hospitals where the blood bank is generally opposite  
16          the operating room, not the morgue.

17          Linear accelerators are generally not  
18          uniformly available around the clock.

19          I do want to make the point that  
20          pathogen inactivation has been shown in vitro to  
21          largely abrogate the need to irradiate product. So  
22          down the line when products are available, these DNA  
23          cross-linking reagents may be a viable alternative,  
24          and I don't think we're part of the worm community.

25          Next slide.

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1           That said, since there was a request for  
2 quantitative data, we did do a survey of all our  
3 constituents. It was done with a pretty short lead  
4 time. So we did not have uniform response. We did  
5 get 345 responses from 195 centers. We very  
6 specifically called the list and did not call the  
7 ABC or the Red Cross centers because they were  
8 having their own direct surveys, which you will hear  
9 about from their representatives shortly.

10           Next slide.

11           The preponderance of centers do, in  
12 fact, use the cesium devices for the reasons you've  
13 heard, reliability throughput and economics. Some,  
14 and only a relatively small number, have X-ray  
15 irradiators, and this becomes relevant in the  
16 statistics.

17           Next.

18           Now, there was significant difference in  
19 the down time reported cesium versus the X-ray  
20 devices. For cesium, less than five percent had  
21 more than 30 days down time versus 21.4 percent. In  
22 fairness to the X-ray devices, that was a relatively  
23 small number of centers, however.

24           Next slide.

25           The economics, again, are not equal.

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1 Although a cesium irradiator may be slightly more  
2 expensive up front, the maintenance costs have been  
3 estimated to be more than 300,000 over the lifetime  
4 of a cesium device, and this is from the National  
5 Academy report.

6 Next slide.

7 And hence, in recommendations, if you  
8 can see in the background, that is a balanced scale.

9 So we want to balance both the risk and benefit as  
10 well as cost and benefit. If cesium irradiators are  
11 replaced, economic considerations should be not only  
12 the cost at time of disposal, but the availability  
13 of replacement devices and reimbursement of all  
14 additional costs.

15 Thank you.

16 MR. RAKOVAN: Okay. Anyone else on the  
17 panel have an opening statement or presentation?

18 I guess we'll just keep on moving this  
19 way.

20 MR. KIRK: Good afternoon. I am from  
21 Rad Source, and Rad Source makes a new type of X-ray  
22 emitter, which has very, very high dose rates, and  
23 the abilities to do things that have never been able  
24 to be done with a point X-ray source.

25 Next slide.

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1                   We have built a number of different  
2 configurations using this emitter. Probably the  
3 most successful one so far is the one up in the  
4 right-hand corner, the RS-2400. The IAEA has just  
5 completed a review of that unit and has begun the  
6 process of getting an article accepted for  
7 publication, and that should be out probably three  
8 or four months, and it talks about its application  
9 in SIT.

10                   The one that we have labeled the RS-3400  
11 there is actually a new type of blood irradiator  
12 which has just been submitted for the 510(k) review.

13                   I'm not going to say anything else about that right  
14 now other than that it's in process, and it is  
15 actually kind of a vertical version of the RS-2400.

16                   So hopefully one of these days you'll be seeing it  
17 around.

18                   Next slide, please.

19                   Based on all of those products, we can  
20 pretty much match any application. I don't think I  
21 mentioned. I forgot the highest dose rate unit  
22 there does ten kilogray per hour as far as output.  
23 So if you think about that, that's considerably more  
24 than you would expect from a conventional X-ray.

25                   Reliability, the one thing that's

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1 changed since we designed the first X-ray irradiator  
2 about ten years ago is that we now have an emitter  
3 that actually can be repaired. You don't have to  
4 throw it away if it goes bad. You can open it up.  
5 You're going to replace the filament. You can do  
6 whatever is necessary, pump it back down, and  
7 recycle it into the unit or another unit.

8 Thirdly, I think if you start  
9 considering the fact that you have to consider the  
10 disposal costs when you're thinking about  
11 irradiators and you think about having a tube that  
12 you don't have to replace, that cost becomes  
13 competitive.

14 That's it. Thank you.

15 MR. RAKOVAN: Ms. Gilley.

16 MS. GILLEY: On behalf of the Nuclear  
17 Regulatory Commission's Advisory Committee on the  
18 Medical Use of Isotopes (ACMUI), Subcommittee on  
19 Cesium Chloride Alternatives, I would like to  
20 provide the following opening remarks and a little  
21 bit about our draft report that we'll be providing  
22 to NRC next month.

23 Cesium chloride irradiators are  
24 responsible for saving lives. The standard of care  
25 that exists in this country will be compromised if

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1 the use of cesium chloride is prohibited or  
2 eliminated.

3 The members of the subcommittee are  
4 Darrell Fischer, who is a patient advocate; myself,  
5 as a member of an agreement state; Ralph Lieto, who  
6 is a medical physicist; Orhan Suleiman, who is a  
7 representative from FDA and is sharing the table  
8 with me today; Dr. Bruce Tomadsen, who is a  
9 radiation medical physicist; Dick Vetter, who is a  
10 radiation safety officer at a large, major  
11 institution; and Dr. James Welch, who is a radiation  
12 oncologist.

13 The National Research Council's report  
14 made several assumptions that seemed questionable to  
15 the ACMUI. The subcommittee investigated these  
16 concerns and raised the following comments by the  
17 ACMUI.

18 Our concerns, first, are the need for  
19 cesium chloride irradiators. We're also interested  
20 in the liability of alternatives that are available  
21 out there, and we also would like to bring to the  
22 table and discuss the current security requirements  
23 that our licensees have had to go forth and do in  
24 order to maintain adequacy for their license.

25 The original report that approximated

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1 ten percent of the blood that was used in the United  
2 States was irradiated. We've had discussions with  
3 the hematologists and oncologists who indicate that  
4 for their particular practices, the values range  
5 between 15 and 40 percent. These patients that are  
6 involved have depressed immune systems and need the  
7 irradiated blood.

8 The lower number probably comes from a  
9 higher fraction of trauma cases where irradiation is  
10 irrelevant.

11 For animal irradiation for research,  
12 research on stem cells and other systematic  
13 therapies increasingly requires whole body  
14 irradiation of the animals, usually mice, before  
15 infusion. This research is growing and may soon  
16 lead to treatments for current untreatable  
17 conditions.

18 Without irradiators available -- next  
19 slide -- hematology and oncology patients would  
20 suffer potential death for the lack of irradiated  
21 blood. Without irradiators available, much of the  
22 stem cell systemic drug research would not be able  
23 to proceed.

24 We looked at the alternatives for cesium  
25 chloride irradiators. These alternatives are

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1 conventional X-ray units and linear accelerators.  
2 Both have been and are used for blood, animal, and  
3 material irradiation.

4           Throughput is lower for the X-ray units  
5 that are currently available out there. With 48,000  
6 blood product units, X-ray tubes, and 50 units per  
7 day operations would replace the tube every 3.7  
8 years, adding to the cost of running the unit.

9           Issues with the X-ray unit for animal  
10 irradiation -- next slide. We're behind -- would  
11 include the different RBE compared with the Cesium-  
12 137, possibly of a factor of two for the lower  
13 energy units, and the dose rates can have an effect  
14 on the biological effectiveness as well as the  
15 anesthesia, more difficult.

16           Penetration may require irradiating the  
17 animals from several different directions.

18           MR. RAKOVAN: Can we make sure we've got  
19 the right slide for you up there? I think we're a  
20 little lost.

21           MS. GILLEY: Okay. Next slide. Next  
22 slide. There we go.

23           Medical linear accelerators are another  
24 option. I apologize. If the radiotherapy  
25 department's accelerator is used, time available for

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1 blood in animal irradiation becomes a problem.  
2 These linear accelerators are used for the treatment  
3 of cancer and are usually very busy. Many  
4 institutions run two shifts a day in order to  
5 accommodate patients.

6 And if it's not being used in the radio  
7 therapy department, accelerators because of their  
8 price tag become a problem at \$1.5 million as the  
9 starting, getting in price for an accelerator.

10 Next we'd like to talk about security.  
11 Since the National Research Council's report raising  
12 the concerns about these units, several things have  
13 changed that are not a part of that report. One is  
14 the security of the users has been enhanced through  
15 the requirement of background checks and  
16 fingerprinting, and this is in response to orders  
17 issued by NRC, increased controls and security in  
18 orders or amendments by the agreement states.

19 The security of the facilities has been  
20 enhanced following the directives of the Nuclear  
21 Regulatory Commission. That means we've gone in and  
22 required the facility to make additional security  
23 capabilities to prevent access to these devices, and  
24 it has also been enhanced and should be enhanced  
25 through a hardening situation where we can actually

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1 go in and prevent the source from being removed from  
2 the irradiator.

3 Next slide, please.

4 Following these three security  
5 enhancements, the units present little hazard for  
6 unauthorized source removal or disruption. The lack  
7 of such security was a major factor for the  
8 production of the original national academy of  
9 science report.

10 In summary, we feel that irradiation  
11 facilities are essential for irradiation of blood  
12 and research. We believe that forced replacement of  
13 Cesium-137 base units would force many facilities to  
14 stop irradiation because of the large expense.  
15 Since most of the facilities are nonprofits and have  
16 few resources for funding new X-ray units and  
17 maintaining the units.

18 And if not leading to the termination of  
19 irradiation, the replacement would put a large  
20 financial burden on the facilities which use and  
21 have little funding.

22 Thank you.

23 MR. RAKOVAN: Okay. We might as well  
24 continue this way. Anyone else have statements that  
25 they'd like to start out with?

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1 MR. KAMINSKI: I'd just make one  
2 statement just about the mechanisms of X-rays.

3 MR. RAKOVAN: Could you get a little  
4 closer to the microphone, please?

5 MR. KAMINSKI: The mechanisms of X-rays,  
6 low energy X-rays and higher energy, for example,  
7 photons or X-rays. I just jotted down some stuff as  
8 we were talking, but the mechanism of knocking out  
9 electrons is different between low and high photon  
10 energies, for example, photoelectric and Compton,  
11 respectively. But the damage is primarily done by  
12 double strand breaks, as you all know out there.

