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IMPLEMENTATION OF LESSONS LEARNED FROM THE

FUKUSHIMA DAI-ICHI ACCIDENT

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WEDNESDAY

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The Lessons Learned from the Fukushima Accident Session of the Regulatory Information Conference met at the Bethesda Marriott Hotel & Conference Center, 5701 Marinelli Road, Rockville, Maryland at 1:30 p.m., William Dean, Session Chair, Presiding.

SESSION CHAIR:

WILLIAM DEAN, Director, Office of Nuclear Reactor Regulation, NRC

PANELISTS:

TOYOSHI FUKETA, Commissioner, Nuclear Regulatory Authority, Japan

PHILIPPE JAMET, Commissioner, Autorite de Surete Nucleaire, France

RAMZI JAMMAL, Executive Vice President and Chief Regulatory Officer, Canadian Nuclear Safety Commission

MICHAEL JOHNSON, Deputy Executive Director for Reactor and Preparedness Programs, OEDO/NRC

BO TANG, Deputy Director General, Department of Nuclear Reactor Regulation, Ministry of Environment Protection, People's Republic of China

T-A-B-L-E O-F C-O-N-T-E-N-T-S

P-R-O-C-E-E-D-I-N-G-S

1:30 p.m.

MR. DEAN: Good afternoon, everyone.

ALL: Good afternoon.

MR. DEAN: Thank you very much. I'm Bill Dean, director of the Office of Nuclear Reactor Regulation. Good afternoon and welcome to what I think will be a very interesting and informational session.

Just a couple of notes, please make sure you silence your electronic devices. If you need to leave the room during the session, please wait for an appropriate break between speakers or leave as silently as possible. The session and all technical sessions including this are being recorded and recordings will be available on the RIC website after the conference.

So four years ago today the Great East Japan earthquake and tsunami created a tremendous humanitarian crisis in Northeastern Japan. Not only did it have a tremendous loss of life and property; it also created a severe multi-unit nuclear accident at the Fukushima Dai-ichi site and nearly create a severe accident at the Fukushima Daini site to the south. I know the events of that day and the days to follow resonate with all of us in this room, and they also taught us a very valuable lesson, that the unexpected

can happen and we have to be prepared for it.

One of the most important experiences that I have had in my career was last year when I had the opportunity to participate in a delegation led by Mike Johnson of senior NRC regulators to go to Japan and to see firsthand the impact of the earthquake and the tsunami at Fukushima Dai-ichi. It also taught me how courageous and brave the operators were on that day and the days that followed and the resiliency of the Japanese people.

The purpose of today's session is to hear from senior regulators from around the world to describe how they have assessed the Fukushima events and more importantly implemented lessons learned that they have put in place or will be putting in place.

As you will see and hear today, there is no one single right answer or response to the Fukushima accident, but there is no question that each and every nation in which there are operating reactors has approached the issue with the same mind set: To put in place the best approach to achieve the appropriate degree of safety enhancements to ensure that we do not experience another event like Fukushima.

So I'm very honored to introduce this very distinguished panel of senior regulators who will be

presenting to you this afternoon. So starting from my far left is Mr. Michael Johnson, who is the Deputy Executive Director for Reactor and Preparedness Programs at the NRC. In this role Mr. Johnson is responsible for regulatory effectiveness and the implementation of the Nuclear Reactor Safety Program and the Agency's homeland protection and preparedness activities.

To Mike's right is Dr. Toyoshi Fuketa. Dr. Fuketa is a commissioner of the Nuclear Regulation Authority of Japan. One of Dr. Fuketa's prime responsibilities in the NRA is to access the degree of risk existing in nuclear-related activities by using the state of the art knowledge, technology and information and to establish regulatory criteria and structures to cope effectively with the potential risks.

To Dr. Fuketa's right is Mr. Tang Bo. Mr. Tang is the Deputy Director General of the Department of Nuclear and Radiation Safety Regulation at the National Nuclear Safety Administration of China. In this position Mr. Tang is in charge of safety regulation of operating nuclear power plants and reactors.