13 The reason why we see bone at low  
14 energies is due to the extra-cellulosseous matrix,  
15 but indeed, there are dosimetric concerns at the  
16 osseous interface and depth dose issues with lower  
17 energies. But, again, I don't think in the majority  
18 of the cases these are relevant too much to animal  
19 research as they can be factored into the picture,  
20 and that's pretty much what I wanted to say.

21 But, again, I think cesium, getting back  
22 to it, cesium does have a good depth dose profile  
23 for small animals and I don't personally think we  
24 should advocate eliminating it. Just the form of  
25 cesium 137 should be changed.

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1 MR. RAKOVAN: Any other panelists want  
2 to make initial statements?

3 MR. NIXON: Hi. This talk was prepared  
4 with my colleagues, Tom Wasiak and Paul Moses and  
5 Blair Menna.

6 Next slide, please.

7 So just to give a brief perspective from  
8 our view as a manufacturer, we are a manufacturer of  
9 both X-ray and cesium chloride irradiators. So we  
10 have dogs in both sides of the fight. We come out a  
11 winner no matter which way this works out.

12 (Laughter.)

13 MR. NIXON: So we like to consider  
14 ourselves more or less an independent broker, to  
15 give you the straight goods. I mean, we offer both  
16 technologies. We want to do what's best for our  
17 customers.

18 So are they already commercially  
19 available, X-ray units to substitute cesium chloride  
20 or cesium-137 and cobalt-60? Well, it depends on  
21 the application, of course, and it depends on what  
22 you mean by "substitution."

23 Currently, we have models available for  
24 low volume, low throughput, self-contained blood  
25 irradiators in X-ray form. We offer the Raycell,

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1 which is the 510(k) approved modality available to  
2 the U.S.

3 No, in terms of high volume, high  
4 throughput, self-contained blood irradiators, and in  
5 terms of a comparison with the gamma cell 3000 Model  
6 II.

7 And in terms of research irradiators  
8 used for stem cell research and so forth, as a  
9 manufacturer, we do not feel that existing units  
10 available in the marketplace today can supplant the  
11 use of cesium chloride or cesium-137 based self-  
12 contained irradiators on account of the voltages  
13 being too low at this time.

14 In the near future or in a few years'  
15 time perhaps we will have prototypes available. At  
16 this time, because of the low energy components, you  
17 get too much dose differentiation between tissue and  
18 bone, and as my colleague expressed, you get these  
19 interface effects that lead to overdosing, and these  
20 overdosing effects vary from one specimen to the  
21 next on account of the shielding issues associated  
22 with low energy photons.

23 Next slide, please.

24 Are X-ray units cost effective  
25 considering initial capital costs, et cetera? Well,

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1 if they weren't cost effective people wouldn't be  
2 buying them. So I would say, yes, they're cost  
3 effective, but as most people realize that are in  
4 the business, there are more costs associated with  
5 that modality by its very nature.

6 Life spans of typical X-ray units, at  
7 least from the history we have to date, is that they  
8 can be used or serviced and used over a period of  
9 five to ten years or as cesium units. We have  
10 cesium units that are 40 years old out in the field  
11 today that are still running.

12 There's more servicing of auxiliary  
13 components associated with X-ray technology.  
14 Calibration of the beam, very difficult from a  
15 dosimetry perspective. I worked in dosimetry for  
16 ten years, and most of the tubes out there use an X-  
17 ray, cabinet X-ray equipment are of the order of 150  
18 kilovolts or around 60 kilovolts. Very challenging  
19 to properly characterize and to find consensus, and  
20 even the experts in the field are constantly  
21 revising their recommended protocols.

22 Next slide.

23 And is there any indication that  
24 performance of the alternatives will improve or  
25 worsen with respect to Cesium-137? I think

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1 technology usually advances forward. Things tend to  
2 improve.

3 On the other hand, there will always be  
4 an inherent limitation because of the extra  
5 complexity. Like any process, you want to make it  
6 more lean. You want to have fewer components that  
7 can go wrong in order for it to be more reliable.

8 In the case of X-ray generation, more  
9 things can go wrong and will, and there's no getting  
10 around that.

11 Tubes have been manufactured for over  
12 100 years, and almost the same could be said for  
13 high voltage power supplies. There's only so much  
14 that can be done.

15 Next slide, please.

16 And in terms of alternative  
17 technologies, what time frame? What's the time  
18 frame future availability of each alternative? And  
19 what's the cost, capital cost, operational cost, end  
20 user costs?

21 Very, very early in the history of the  
22 use of these kind of technologies, way too early to  
23 tell what the overall cost will be; very difficult  
24 to estimate. A lot depends on developments that are  
25 going to occur in the near future.

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1 I'll leave it at that. Thank you.

2 MR. RAKOVAN: Thank you.

3 Please.

4 MR. McBRIDE: I'd just like to add a  
5 little bit to that. I mean, I think the cost  
6 depends to a certain extent on the applications.  
7 Astro did a breakdown of the costs of X-rays  
8 compared with cesium units for research  
9 applications, and they reckoned that it's probably  
10 going to cost about five times as much to run an X-  
11 ray machine as the cesium source.

12 A lot of this actually goes into physics  
13 time. The actual calibrations, the maintaining the  
14 machine, and just, you know, getting goods at a  
15 homogeneity of fields and other issues which are  
16 really important if you're doing, for example, you  
17 know, small animal work, which is tough, I think,  
18 for X-rays anyway, but it does depend to a certain  
19 extent I would say upon the application. You  
20 certainly are looking at a higher cost, also bigger  
21 supporting.

22 MR. SULEIMAN: I want to just add a few  
23 points that needed to be emphasized. Radiation is  
24 the only prophylactic treatment for graft versus  
25 host disease. There aren't any alternative

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1 methodologies. I've been assured by some of my  
2 colleagues, actually Dr. Phillips of the Center for  
3 Device and Rad Health, who will be on one of the  
4 panels tomorrow, that basically in terms of FDA  
5 clearance, hardening of these irradiators shouldn't  
6 impact on us in any way, shape or form in terms of  
7 getting them cleared.

8           So this has come up in other types of  
9 discussions where people have accused FDA is going  
10 to -- this is going to cause significant slow-down  
11 of the process, but this should be transparent to  
12 us.

13           And the third thing I want to mention is  
14 my entire into this whole area a few years ago, and  
15 what bothered me then -- so I'm going to share that  
16 frustration with you -- I was very much involved  
17 with the decision to use radiation to render the  
18 mail safe after anthrax issue, and I won't tell you.

19           It's a long story. It's a very long story, but  
20 within 24 hours of convening a task group, the  
21 decision was made to use accelerators, and I was  
22 accused of being a cobalt advocate, and I said  
23 absolutely not. I thought we ought to put all of  
24 the irradiators or all of the sources on the table.

25           We're dealing with large volumes of mail, large

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1 intensities, and so on. We needed to know the dose  
2 that would do what we wanted to do.

3 And the fear was that any explosion  
4 would basically cause contamination, and I  
5 unsuccessfully argued that, by gosh, if there was  
6 going to be an explosion, I'd just as soon have it  
7 in a nice, shielded room than elsewhere.

8 But it was obvious I was clearly  
9 outnumbered. In a democracy you know when to sort  
10 of back off, but that phobia -- and I would be very  
11 concerned professionally and individually to  
12 basically make some decisions without having all of  
13 the scientific risk and all of the advantages and  
14 disadvantages of all of these technologies on the  
15 table.

16 And there are clearly alternative  
17 technologies, but the economic issues and questions  
18 haven't been answered, at least to satisfy me, but I  
19 suspect it hasn't answered a lot of other people  
20 either.

21 MR. RAKOVAN: Okay. Real quick, before  
22 we continue, I just wanted to go ahead and read kind  
23 of the intro to these questions that was in the  
24 Federal Register notice.

25 An alternative technology is defined in

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1 the context of this document as a technological  
2 process that provides the same societal benefits as  
3 the devices that utilize cesium chloride at the  
4 present time, but without the use of radionuclides.

5 Some of the potentially feasible alternative  
6 technologies include such processes as X-ray  
7 irradiators or electron beam irradiators.

8 Previous reports, such as those prepared  
9 by the Radiation Source Protection and Security Task  
10 Force and the NAS referenced above addressed the  
11 issue of alternative technologies to a limited  
12 extent. A more extensive examination of the  
13 feasibility of these and other alternative  
14 technologies is needed.

15 Therefore, in considering Issue No. 2,  
16 use of alternative technologies, there are four main  
17 issues that should be considered and discussed.

18 The first one we have up here, Question  
19 2-1, are X-ray generators already commercially  
20 available as substitutes for applications that do  
21 not require the gamma rays with Cesium-137 and  
22 Cobalt-60?

23 MR. KAMINSKI: I can answer at least for  
24 the Cobalt-60. The answer is yes. I mean, we do it  
25 clinically every day. For Cesium-137, again, for

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1 small animals that energy is ideal, but X-rays, I  
2 think, in many cases would be satisfactory.

3 MR. RAKOVAN: Further discussion?

4 MR. WAGNER: Thank you.

5 The American Red Cross uses Cesium-137  
6 irradiators. We have 32 units in the field. We  
7 also have seven X-ray devices. There are seven  
8 Raycells and one RS-3000. We have 32 regional blood  
9 centers.

10 The X-ray devices are 510(k) cleared,  
11 and so they're available for use for irradiating  
12 blood. So we use both devices.

13 MR. RING: Joe Ring, Harvard.

14 One of our faculty members in a foreign  
15 laboratory that he runs, he has been able to use X-  
16 ray machines to inactivate mitosis in cells.  
17 However, he's found them problematic in that he has  
18 to actually have two instruments so that he can do  
19 his work, which basically doubles the cost.

20 MR. RAKOVAN: I had a gentleman who was  
21 standing at the second mic. If you could introduce  
22 yourself, please.

23 MR. MORGAN: Tom Morgan, University of  
24 Rochester.

25 We're a Level 1 trauma facility for

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1 seven counties in central-western New York. We  
2 choose to irradiate all blood products. That's 28  
3 to 30,000 units a year.

4 So my question for the manufacturers  
5 are: how many of your irradiators would I have to  
6 purchase to meet that 28 to 30,000 units a year,  
7 assuming a rate of 75 to 90 units a day, you know,  
8 365 days a year?

9 MR. RAKOVAN: Somebody want to take a  
10 stab at that one?

11 Please.

12 MR. WAGNER: I'm not a manufacturer, but  
13 I know that the irradiation time for one of the X-  
14 ray devices is about five or six minutes, and you  
15 can fit basically three blood bags in at a time. So  
16 I'm a little bit slow at math, but I guess you can  
17 go through it yourself and sort out how many you  
18 would need for your facility.

19 MR. KIRK: I'm not going to comment on a  
20 510(k), but the device that we use to develop the  
21 unit would probably do somewhere around five, 500 mL  
22 bags of blood in the three minute range. I don't  
23 know exactly what that calculates out to, and I'm  
24 not sure that's what the submission says, but I know  
25 from the IAEA work that's about where it would be.

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1 MR. GERSABECK: My name is Edward  
2 Gersabeck. I represent the Department of  
3 Agriculture.

4 I think we take the lead in small  
5 animals because our insecteries produce anywhere  
6 from 1.5 to two billion sterile small animals per  
7 week for release both in the United States and  
8 overseas. We actually own all three technologies.  
9 We have several cobalt based irradiators. We have  
10 several Husman cesium based irradiators. We  
11 actually own some of the X-ray technology, and I  
12 know you've asked for non-anecdotal type of  
13 information. So let me give you our perspective.

14 Over the last three years, we've  
15 invested over \$1.6 million in three X-ray machines,  
16 and we have found them so unreliable that we this  
17 year purchased for three-quarters of a million  
18 dollars a cobalt machine for in insectery in Panama  
19 and just over a million dollar machine for our  
20 Moscamed facility in Guatemala.

21 Our position is at least for insectery  
22 type uses, that we're probably at least two years  
23 away for the technology to actually be usable or to  
24 be recommended, but for our department we have  
25 chosen not to pursue X-ray technology in our

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1 facilities overseas.

2 One thing we became aware of is as these  
3 machines age and go off warranty, we'll have to  
4 establish our own engineering staff to rewire or  
5 replace the filaments in the machine, which means  
6 have to establish a workshop. We have to train  
7 personnel.

8 So besides the increased electrical  
9 costs in operating these machines, there's ongoing  
10 additional labor and training to keep these machines  
11 in operation.

12 Thank you.

13 MR. NIXON: If I could interject to the  
14 discussion, can we speak to the specifics as to what  
15 technologies are available for what applications  
16 today?

17 MR. RAKOVAN: Anyone want to step in and  
18 address? Please.

19 MR. SVAJGER: Maybe someone in the NRC  
20 staff can tell me this, but there's got to be a heck  
21 of a lot more licensees than just blood irradiators,  
22 and this morning I heard 1,100 facilities using  
23 blood irradiators. So there has got to be tenfold,  
24 100-fold more licensees than just that.

25 So what I'm saying is let's not just

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1 focus totally on blood irradiated entirely. There's  
2 a huge percentage of cesium chloride as well.

3 With that I'll sign off.

4 MR. McBRIDE: Well, I guess I have a  
5 non-blood irradiator. I'm a cell irradiator and an  
6 animal irradiator.

7 You know, I think that we are kind of  
8 trying again to put everything into one kind of  
9 bucket here, and I agree with you, you know, that  
10 really there are different irradiators for different  
11 purposes, and as a radiation biologist who kind of  
12 spends my life, and, you know, irradiating and  
13 looking at cellular, molecular and whole animal  
14 processes, you know, it's important to have that  
15 availability of resources.

16 So I use cobalt. I use X-rays, and I  
17 use cesium sources, and I use them under different  
18 circumstances for different purposes, you know. And  
19 to break that down, I's probably need an hour  
20 lecture to actually explain the complexities of  
21 doing all of these different types of studies.

22 If you're looking at the rapid molecular  
23 assays for radiation end use responses or DNA  
24 damage, that's a very different thing from looking  
25 at the response of gut or brain in a mouse or a rat.

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1       So you really need the flexibility, but whenever it  
2 comes down to it, you know, the cesium sources are  
3 the work horses for all of this.

4               This is the kind of big base. They can  
5 be used by people who have no knowledge of radiation  
6 and no knowledge of physics. They can just walk in  
7 and irradiate their cells, their feeder layers or  
8 whatever, walk out again and, you know, it is very  
9 easy, very low cost, really no backup almost. I  
10 mean, it really is a very cheap process.

11              Going to X-rays, you've heard about the  
12 lack of reliability. They are a lot more costly,  
13 and the lost of cost, as I say, goes into physics to  
14 actually get good dosimetry whenever you're trying  
15 to do, in particular, animal radiations is tough, in  
16 particular if you're doing small bits of animals,  
17 you know, rather than your whole body irradiation.

18              I think the availability of X-rays and  
19 cobalt is a big problem. You know, we've got five  
20 cesium sources at UCLA. We have got one X-ray  
21 source which isn't working. We've got two cobalt  
22 sources, one of which we use for big animals, but  
23 you know, we would have to replace all of those  
24 cesium sources with X-ray machines, which as we  
25 said are not really all reliable whenever it gets

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1 down to it.

2 And also are not user friendly for the  
3 people that just want to walk in, irradiate some  
4 cells, and walk out again. It's more complex than  
5 that whenever it comes to the considerations of  
6 using X-rays.

7 So I think that, you know, it's really a  
8 big mistake to kind of limit the sources in any way  
9 at all. We really need to kind of maintain all of  
10 these sources really for different purposes, you  
11 know, and certainly there are some of these purposes  
12 that people will use cesium because it's available  
13 and it's easy and they could use another source, but  
14 there are other purposes where we can't do that.  
15 Cesium is essential.

16 There are other purposes where X-rays  
17 are better. You know, that's the way it goes. It  
18 just depends on what you want to use the radiation  
19 for. So we can't lump all of these together.

20 MR. KAMINSKI: I just want to say I  
21 agree. We definitely need Cesium-137. Again, we  
22 need to seek out alternative forms. I think it's  
23 important.

24 MR. RAKOVAN: Sir, if you can introduce  
25 yourself, please.

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1 MR. ZIMMERMAN: Peter Zimmerman, King's  
2 College, London, retired.

3 I am a physicist, and I do do numbers  
4 fairly well. The gentleman behind me from Rochester  
5 suggested that he needed to do 30,000 units of blood  
6 a year. Thirty-six thousand five hundred would be  
7 100 units a day. So let's take that number.

8 One of the source manufacturers said he  
9 could do five bags in three minutes. He needs to do  
10 20 times that to keep up with a day. Twenty times  
11 three minutes is an hour. Let's take another hour  
12 for in and out time. That means that basically  
13 between two and three hours of duty a day on the X-  
14 ray machine is perfectly adequate. I seriously  
15 doubt that you'll have to buy more than one blood  
16 irradiator to handle that load.

17 I was very disappointed with the  
18 attitude that I heard on a couple of people's part,  
19 but mostly of the Advisory Committee on Medical  
20 Uses. Nobody is actually talking necessarily about  
21 taking away your cesium gamma spectrum. We're  
22 talking about taking away cesium chloride, and let  
23 me point out that the only nuclear or -- pardon me --  
24 -- radiological terrorist scenarios you can dream up  
25 that kill a lot of people use and exploit cesium

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1 chloride.

2 I'm not at liberty to discuss what those  
3 are, but they're pretty bad.

4 You've talked about security. Well,  
5 security is not just in the fingerprinting or even  
6 in the locks and keys. It's in an ongoing security  
7 check that prevents good employees from going bad.  
8 I could mention the name of Aldrich Ames and Hansen,  
9 just to name a couple of good employees who went  
10 real bad.

11 So to say that you've implemented the  
12 security measures is not to say that those security  
13 measures can ever be considered adequate unless you  
14 have really intrusive, ongoing personnel monitoring.

15 I think we are going to have to face the  
16 fact that cesium chloride in a water soluble form is  
17 going to have to come out of circulation.

18 Now, I'll make two points about  
19 reliability. First is as far as skills needed,  
20 every dental technician can run an X-ray machine.  
21 It's not that hard to build an X-ray machine that's  
22 got a switch on it, on and off. It really isn't.

23 When I was a grad student, a post doc,  
24 and a professor doing high energy and nuclear  
25 physics, many accelerators were considered the most

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1 unreliable instruments ever built by the hand of  
2 man. They are now one switch on, one switch off,  
3 operated by a technician in medical treatment  
4 centers.

5 Yes, they do break down, and yes, they  
6 have to be repaired, but that's true of almost  
7 everything.

8 Thank you very much.

9 MR. KAMINSKI: I just want to echo your  
10 thoughts. I agree with everything you've said  
11 concerning alternative forms of cesium-137. We have  
12 to look at those, and I think it's critical to  
13 remove cesium chloride from common use.

14 MR. SULEIMAN: Yes, I always have  
15 trouble interpreting questions, but I'm looking at  
16 2.1, and if it's a question of 662 keV photons, I  
17 don't see X-ray or anything else replacing it. So  
18 for some types of application, scientific radiation  
19 biology, whatever, I don't think there would be if  
20 you were to eliminate it completely.

21 And I also think the issue is going to  
22 translate less into what's the alternative for  
23 cesium as to what's the alternative for the  
24 chemical, you know, physical form of how the cesium  
25 is. I mean, that's my sense of where we're going.

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1 MR. POWELL: Brian Powell, Constellation  
2 Energy representing nuclear power again.

3 As far as the question, I'd like to  
4 answer it from our perspective in a broader sense.  
5 When we were faced with the regulations that asked  
6 us to take a security of our radioisotopes, we took  
7 that very seriously, and it would be a real  
8 challenge for someone to get into any of our plants  
9 to try to get a hold of something that they  
10 shouldn't.