To my right is Mr. Ramzi Jammal. Mr. Jammal is Executive Vice President and Chief Regulatory

Officer of the Canadian Nuclear Safety Commission.

And to his right, Mr. Philippe Jamet. Mr. Jamet is a commissioner of the French Nuclear Safety Authority. One of Mr. Jamet's responsibilities was to lead the board for the peer review of the post-Fukushima European stress test in 2012.

And with that, I would like to introduce Mr. Jammal, who will be our first speaker.

(Applause.)

MR. JAMMAL: Thank you very much, colleagues, friends, ladies and gentlemen. I think you should hold your applause until the end just in case I didn't deserve it.

(Laughter.)

MR. JAMMAL: So for the record, I will be presenting to you that sign up here -- actually -- okay. We're losing the slide. In any case, that's fine. In Canada post-Fukushima we started right away an action plan, and the action plan was stemmed from a directive that I have issued right after the event that require the licensee to do quickly a short-term lessons learned from walkdowns and to reestablish the evaluation of the safety case of our nuclear power plants.

We started to examine the events. The events that are not credible, the events that have been

historically regarded as non-credible and will not take place in Canada.

So right after the Fukushima itself we conducted examination. The examination was conducted by a task force, and the task force provided me with recommendations. In addition to the task force that was internal to the CNSC the president of the CNSC has established an external advisory committee. The external advisory committee was constituted of non-nuclear experts. They were experts from the Transport Safety Board, politicians, the Deputy Minister of Energy, and the chancellor from the University of Ottawa, and they looked and critiqued our task force report and provided us with a recommendation.

As you can see from the slides that by April 2012 the external advisory group presented their findings to the president and they presented to the commission itself. And the report itself actually has incorporated all of the information provided by the external advisory committee. We had three public consultation rounds, so at every stage of the draft of the CNSC action plan we went out for public consultation and review.

As the chief regulatory operations officer

we set the dates for the implementation of the action plan: short-term, by December 2012, mid-term by December 2014, and the long-term elements are December 2015. So we've closed short-term actions, we've closed the mid-term actions, and we are currently going towards the closure of 2015 elements.

What we'll do is I'm going to go briefly through the action plan, the assessment evaluation and the key things I would like to share with you is the implementation element associated with the action plan.

So what did the action plan call for? Strengthening reactor defense-in-depth. Calls for enhancing emergency preparedness and response. Improving the regulatory framework and processes. The task force made recommendations to the CNSC itself to carry out amendments to its regulation, and then enhancing the communications and update education with respect to the public response and the knowledge.

The key principle in the CNSC regulatory philosophy and implementation that CNSC, we shifted our focus now from accident prevention to accident prevention and mitigation. So in other words, I will share with you we are no longer saying it's not going to happen. I will share with you the details that we

went through to say even though what if here's what's going to happen, are we going to be prepared in order to regulate the mitigation associated with the events itself.

So here's the action plan, and the action plan itself did not just focus on nuclear power plants. Our action plan is comprehensive. First and foremost the highest risk, the nuclear power plants, followed by the directives issued to research reactors and at the same time uranium mines facilities and processing facilities. So our action plan covers the whole aspect. In this presentation, I'm focusing only on nuclear power plants.

Most of you know that the concept of defense-in-depth is not new. As a matter of fact, we have an international strong foundation based on the safety principles, the INSAG, that has submitted its report to the IEA, and our fundamental principle for the defense-in-depth is based on the insight and then focused on the implementation element and the assessment.

Major principle: control, cool and contain. And of course we have applied all the levels that have been recommended by INSAG from level 1 to level 5. And I will go through each one of them

quickly.

We started with the design basis and the safety case to ensure that is there a need for design modification? And of course the answer is yes. And I will share with you what the first assessment was. The inherent safety elements of the can do is the large makeup of the heat sink capability with a fuel that is uranium, natural uranium burning fuel.

So without going in details, of course there is a lot of heat capacity, heat sink capacity and megatons of water, even heavy water, D2O, and to include within the calandria and also the calandrium.