11 We have the full background and the  
12 fingerprints and the ongoing security investigations  
13 that were mentioned before, and we're at the point  
14 now where we're looking at alternatives not just to  
15 things that are up for discussion today, the cesium,  
16 but you know, some of the other isotopes of concern  
17 that were used, for example, the ones that we need  
18 for the radiography.

19 We're looking at replacing the iridium,  
20 cobalt, selenium with the pulsed X-rays for the  
21 smaller diameter piping. So it seems like, you  
22 know, we could increase the security measures to a  
23 level where we could be patient until these  
24 alternatives to the cesium chloride were available,  
25 then I think we would be happy to replace them as

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1 they became available, but they're not available.

2 We're doing what we can in the meantime,  
3 and we're taking a bigger and broader look at  
4 eliminating all of our sources of concern if we can.

5 Thank you.

6 MR. RAKOVAN: All right. The gentleman  
7 right next to the -- please.

8 MR. THOMAS: I'm Jerry Thomas, Wichita,  
9 Kansas.

10 Focusing specifically on X-ray  
11 generators and nothing else, when we look at the  
12 quality assurance required as well as the  
13 calibration that's been pointed out by others, my  
14 focus is specifically on the hospital and the blood  
15 bank arena. I ask the question: do we have the  
16 qualified and trained and skilled individuals?

17 Yes, I recognize you can turn them on  
18 and off, but the comment on the linear accelerator  
19 is there's a substantial quality assurance program  
20 associated with an accelerator before you turn it on  
21 with a patient every day.

22 That same type of program would have to  
23 be in place for any use of X-ray sources, I would  
24 think, in the irradiation of blood products.  
25 Consequently, not only do we need to think about

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1 this as an alternative, but do we have the resources  
2 available across the country in the heartland of the  
3 country and the west of the country where we don't  
4 have necessarily the level of expertise that is  
5 sitting in this room or in our universities?

6 And I recognize that industry has made  
7 this pretty much turnkey in their current products,  
8 but again, there is a quality assurance issue that I  
9 think needs to be looked at very critically before  
10 one jumps into the X-ray source as the only source.

11 MR. FITZGERALD: Just to go back to the  
12 question that's up there, are there alternatives  
13 where you don't need cesium or cobalt gammas? I  
14 mean, I think our researchers at NIHS said yes,  
15 there are applications where that's true, but for  
16 the most part, the majority of our research does  
17 require the cesium-667 or whatever keV. That's what  
18 they want and that's what they need.

19 So we do have people who would be  
20 willing to use an X-ray source if we had it for some  
21 mechanisms to do some of the work, but the majority  
22 of our work requires the cesium irradiator.

23 MR. GORLI: Jed Gorli, AABB.

24 I'd just like to point out that lean and  
25 disaster preparedness are inimicable. While we try

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1 to have as efficient systems as possible, and I  
2 cannot gainsay the elegant mathematics of our recent  
3 presenter, we do not function as a constant steady  
4 state manufacturer, but rather we need to be  
5 prepared for the bus accident and generating a lot  
6 of stuff fast.

7 So in certain cases, but no means all,  
8 there may be reasons either for reliability or  
9 throughput that one might need additional X-ray  
10 devices. This is not a matter of feasibility. This  
11 is, however, a matter of economics.

12 MR. NIXON: I just want to speak a bit  
13 to some of the points or opinions raised by Peter  
14 Zimmerman.

15 In terms of manufacturing X-ray  
16 equipment, one has to understand that although X-ray  
17 technology is not new, it has been around for 100  
18 years, the application used when you do blood  
19 irradiation, it's different from the history of  
20 development of the X-ray tube the way it was used in  
21 the past. The new operational modality involves  
22 irradiating cycling in periods, say, five minutes at  
23 a time, first as a continuous operation, say, in an  
24 X-ray scanner instead of an airport or the odd  
25 explosions out of a hospital. That's brief.

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1           So speaking to that point, when you  
2 change the application and how a device is used or  
3 how a technology is used, very often you find  
4 yourself facing many problems.

5           And I want to speak to another aspect,  
6 too. With regards to cesium chloride having to be  
7 banned because it's bad, bad, bad, until there's a  
8 viable alternative form of cesium-137 available on  
9 the marketplace, I mean, the best one should expect  
10 from reasonably thinking, reasonably calculating  
11 people in terms of risk analysis, in terms of cost  
12 and so forth is that you mitigate as much as you can  
13 until something is available.

14           Now, the nuclear industry is the most  
15 heavily regulated industry in the world. When you  
16 compare that with the proliferation of X-ray  
17 technology, for instance, you have to consider that  
18 there will be terrorism uses of X-ray technology as  
19 well. I mean, one can envision a portable generator  
20 being put into a truck or on a float and driven  
21 through crowds, maybe this happening 100 cities at a  
22 time. You know, how are you going to stop that?

23           So where is the regulation being applied  
24 to, say, that alternate form of technology?

25           So you have to think outside the box

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1 sometimes and, you know, do the best you can, put  
2 your money and your resources to attacking the  
3 biggest problems.

4 MR. ZIMMERMAN: I am certainly aware  
5 that the blood irradiation problem is different from  
6 the tooth irradiation problem. Nevertheless, we are  
7 talking engineering in what is, indeed, a mature  
8 science with mature technology. It is not something  
9 you will have tomorrow, but if the decision is made  
10 to do the replacements, you'll have it on the market  
11 in a small number of years, easily totable, easily  
12 tabulatable on the fingers of one hand.

13 Now, as to your questions about thinking  
14 outside the box, believe me, those of us who have  
15 done for the last five years a lot of worrying about  
16 radiological terrorism, we are aware that you could  
17 take an X-ray machine and put it on a float, but we  
18 would question the ability of you to get a power  
19 supply to make it reliable and so on. We would  
20 suggest that right this minute cesium chloride  
21 powder looks a higher hazard that portable X-ray  
22 machines in the hundreds of kilovolt range with very  
23 large beam currents.

24 We would say spend the money right now  
25 to begin exploring alternative forms of cesium.

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1 Yes, I know you want to preserve the spectrum of the  
2 photons from cesium because if you do not, you have  
3 to do a lot of research to calibrate a spectrum of  
4 let's just say 500 kilovolts against 680 kilovolts,  
5 and you don't want to do that if you can avoid it.

6 I'm a physicist. I understand that, but  
7 I also understand the other risks that we run with  
8 cesium chloride as the source of the cesium photon.

9 MR. KAMINSKI: And I think the greatest  
10 risk is probably damage to the infrastructure and  
11 not so much to people. I mean, of course, you'll  
12 have long-term effects, but acute effect in  
13 radiation dispersal device would be minimal. It's  
14 just billions of dollars to clean up if someone  
15 decides to release it in New York or any other large  
16 city.

17 I mean, you're talking a major economic  
18 disaster. You think what we're going through now is  
19 bad.

20 MR. RAKOVAN: I had a couple of hands I  
21 wanted to get to. I think you had yours up.

22 MR. LIU: I'm Bill Liu with University  
23 of California, RSO.

24 A question for the American Red Cross.  
25 In the case of your machine irradiation of blood

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1 products, in the places where there's a single  
2 machine and that machine is not working and perhaps  
3 it takes a week to bring back into service, how is  
4 that problem remedied?

5 MR. WAGNER: We have several sites that  
6 only have X-ray devices and no gamma irradiators.  
7 In the Red Cross we have the ability though to ship  
8 blood pretty efficiently. Otherwise we wouldn't  
9 have regional centers.

10 I guess now is as good a time as any to  
11 talk about breakdown just for a moment. Among our  
12 32 cesium-137 chloride irradiators, there have been  
13 51 instances of breakdowns during the last three  
14 years. For the X-ray devices, there have been 21  
15 occurrences of breakdowns of the Raycells in the  
16 last three years.

17 Of course, we have fewer devices, and  
18 when you do it per device and figure out the  
19 breakdown rate, there's about a 66 percent increase  
20 in the breakdown rate when comparing the Raycell  
21 devices to the cesium devices.

22 For the most part, in 66 percent of the  
23 breakdowns the device could be repaired within one  
24 day, usually by on-site staff or a local contractor.  
25 However, two repairs took 26 and 37 days to

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1 complete and probably involved off-site, non-local  
2 service. The average time for repairs that were  
3 greater than one day was 15.5 days, plus or minus  
4 12.2 days, and this compares to 37 percent of  
5 breakdowns that could be repaired in one day for the  
6 gamma irradiators.

7 And in addition, those irradiators took  
8 more than one day to repair, averaged 15.4 days plus  
9 or minus 12.3 days for the gamma irradiators, again,  
10 indicating probably that off-site service was  
11 necessary, and of course, this makes sense because  
12 as we know, the gamma irradiators are a regulated  
13 device with safety concerns and require specialized  
14 staff many times to fly in sometimes from other  
15 countries to repair the device.

16 MR. RAKOVAN: I have two hands in the  
17 back of the room that I wanted to go to.

18 MR. WASIAK: Tom Wasiak from Best  
19 Theratronics.

20 I have a couple of comments regarding  
21 the information provided by the gentleman who put an  
22 amount on the back of the napkin or maybe in his  
23 head and compared the, let's say, blood irradiators  
24 to the X-ray equipment. I think part of that was  
25 the dental X-ray equipment, let's say.

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1           As we kept hearing from many people  
2 around here, the current state of technology is such  
3 that X-ray equipment for blood irradiation, for  
4 example, which is the main application, most units  
5 being used right now, is not quite there as where  
6 cesium is. It may not be there for a long period of  
7 time. It will be improving. No doubt about it, but  
8 in comparison with dental X-ray, I think we'll get  
9 there, but there is significant differences in  
10 technology, although it's all the same X-ray. The  
11 major differences are just listed, a couple of  
12 numbers.

13           Dental X-ray equipment uses in terms of  
14 power probably a couple hundred watts. Blood  
15 irradiators use about, you know, 6.4 kilowatts,  
16 right? In terms of high voltage, dental equipment  
17 uses 30 kilovolts, let's say, or low energy. We are  
18 using 160 kilovolts.

19           In terms of irradiation time, they are  
20 only on, actually tubes, for a split of a second for  
21 dental X-ray. For blood irradiation, they run  
22 continuously for five, six minutes.

23           Yes, it's still the same technology.  
24 However, technological differences are big enough to  
25 cause certain technological troubles. That's

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1 unfortunately the current state of technology. It  
2 will improve. It will take time.

3 Another little point, I just wanted to  
4 clarify the numbers. I think the gentleman  
5 referring to the numbers mentioned that there is an  
6 X-ray irradiator that can irradiator five bags at  
7 the same time with irradiation time, two minutes.  
8 Unless I misheard it, I'm not aware of that X-ray  
9 irradiator, though I'm aware of cesium blood  
10 irradiator that can meet these numbers.

11 The only blood irradiator that is  
12 currently on the market irradiates two to three bags  
13 at the time, and it takes five to six minutes. So  
14 if you do that math, including 50 percent for  
15 loading or additional 100 percent of time for  
16 loading/unloading, irradiating 100 bags a day would  
17 take ten hours of continuous operation with breaks  
18 for loading, unloading and so on.

19 So just a point for clarification.

20 MR. MOSES: Paul Moses, Best  
21 Theratronics.

22 In speaking to the Red Cross, I'm very  
23 familiar with the Red Cross account, and we would  
24 have probably the largest number of units within the  
25 Red Cross family of sites.

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1           When you speak and talk about breakdowns  
2           and different numbers, I think you have to take into  
3           consideration that some of the Red Cross units have  
4           been out there for 25, almost 30 years. So when a  
5           unit is that old, what will happen -- and it has  
6           happened. I could name specific sites -- but they  
7           have actually broken down. We've had to fly down,  
8           fix them, and this is like a unit 25 years old,  
9           mention to them, you know, this unit paid for itself  
10          22 years ago.

11                           (Laughter.)

12                   MR. MOSES: And it might be a good idea  
13           that you just bought a new one.

14                   And the thing is that when you start  
15           looking at the numbers, you have to be mindful of  
16           when you're talking of an X-ray unit that's only  
17           been out there for a short time versus a cesium unit  
18           that's been out there forever.

19                   MR. WAGNER: Paul, I agree with you  
20           totally. Just for information, of the 32 irradiator  
21           devices that we have, I know the age of 27 of them,  
22           and the average age is 15 years basically, plus or  
23           minus five years. So if you want to make a donation  
24           to the Red Cross, we can --

25                           (Laughter.)

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1 MR. WAGNER: -- purchase some units.

2 Also, what Paul did not bring up, but  
3 which I think is important, is that no one really  
4 knows what the lifetime of these X-ray irradiators  
5 are. You know, the manufacturer, we've heard ten  
6 years, but there's no data out there that says how  
7 long they will last, and until they last 30 years  
8 they're not equivalent at least in terms of lifetime  
9 presumably as the irradiators.

10 And so it's possible you would have to  
11 go and replace them possibly more frequently. I  
12 don't know because there's no data out there.

13 MR. SULEIMAN: I've got to add balance  
14 back to this discussion. Those of you who  
15 understand X-ray technology, some of the high output  
16 computed tomography X-ray tubes, the reproducibility  
17 and accuracy of modern medical imaging technology  
18 and output, the technology is clearly here and has  
19 been here for many, many years. So to imply that  
20 the technology is not capable to put reproducible  
21 output over a period of time is, in my opinion, just  
22 wrong.

23 However, maintenance and quality  
24 control, if you neglect a high quality car, it's not  
25 going to last as long as a less expensive car that's

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1 maintained on a regular basis. So the issue with  
2 electronic products more so than the radioactive  
3 sources is to require long-term maintenance and  
4 calibration and so on.

5 But to imply that the technology is not  
6 up to the task is wrong. It's the human factor, the  
7 maintenance, the calibration. So there's little  
8 doubt in my mind. Energy aside, unless you can come  
9 up with an X-ray source that can generate a 662 keV  
10 photon, that for scientific applications the non-  
11 radioactive technology is clearly, you know,  
12 capable. And, again, I'm not addressing economics.

13 I'm not addressing the market for this sort of  
14 product. You sell a lot more CT scanners than you  
15 do blood irradiators.

16 MS. GILLEY: Debbie Gilley.

17 In our review in our report from the  
18 ACMUI, we indicated that 48,000 blood product units  
19 per X-ray tube, and if you did 50 units a day, that  
20 would be about 3.7 years per X-ray tube. Then it  
21 would need to be replaced.

22 MR. KIRK: Randol Kirk from Rad Source.

23 Look. With an X-ray machine, you have  
24 to treat the tube as a consumable. It is. There's  
25 no getting around it. It's no different than the

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1 light bulb in your house. If you leave it on 24  
2 hours a day, it's only going to last half as long as  
3 if you only run it at night.

4 So anybody who doesn't think about that,  
5 who doesn't, quite frankly, manage up front or  
6 preemptively look at tubes, power supplies, that  
7 sort of thing, to have them switched when they need  
8 to be is always going to have down time. It has got  
9 to be a joint effort in order to make sure that you  
10 are ahead of the curve with an X-ray machine because  
11 it's always going downhill.

12 MR. RAKOVAN: I think we've already kind  
13 of gone into the next question already. Michelle,  
14 if you want to bring it up, Q 2-2. Are X-ray tubes  
15 cost effective considering the initial cost,  
16 operating costs, and requirements for more  
17 maintenance, for periodic calibration and  
18 replacement than radioactive sources?

19 I figure since we were talking about it,  
20 we might as well have it up there. Anybody want to  
21 continue on that particular question topic?

22 MR. KIRK: Randol Kirk again.

23 Actually we think we have hit on a  
24 relatively good solution. It's a matter of having  
25 the availability of being able to open up the tube,

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1 repair it, close it up again and reuse it. Again,  
2 this is a brand new concept.

3 The best we've been able to do so far is  
4 somewhere less than 1,000 hours of use. We think we  
5 can get considerably higher than that, but even at  
6 1,000 hours, if you think about the calculations  
7 that were just done here a little while ago, two  
8 hours a day or whatever they were, 1,000 hours is a  
9 year and a half before you have to do anything to  
10 the tube, and that's a huge, huge operation to  
11 irradiate that type of blood. I would guess only  
12 the Red Cross would come close to those kinds of  
13 numbers.

14 MR. RAKOVAN: I'm hearing some  
15 disagreement from the crowd. If somebody wants to  
16 take that to the microphone and explain it.

17 MR. GERSABECK: Yeah, this is Ed  
18 Gersabeck with USDA again.

19 We're operating our irradiators, our two  
20 gamma cells and two Husmans in Guatemala 22 hours a  
21 day, seven days a week, and even with the guarantee  
22 of 2,000 hours on the rad source tubes, the best  
23 we've been able to get is about 700 hours, and even  
24 if you got 2,000, that would only be 80 days or less  
25 than three months. So we'd be into this continuous

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1 rebuilding the tubes.

2           And we've been quoted a price of if you  
3 didn't have your machine shop capabilities, if you  
4 just go out on the street and buy a new tube, the  
5 last price we were quoted was \$50,000 which got us  
6 interested in starting to set up our own machine  
7 shop and training our own engineers to actually  
8 replace these tubes.

9           So there is a lot of hidden cost and, as  
10 I say, in a continuous operation, I'll give you an  
11 example. If we're irradiating 300 million flies per  
12 day, which is basically what USDA is doing, at a  
13 cost of \$1,500 to \$2,500 per million, to have a  
14 machine go down, we are losing a horrendous amount  
15 of money per day until we get that machine back up.

16           Our down time on the Husman irradiators,  
17 even the gamma cells has never been more than one  
18 shift, six to eight hours, and a lot of that is just  
19 going into town and getting a new motor for the  
20 mechanics of it.

21           So in our industry, in our protection of  
22 agriculture where we're sterilizing insects, the  
23 reliability has to be there. You know, every day,  
24 seven days a week we can't shut down or we just  
25 start losing a lot of -- because you can't shelve

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1 living animals. You can't just put them on a shelf  
2 for a week until you get a part in. I mean that's  
3 the reality of what we're doing.

4 Thank you.

5 MR. KIRK: I would like to remain  
6 professional about this, but --

7 MR. RAKOVAN: Please do.

8 (Laughter.)

9 MR. KIRK: -- I really feel that some of  
10 the circumstances represented there are not  
11 accurate, and I'll just leave it at that.

12 MR. RAKOVAN: Any further discussion on  
13 this question? Yes, please.

14 And thanks to you three guys on the end  
15 there for all sharing the mic. I appreciate that.

16 MR. SVAJGER: Regardless of the use of  
17 X-ray tube or you need to replace a tube or reload a  
18 cobalt safety source, they're both pretty expensive  
19 as opposed to cesium which goes on and on and on.

20 MS. SHEPHERD: Mary Shepherd, JL,  
21 Shepherd & Associates.

22 Red Cross is not the only 24-7 user of  
23 blood irradiators. Every major metropolitan  
24 hospital with an oncology department, and if you're  
25 a large metropolitan area, multiple hospitals

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1 operate in this modality. I think UCSF is one of  
2 them, and there are many, many centers across the  
3 country that especially if they're doing oncology.

4 Neonatal work, UCLA does not outsource  
5 blood irradiation. Their protocol is in house only,  
6 and I think there's a lot of other places that are  
7 like that. It's imperative that it's not just a  
8 couple of hours a day. It really depends on the  
9 center and what the work they're doing.

10 And bone marrow irradiations, also  
11 extremely complex and patient demanding.

12 MR. KIRK: I just wanted to ask what  
13 kind of numbers of units that that -- the 24 hours a  
14 day doesn't answer the question. It's what kind of  
15 units does it.

16 MR. WAGNER: In the Red Cross, for  
17 fiscal year '08, 475,000 units were irradiated, and  
18 we believe that demand for irradiated blood has  
19 increased by about ten percent in the last year, and  
20 I might also comment that I believe that there's  
21 probably more blood irradiation at the hospitals  
22 than there are at the Red Cross, and there are some  
23 good medical reasons for this, for red cells. When  
24 you irradiate red cells, they release potassium and  
25 that released potassium can be harmful to neonates.