So in our assessment we determined that the fact that the relief pressure will open and must open with respect to the evaluation when there is a loss of power or there is a loss of air pressure. In addition, you see the makeup, standardized makeup of water into the steam generators. When I say "standardized," that means at every site, ever connectivity is identical to every and other reactor, and that we went further, that when we have multiple sites in the same province that the connectivity is identical from site to site.

In addition, we enhanced the capacity of the water makeup, and in specific the NMSS, the main steam safety valves and the feedwater supply. The

evaluation was to take into consideration the assessment of severe accidents and the capability to withstand the severe accident and ensure cooling for minimum of almost eight days continuously without any external support. But I will provide the details for each element.

The analyses and reassessment -- I'm being I only have 5 minutes left, so we'll -- 5 minutes out of 10. The design improvements -- I will focus on the design improvements. So what you have here on the left-hand side is the analyses and the reassignment, and then the design improvement. So definitely the EMEs were expanded and enhanced for every site and every reactor. The upgrades, reliability of battery supply was increased and the protection against flooding has been improved.

So here's an example of the licensee's upgrades. And when I speak of implementation, that means the work has already been completed. It is not on the books, it's not under evaluation, it has been implemented and installed.

With respect to the fourth level of defense, the water makeup to the calandria itself and the calandria vault in order to maintain and ensure there is a heat sink and improve the pressure relief

capability of the calandria vault. And we put an emphasis on the capacity of the instrumentation to withstand beyond-design-basis severe accidents to include full station blackout and the capacity to maintain and implement severe accident management guideline when instrumentation is not available or a blackout has dominated the fact.

So when I said we did not stop at the prevention, we said we have a heat sink and we said there is no mitigation. What is it going to happen? And I'm going to briefly, for the sake of keeping on time here, show you that the elements associated within the calandria itself and saying what's going to happen if the fuel damage occurs, if we deplete unmitigated again the heat sink within the calandria itself? What's going to happen to the corium? And we've done the analysis.

What you see at the bottom of this slide is a design change to permit water makeup to calandria vault will maintain calandria vessel integrity. Those have been implemented. So in other words that the capacity for heat sink is already in place. As the corium in-vessel retention, if we don't do any mitigations, after 56 hours molten of the fuel debris will start to fall into the bottom of the reactor and

the vault and we will start to do the containment protection through controlled venting.

So this presentation shows that the result of the makeup -- both capacity for water makeup at the calandria, inside the calandria vessel itself and the water makeup capacity as an added heat sink with respect to the reactor building vault and the calandria vault itself.

So here's an example of the emergency mitigation measures. Emergency water supplies to include air-cooled diesels and the capacity of equipment qualification that already taken place.

As I mentioned before, ventilation of -- containment venting is very, very important in order to protect the containment itself, and we started with the installation of passive autocatalytic re-combiners.

Here's additional filter venting in order to protect the containment. Again, it is passive. So in other words, you do not need power to operate it and it can be manually operated if the capability to -- if there was any failure. And these are the PARs which converts the hydrogen into water with respect to absorb any potential hydrogen. In addition to the PARs or the filter venting there has been added the cooling

air-conditioning capacity cooling, and that our site-specific and design-specific based on the reactor itself.

We did not forget the spent fuel pool. In Canada the spent fuel pool is unique because they are outside the reactor building and criticality is not an issue, nor is the heat load because of the low burnup factor and it's natural uranium. Even though it's such a low risk, we've implemented enhancement with respect to water makeup, the capacity to look at and instrumentation to monitor the water level and to include -- I believe it's a research -- yes -- no, it's not here, but to include the makeup water in the research reactor. But here is an example of the piping in order to feed into the fuel pool.

In addition to the big elements that we face in Canada, just like any other place, is the capacity to have coordination between federal, provincial, local authority and to include the operators. The difficulty in emergency management is phenomenal and everything thinks because we have ink on paper that we'll respond accordingly, but the challenge was how do you communicate, how do you ensure public transparency and how do you ensure public protection?