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1           And so the hospitals prefer to irradiate  
2 the blood at site so that they can get the blood red  
3 cells at least to the patients who need it soon  
4 rather than later during storage.

5           For platelets, they could be irradiated  
6 at centralized facilities, but the hospitals already  
7 have gamma irradiators.

8           MR. GORLI: The AABB collects data via  
9 the NBRDF. Over two million blood products were  
10 irradiated in 2006. There's over 20 million blood  
11 products produced annually. Therefore, that's the  
12 genesis of the about ten percent figure. Obviously  
13 it's a higher proportion of platelets.

14           Wearing my MBA hat I would simply point  
15 out that Paul Moses has pointed out that the market  
16 answers the question. They're for sell and they're  
17 selling. That said, the Red Cross data, the ABC  
18 data, and the AABB data, all find that they're about  
19 ten percent of the total irradiators out there.

20           So they're selling, but if they were as  
21 cost efficient obviously they'd be selling more.

22           MR. RAKOVAN: Any further discussion on  
23 this question in terms of cost effectiveness before  
24 we move on to the next?

25           (No response.)

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1 MR. RAKOVAN: Okay. Let's go ahead and  
2 put Question 2-3 up there. Is there any indication  
3 that the performance of the alternatives will  
4 change, improve or worsen, with respect to cesium-  
5 137?

6 We may have touched upon this already,  
7 but does anyone have something that they'd like to  
8 continue the discussion on this?

9 Please.

10 MR. MINNITI: Yeah, it's Ronnie Minniti  
11 from NIST.

12 This question is probably for Mr. Kirk.

13 Correct me if I'm wrong, but I believe the maximum  
14 voltage, the state of the art today, is around 300,  
15 400 kilovolts for X-rays, and that translates if you  
16 filter such a spectrum to get a monochromatic  
17 spectrum, you can get maybe up to 200-something, 250  
18 keV. So can you go higher than that?

19 And if not, what do you think about that  
20 in the future, if that's possible or not?

21 MR. KIRK: Well, hint, hint, we have  
22 written a grant request to put together a machine  
23 that will operate at 500 KeV, and at 500 KeV with  
24 this new technology we're using, you have enough  
25 photons that you can filter very, very hard and

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1 still have enough left to do something with.

2 So, yes, we believe it's possible. Is  
3 it today? Is it tomorrow? No, it's probably in the  
4 same time range as anything else.

5 MR. MINNITI: Okay, I guess, but what  
6 would be the main energy then? We would be talking  
7 around 400 tops, right, or maybe even less than  
8 that?

9 MR. KIRK: Yeah, if you were to go to  
10 500, then you would probably have a distribution  
11 from maybe 275 to 380 or depending on what you were  
12 filtering with and if you could optimize that.

13 MR. MINNITI: So is it correct to say  
14 then that the technology is not there today or --

15 MR. KIRK: Oh, no, I'm just saying it  
16 will be three to four years before you can even get  
17 to that level.

18 MR. MINNITI: To that level, but not to  
19 600 KeV.

20 MR. KIRK: I think that --

21 MR. MINNITI: I think that it's a fair  
22 question since this morning when we were talking  
23 about the other alternative about the cesium form,  
24 right, we were asking, okay, if this would be  
25 available and we had an answer for that. So I think

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1 we should explore that question, too, for this other  
2 alternative.

3 MR. KIRK: I think it would be difficult  
4 to go much beyond 500 keV as a peak.

5 MR. MINNITI: As a peak.

6 MR. KIRK: As a peak.

7 MR. MINNITI: Yeah, okay.

8 MR. KAMINSKI: That would just be for a  
9 standard X-ray tube. I mean, certainly there are  
10 other ways to increase the energy, such as LINACs,  
11 linear accelerators and so forth that we use  
12 clinically so that 18 mV or whatever, of course, if  
13 you need to go that high, but it's much more  
14 expensive.

15 MR. MINNITI: Yes.

16 (Laughter.)

17 MR. RAKOVAN: Got a question in the  
18 back. If you could introduce yourself, please, sir.

19 MR. ROGERS: Yes, sir. Steve Rogers,  
20 U.S. Army Primary Irradiation Standards Laboratory.

21 I noticed most of the discussion so far  
22 has been on irradiations. I'm from the calibration  
23 side of the house. Between ourselves and the  
24 secondary laboratories beneath us, we calibrate tens  
25 of thousands of survey instruments and dosimeters

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1 per year, and we have noticed a significant  
2 difference in instrument response between  
3 calibration of X-ray and calibration with cesium-  
4 137.

5 Now, I know we're talking specifically  
6 about cesium chloride, but if cesium-137 were to  
7 disappear in any form and be replaced by X-ray,  
8 we're talking about a lot of instruments that would  
9 have to be recalled for recalibration out of cycle  
10 at significant cost and adverse impact to our  
11 soldiers trying to accomplish their missions, as  
12 well as manpower in the calibration labs themselves,  
13 and at several of our facilities we're short handed  
14 already.

15 Thank you.

16 MR. RAKOVAN: Further discussion on  
17 Question 3?

18 (No response.)

19 MR. RAKOVAN: Okay. Let's move ahead on  
20 to the final question, 2-4, regarding the  
21 availability of alternative technologies. (a) What  
22 is the time frame of future availability of each  
23 alternative, and (b) what is the cost for each of  
24 the alternative technologies, capital cost,  
25 operational cost, cost to users?

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1           Again, I think we've kind of talked  
2 about this a little bit, but if there's further  
3 discussion on this issue or any of the other issues  
4 that we've covered in terms of use of alternative  
5 technologies.

6           MR. NIXON: There's been a lot of talk  
7 about the availability of technologies in the  
8 context of prototypes. As a manufacturer who has  
9 lived the life cycle of starting with a prototype  
10 and working into a marketable product that has an  
11 acceptable or semi-acceptable degree of reliability,  
12 there is a big difference, and there could be a  
13 fairly long learning process involved.

14           So I just wanted to caution people into  
15 thinking in terms of time to market of a viable work  
16 horse X-ray technology to supplant the use of  
17 cesium-137. We're talking several years down the  
18 road, and that's after the prototype comes to  
19 market.

20           MR. RAKOVAN: Further discussion?

21           MR. GORLI: Pathogen inactivation for  
22 plasma and platelets is actually licensed in Europe,  
23 but it probably can't catch on until all cellular  
24 products have a licensable treatment. Red cells is  
25 still probably several years away, but Dr. Wagner

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1 could probably comment more accurately.

2 MR. WAGNER: I think red cells are back  
3 to square one with respect to clinical trials, and  
4 as you know, you have to go through a number of  
5 clinical trials successfully and then regulatory  
6 review. So I don't see that around the corner soon  
7 in the States.

8 MR. RAKOVAN: Further comments? See on  
9 the end, please.

10 MR. FITZGERALD: With regard to  
11 alternative technologies, I just want to say that at  
12 the NIH as a whole, there are over 20 cesium  
13 irradiators. So jus the capital cost of just  
14 replacing those alone, I understand that the  
15 government is going to write a big check hopefully  
16 in just a couple of days, but that kind of puts  
17 pressure on the rest of us to hold down cost. So I  
18 just want to make sure that's understood.

19 MR. RAKOVAN: Please, if you could  
20 introduce yourself.

21 MR. CONNELL: Len Connell at Sandia.

22 With all of the discussion about cost,  
23 and I know --

24 MR. RAKOVAN: Sir, is the microphone on?

25 MR. CONNELL: Is it on?

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1 MR. RAKOVAN: Yes. Please just stay  
2 that close if you would.

3 MR. CONNELL: Oh, yeah. Okay. Just a  
4 discussion about cost. One of the things we also  
5 brought up in the National Academy's report and it  
6 was just discussed here about the market right now  
7 has shown that there's a ten percent, you know,  
8 intrusion in the market with X-ray machines, but one  
9 of the things we noticed in the National Academy  
10 study was that a lot of the costs are not actually  
11 seen by the user and particularly the disposal  
12 costs.

13 Again, it's hard to judge what that cost  
14 is because we don't have a real disposal capability  
15 right now. All we're doing with the off-site source  
16 recover program is we're taking your cesium sources  
17 and we're storing them.

18 If you started to look at the true cost  
19 of disposal and if we were to really ask your users  
20 to pay for that, I think you might see the market  
21 change a little bit. So that's one aspect I don't  
22 want you to forget, is that the user cost is not the  
23 true cost to society, that all of us as taxpayers  
24 are ultimately going to have to pay to dispose  
25 ultimately of these sources.

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1                   And we already mentioned about the  
2 terrorist cost. You know, we don't really know what  
3 the probability of one of these events are, but as  
4 has been mentioned, if you had a terrorist event  
5 involving cesium, the economic consequences could be  
6 pretty high.

7                   Thanks.

8                   MR. RAKOVAN: And actually I think we'll  
9 be talking about some of those issues tomorrow in a  
10 few of our panels. So that's a good advertisement.

11                   Thank you, sir.

12                   (Laughter.)

13                   MR. MORGAN: Tom Morgan, University of  
14 Rochester.

15                   I asked a vendor about how much it would  
16 cost to dispose of the cesium-137 blood irradiator.

17                   He quoted me \$35,000 to pick it up and dispose of  
18 it and \$70,000 for rental of the Type B container  
19 for shipping. So there's a particular cost point,  
20 and that's one month old.

21                   MR. RAKOVAN: Sir, sir, sorry. Go to  
22 get to a mic.

23                   MR. MORGAN: I asked this individual,  
24 "What would you charge me to take this thing off my  
25 hands?" And he told me it was \$105,000, broken out

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1 as I just said.

2 MR. RAKOVAN: All right. Any further  
3 discussion on this particular issue? I've got one  
4 more or two more hands.

5 MR. COPPELL: Yes, hi. It's David  
6 Coppel from REVISS here.

7 I just wanted to comment on the issue of  
8 disposal cost for cesium-137. I agree it's  
9 difficult to work out what they are because there is  
10 no disposal route right now. We're all in the  
11 situation where we have to adopt long-term storage  
12 techniques.

13 However, my understanding is that pretty  
14 much all of the Cesium-137 that's used in the world  
15 is actually separated from spent fuel. So this  
16 material isn't generated particularly for this  
17 purpose. It exists anyway, and the responsibility  
18 and the task of storing it and ultimately disposing  
19 of it will exist whether or not we use it for this  
20 application.

21 MS. SHEPHERD: Mary Shepherd, Shepherd &  
22 Associates.

23 One thing we did not talk about was the  
24 carbon footprint of using a gamma irradiator versus  
25 alternate technologies, the expense of the

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1 electricity, the amount of electricity that it takes  
2 to run these machines, whether that be a PET or an  
3 X-ray or linear accelerator, and in today's  
4 uncertain world with fuel what it is, it's an  
5 important point to bring out. What does it actually  
6 cost to run all of this different technology  
7 electricity-wise?

8 MR. RAKOVAN: Go ahead.

9 MR. WAGNER: Yeah, we've done some  
10 calculations for the Raycell for blood bank. I  
11 really can't speak for all of the other applications  
12 because obviously they're different for every  
13 application, but for one site that uses two  
14 Raycells, a single Raycell instrument with its use  
15 was estimated to cost about \$2,000 per year per  
16 instrument, and so if we had to replace every gamma  
17 irradiator with a Raycell, I think it would cost us  
18 about \$60,000 a year more in electricity and water  
19 and sewage cost.

20 MR. RAKOVAN: Okay. We seem to be kind  
21 of moving in that general direction anyhow. So why  
22 don't we go ahead and take a look at the parking lot  
23 issues since we've got about a half an hour left of  
24 today, if that's all right with everybody.

25 Charlie, I think the first three came

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1 from you. Did you want to address those or did you  
2 just want me to throw them out as conversation  
3 topics?

4 If you're going to talk, I need you on a  
5 mic, man. Sorry.

6 MR. MILLER: You know, the intention of  
7 my comments were to try to capture that as part of  
8 the default process for the parking lot, and I think  
9 it's going to take the full discussions of the whole  
10 conference before we can ferret those out  
11 completely.

12 MR. RAKOVAN: Okay.

13 MR. MILLER: So they were intended to  
14 just keep people's consciousness as to some of that.

15 The other comment I'd make, while it's  
16 not on the parking lot, is for the benefit of  
17 everyone in the room, although I know many know  
18 that, currently the Nuclear Regulatory Commission  
19 has no regulatory authority over X-rays, but the  
20 states do, and so suddenly if that were the only  
21 technology available, it would solve the Nuclear  
22 Regulatory's problem, but it certainly wouldn't  
23 solve the state's problem.

24 (Laughter.)

25 MR. MILLER: So I just wanted to make

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1 sure that people were aware of the fact that , you  
2 know, as we ponder the alternatives, the NRC has to  
3 ponder also what's within our regulatory purview and  
4 what do we do about what's in our regulatory  
5 purview, and I'll let the states speak for  
6 themselves, although they do have to deal with this  
7 from those things that we do regulate. The states  
8 regulate that with a compatibility in a way that we  
9 do.

10 Thank you.

11 MR. NIXON: I wanted to just reiterate  
12 when we talk about cost, outside the security issues  
13 the cost to patient care not only here in the  
14 continental United States, but in the rest of the  
15 world if the use of cesium or cesium chloride today  
16 were to be banned, patient care would be compromised  
17 all over the world. Many countries do not have  
18 reliable power supplies and so forth. We construct  
19 our cesium irradiators with back-up power supplies  
20 so that they can operate in times of power outages  
21 and so that patient care is not compromised.

22 So that is a relative major advantage of  
23 cesium based technology over electrically generated  
24 irradiation.

25 MR. RAKOVAN: Mr. Wagner? Your tent is

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1 up. So did you? No? Okay. Sorry.

2 Any additional discussion? Please, if  
3 you could introduce yourself if you would.

4 MR. JARDINE: Would it be appropriate to  
5 comment on 1.1 again?

6 MR. RAKOVAN: Right now as far as I'm  
7 concerned, I think the whole day is open for  
8 discussion.

9 MR. JARDINE: I just want to come back  
10 to the question since the manufacturers were not  
11 here from Mayak, primarily to our U.S. visa control  
12 problem, but having worked with Russia and having  
13 done seven of these engineering studies with  
14 Russians on different parts of plutonium processing  
15 basically and three at Mayak, I wanted to make this  
16 statement that we have to realize that cesium comes  
17 from the one reprocessing plant in the world that  
18 designed a process, separate cesium nitrate. It  
19 cannot be done in France or Japan. The U.S. has no  
20 capability.

21 The Russians have been looking in the  
22 past at alternatives to cesium chloride, and they're  
23 looking today at alternatives, and it's basically a  
24 glass and a ceramic. I will not be specific. Those  
25 options exist. The Russian process, as I said,

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1 would take about five years.

2 What it consists of is parallel  
3 engineering studies and design with the scientific  
4 development and science and R&D, and it's basically  
5 a one year technical economic feasibility  
6 engineering study that compared two options, glass  
7 and ceramic.

8 In parallel, the scientific institutes  
9 prepare data on what these forms are in the glass  
10 and ceramics so that the engineers can decide which  
11 option is best after one year.

12 The next step if they're able to select  
13 one option is to go to the next step of engineering,  
14 which is one year in parallel as the R&D continues  
15 on the one form or two forms.

16 But I have a problem, and the Russians I  
17 think would, of deciding which form because there's  
18 different issues fabricating a powder, a ceramic or  
19 a glass, and the range of capsules that have to be  
20 filled for the different customers that Mayak has.  
21 You cannot pick a single option. These technical  
22 and engineering feasibility studies will identify  
23 these issues in collaboration with the Russian  
24 institutes.

25 Quite frankly, it's my opinion our U.S.

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1 laboratories would not be very useful to this  
2 process because they don't really know how to  
3 contribute and often, quite frankly, can't work with  
4 the radioactive materials.

5           During the second one-year engineering  
6 study is when they specified equipment and start  
7 procuring it, and it's called an open ended  
8 justification investment. After two years then they  
9 will start the construction of the facility or the  
10 refurbishment of an existing facility at the RT-1  
11 reprocessing plant, and that will take two years.

12           In parallel, again, the scientific R&D  
13 is continuing along with the qualification tests  
14 that have to be done. You heard Aloy talk about the  
15 fire test, the mechanical strength test. They have  
16 to refill these containers or capsules, and that's  
17 why you come up with about four years until you have  
18 your facility ready to operate, and then the fifth  
19 year you hopefully are in a position to begin what I  
20 would call cold and hot tests and start producing  
21 these capsules in a production line so that you  
22 could get serial samples, and it's very difficult to  
23 see how it could go faster than that. It will  
24 involve, you know, the collective Russian team doing  
25 this work, and they're prepared to do it.

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1 I'm aware that they're thinking about it  
2 and they're doing it, but that's the time line and  
3 the basis for five years, and they do have options  
4 of glass and ceramic to be decided upon, and that  
5 first year study will determine the cost and then  
6 verify it's feasible from the engineering standpoint  
7 at the Mayak facility.

8 Thank you.

9 MR. RAKOVAN: Okay. Ms. Fairobent.

10 MS. FAIROBENT: Yes. I have a question  
11 for you. During the time that they may be retooling  
12 to look at the ceramic or glass, are they still able  
13 to to produce the cesium chloride form? or would  
14 they be shut down out of production and if so, what  
15 sort of stockpile do we have if we're not pulling  
16 cesium chloride out of use until an alternative form  
17 is available?

18 MR. JARDINE: I think she said during  
19 the first year. They would continue, my assumption.

20 I'm not Mayak. My assumption is they would  
21 continue to produce the revenue generating cesium  
22 chloride until they were in a position to make a  
23 decision how will they best proceed to install the  
24 new facility or processing line, next door in a  
25 different hot cell, different building or have to

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1 fabricate a new one.

2 So I anticipate they're now market  
3 driven. They'll continue to produce these sources  
4 and find a way to bring on the second process, which  
5 is high risk and may not work. It's not a known  
6 technology.

7 MR. RAKOVAN: If you could introduce  
8 yourself, please.

9 MR. FORASTE: Yes, good afternoon. My  
10 name is Steve Foraste. I'm representing QSI Global.

11 We're a manufacturer of cesium products  
12 for industrial uses, and we don't use cesium  
13 chloride except for as a feedstock, but I have been  
14 to the plant in Russia where our sources are  
15 manufactured, and we make a few thousand of these a  
16 year, but what we're making are things that are  
17 about three orders of magnitude below a blood  
18 irradiator source.

19 One of the problems with scaling up our  
20 process to handle the blood irradiator is  
21 disbursability. The cesium when it's put into the  
22 glass is raised to such a temperature that a lot of  
23 it is actually lost in the plant. A big part of the  
24 quality control in manufacturing this is trying to  
25 optimize the yield in the plant.

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1           So while I understand that cesium  
2 chloride is a very large danger as far as  
3 disbursability in a terrorist scenario, if we were  
4 to scale up our existing process today at Mayak, we  
5 would have a disbursability issue at Mayak.

6           They're famous for a large one about 51  
7 years ago, but I wouldn't want to repeat that today.

8           I know David made a presentation on behalf of  
9 REVISS on where cesium glass is today, but I can say  
10 that our glasses are not up to the task yet for  
11 blood irradiation.

12           MR. RAKOVAN: Very good. One thing that  
13 I wanted to point out, I apologize. I forget who  
14 brought this up to me, but the question to keep in  
15 your head that I put on the parking lot, the  
16 gentleman said during the lunch break, I believe, or  
17 one of the breaks, would it be great for NRC to have  
18 an Advisory Committee for this and what the thoughts  
19 were on that. So he asked us if I'd put that under  
20 the parking lot and I wanted to do so.

21           So just something to have in your head.

22           He said this is a complex issue. So there's an  
23 advisory committee of some sort needed for it.

24           MR. RAKOVAN: Sir.

25           MR. MORGAN: Tom Morgan, University of

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1 Rochester.

2 I brought that up, and the Advisory  
3 Committee on the medical use of isotopes I'm sure  
4 has been very useful to the NRC, and this is such a  
5 complex issue. There are so many stakeholders, so  
6 many different paths that we have to walk to make  
7 sure we get it right that that was my recommendation  
8 for the committee.

9 MR. RAKOVAN: Please. If you could  
10 please introduce yourself.

11 MR. PHILLIPS: Bob Phillips, FDA.

12 This morning the people from Russia were  
13 indicating that they had a long development program  
14 to develop alternate sources. They're also the only  
15 source of cesium iodide chloride in the world.  
16 Given the resurgence of nuclear power in the United  
17 States because of our energy problems, does anybody  
18 see any future for reprocessing to come back to the  
19 United States?

20 MR. RAKOVAN: Anybody want to touch that  
21 one?

22 (Laughter.)

23 MR. SULEIMAN: It's above my pay grade.

24 (Laughter.)

25 MR. NIXON: I'll just make a small

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1 comment. I wouldn't profess to speak for anybody in  
2 the U.S., but cesium is usually extracted as part of  
3 a bomb making project, right? It's a separation  
4 when you're extracting plutonium from spent fuel.

5 So those are the conditions that lead to  
6 the production of cesium as far as I know it.

7 MR. RAKOVAN: Any further discussion?  
8 Please, sir.

9 MR. ALOY: Albert Aloy from Radium  
10 Institute, St. Petersburg, Russia.

11 I would like to correct you because it's  
12 the cesium that's the byproduct from reposition  
13 (phonetic) of spent nuclear fuel, not recovered from  
14 plutonium. Now we have developed the new, simplest,  
15 purest process which oriented only for uranium  
16 extraction from the spent nuclear fuel, and  
17 plutonium is not now the main valuable product, and  
18 our approach is because we use only the mixture of  
19 new plutonium and the transfer uranium elements in  
20 future, and the reactor is a fast reactor.

21 So I would like to correct you because  
22 our purpose is not plutonium extraction during the  
23 processing, but of course, we have also very old  
24 vests, the same vests like in the Hanford site or in  
25 Savannah River where the cesium is a byproduct like

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1 Strontium-90 collected in a big amount, and because  
2 of this different tanks with different history, the  
3 Mayak people can study the ratio between stable  
4 isotope of cesium and Isotope-135 and the long-lived  
5 cesium isotope and cesium-137 and select the same  
6 product which corresponds mainly for the purpose of  
7 irradiation, of irradiation sources.

8           And so the different vests which  
9 collected from the old time is a product or a  
10 byproduct for cesium extraction now, and of course,  
11 we know that cesium chloride is dangerous, very  
12 soluble, dispersible form, and we start to work, R&D  
13 work for replacement of this salt even in former  
14 Soviet Union, but now it's more and more in phases,  
15 made more in phases for the study now.

16           And if you say about the risk from my  
17 point of view, from Russia, from rare countries this  
18 risk may be going. I think that in the United  
19 States or in Europe we have a good controlling  
20 system for the sources, the users, and so the risk  
21 is very, very low level.

22           But developing country and country with  
23 developing economics, they cannot use the LT-90 for  
24 like an X-ray installation because more expensive,  
25 operational personnel, additional with high

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1 educational level.

2 And so I think that the main risk is on  
3 the border of the country. It is terrorists may use  
4 outside from USA cesium chloride to spread it inside  
5 in the country, and because inside the country it's  
6 too difficult and control use of these sources.

7 This is my opinion.

8 (Laughter.)

9 MR. ALOY: But main risk, main level of  
10 risk, of course, from using cesium chloride outside  
11 of developed country, of Europe or USA, Canada.

12 But cesium chloride very attractive for  
13 this developing country, for cost and for long-lived  
14 service.

15 MR. KAMINSKI: Just to make one fast  
16 point, you know, what worries me is having cesium  
17 chloride in these Third World countries and then  
18 shipping it over in a lead cased container or  
19 whatever, and we know the ports aren't monitored  
20 very well, I mean, and it's not that difficult to  
21 conceive of an event here in the U.S. either.

22 MR. ALOY: I'm sorry. I am not  
23 understanding what you said.

24 (Whereupon, translator spoke with Mr.  
25 Aloy.)

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1 MR. ALOY: But I think the revised case  
2 involves a controlled system in Russia, and the  
3 control is very strong, on the top level. Yes?

4 MR. COPPELL: Maybe just to repeat the  
5 question, I think the point you were making was the  
6 bigger risk may be the cesium chloride that's  
7 somewhere in use in a developing economy might be  
8 appropriated, shipped into the U.S. or into Europe  
9 or anywhere else disguised essentially, and  
10 encapsulated in some shielding material that makes  
11 it difficult to detect.

12 MR. RAKOVAN: Sir, if you're going ot  
13 say something, I'm sorry. I'm going to have to ask  
14 for your mic to be on.

15 MR. COPPELL: Yeah, so I think everybody  
16 recognizes that, and I think it's the reason why  
17 this is an international issue really. I mean, of  
18 course, here in the U.S. what you can address is  
19 what you can control in the U.S., but equally  
20 everybody else has to participate because this is an  
21 international concern, and we need to find a way of  
22 resolving it in a way that minimizes the risk  
23 internationally.

24 I was just going to say one thing about  
25 the comments earlier regarding time scales for

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1 development of a potentially alternative technology  
2 for cesium at Mayak. This morning I made the point  
3 that there is a program; there is a project which is  
4 receiving a lot of attention at Mayak and which the  
5 general director of the whole of Mayak is fully  
6 aware of and very focused on.

7           The reason why I think we're being a  
8 little bit unclear about time scales is because  
9 they're not very clear about them yet. So I really  
10 don't think it's particularly helpful for us to  
11 actually try to fix in our mind an exact time frame  
12 right now.

13           It's going to be a few months before  
14 we're in a position to actually make a clear  
15 statement about what's going to be involved, how  
16 long it's going to take and what the other  
17 implications, for example, cost implications might  
18 be.

19           I realize that everybody is focused on  
20 this issue right now, but I think if we could just  
21 have a little patience, give our colleagues in  
22 Russia until maybe spring or early summer next year,  
23 I'm fairly confident they'll come back with  
24 something that is detailed to the extent that we can  
25 use it.

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1 Thanks.

2 MR. SULEIMAN: This is a really, I  
3 guess, stupid question, but if you take powder and  
4 put it in some epoxy, I guess it's going to cook or  
5 whatever, but where are the chemists? Could  
6 somebody explain what would happen with that kind of  
7 effort to solidify the powder?

8 MR. RAKOVAN: Anybody up for talking  
9 epoxy?

10 MR. SULEIMAN: Wouldn't it affect the  
11 disbursability? I mean, I'm sure this has been  
12 looked at, but I'm just curious. Somebody has got  
13 to know the answer to that.

14 Why is making it a non-powder so  
15 difficult?

16 MR. MORGAN: Tom Morgan, University of  
17 Rochester.

18 I'll try and take a shot at that. Epoxy  
19 is an organic compound. With that much amount of  
20 radioactivity you're going to have tremendous  
21 radiolysis, and it's going to break down. It isn't  
22 going to work in an epoxy.

23 MR. COPPELL: Sorry. I agree with that,  
24 absolutely. You generate an awful lot of radiolysis  
25 products, which means that it's pretty difficult to

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1 encapsulate it in anything, and pretty soon, you end  
2 up with a kind of gooey black mess, which is going  
3 to be --

4 MR. RAKOVAN: What's wrong with that?

5 MR. COPPELL: Well, it's going to be  
6 pretty disbursable and fairly soluble. The cesium,  
7 if it's put into the mixture, let's call it, as a  
8 salt, which is usually chloride, but it doesn't have  
9 to be; it could be sulfate or nitrate. Then either  
10 way, by the time you've broken down this epoxy  
11 compound which isn't going to take very long, then  
12 you've just got soluble cesium left.

13 So it really needs to be in a matrix  
14 which can withstand a significant amount of  
15 radiation damage without changing its nature, which  
16 is why everybody talks about either ceramics or  
17 glasses.

18 MR. ALOY: I would like to say again  
19 about the testing of the performance of the sources.

20 Because we have the double encapsulated in  
21 stainless steel sources with welding each capsule,  
22 and some capsules we need for testing for fire.

23 It's 800 Centigrade at half hour. During this  
24 testimony, epoxy raising or as an organic compound  
25 will be decomposed with high pressure inside, and

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1 welding area will be destroyed.

2 So it is impossible to use any compound  
3 containing organic or water inside in the capsule.  
4 So only ceramics or glasses, inorganic materials may  
5 be used, and we compare these properties as a  
6 feasibility study because one material may be easy  
7 for production, but other material may have more  
8 performance properties for resistant to  
9 reachability.

10 So we must compare and now all studies  
11 performed on surrogate materials, and maybe after  
12 one year you'll hear data to compare properties with  
13 the real Cesium-137.

14 Maybe I not understand your questions  
15 correctly.

16 MR. RAKOVAN: Last comment of the day.

17 MS. SHEPHERD: Mary Shepherd.

18 The testing that we're discussing is a  
19 special form capsule testing that's usually required  
20 for transportation and for licensing issues.

21 There's special form and there's NASI testing that's  
22 involved with the manufacturer before you're allowed  
23 to distribute or transport. And that's a whole  
24 other factor that's trying to be addressed, and  
25 those are real requirements unless the IAEA and the

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1 other governmental agencies change those  
2 requirements for the production of any kind of  
3 source, special form.

4 MR. RAKOVAN: Okay. Looking at the  
5 agenda for tomorrow, we've got registration starting  
6 at eight. I'm sure we'll have more food out. We'll  
7 be starting promptly at 8:30, starting on Issue 3,  
8 and then we'll move on to four and five tomorrow.

9 So we'll see you all tomorrow. We'll be  
10 in the same room.

11 (Whereupon, at 4:53 p.m., the workshop  
12 was adjourned, to reconvene at 8:30 a.m., September  
13 30, 2008.)

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