So there has been quite a bit of enhancements from the backup power and to the communication and the stationary boundary monitoring and those modeling capability. And in Canada we've conducted a hypothetical assessment with respect to severe accident where we modeled the dispersion and the dispersion was modeled quote/unquote, "in layman's term;" that is, the fuel in the parking lot, what protective measures the public will have to do. And we did the assessment with respect to evacuation, sheltering and protective measure to include the sodium iodide. So there were mobile command centers, capacity to evacuate and enhancement to emergency response centers.

The integration, as I mentioned, of federal, provincial and local emergency plans. We conducted exercises as part of the actual planned major facilities we'll have to conduct not just on site, but off site. And the last exercise we've had was a collaboration with observers from U.S. NRC, from France, where they came and observed the licensees and the Canadian response. And here's capacity to mobilize and evacuate, decontaminate and provide the sodium iodide.

The key point I would like to leave you

with; I know that I'm eating up time for my colleagues here, is we cannot drag on Fukushima forever. The continuous enhancement for safety must continue. We cannot be complacent. So the accident prevention is one element. The improved mitigation of the accident consequence is one element. Public protection is one of the most important elements.

I gave a presentation to the Canadian Radiation Protection Association before I did this. We did a survey. I reviewed the survey of people trust, the public trust to government officials, to include regulators. Do you know where we stand on the rank? In Canada government officials and the regulators were -- we are one notch above used car salesmen.

(Laughter.)

The only people who's got the trust of the public: first responders, fire fighters, emergency personnel. So that's why we establish the discussion with the local authorities and the responders that the people are going to listen to. And we should not forget the fact that in the public response is politicians, because when the public is going to complain about issues, the politicians will react. And trust me, you do not want politician making decisions for the regulator, because they're not going to make the right

one.

So in conclusion, mitigation, prevention. Prevention and mitigation are key integral for enhancement of safety. And Fukushima cannot be dragged on forever. We must continue with our enhancement of safety and the implementation, what is required to ensure safety for the public and the environment. Thank you.

(Applause.)

MR. DEAN: Thank you, Mr. Jammal. And now Mr. Tang from NNSA.

MR. TANG: Good afternoon, ladies and gentlemen. And first I must be sorry for my poor English. I will introduce some situation for Chinese about safety enhancement of the nuclear power plant in China after Fukushima accident.

My introduction can divided into the three parts. First part is an overview, and the second part is NNSA actions, and third part is recent works of NNSA.

After the Fukushima accident NNSA took safety enhancement actions which was composed of the major three phase as follows: Phase 1: We conduct a comprehensive safety examination nuclear power plants. Phase 2: We conduct external events in the station blackout safety margin evaluation. Phase 3: We

wanted to formulating the new safety requirements for new nuclear power plants based on the conclusions of examination, evaluation and experience feedback from Fukushima nuclear accidents.

After Fukushima accident NNSA conducted a comprehensive safety examination on nuclear power plants in operation and under construction in China from March to December, 2011. The examination try to find out potential safety weakness according to laws, regulations, and the experience feedback from Fukushima accident.

We have conclusion from the examination. First, the design, construction and the operation of nuclear power plants in China meet the requirements of Chinese safety regulation. Second, nuclear power plant in China are fully capable to deal with design basis accident and have basic capability to prevent and to mitigate severe accidents. But some potential improvements exist to enhance capability of nuclear power plants against external events and station blackout, etcetera. Our improvements can be divided into the short-term and the medium-term actions.

During our implementation process we found some misunderstanding and disunity on improvement measures among nuclear power plants. So NNSA develop

generic technical guidelines on post-Fukushima improvements actions. The generic technical guidelines aim to provide guidance for nuclear power plants to carry out post-Fukushima improvements measures, to standardize the common improvements, to reach technical integrity during the implementation, to coordinate the depths and the widths of safety improvement strategies, to define definite improvements acceptance criteria.

Technical guidelines on following common improvement items were put forward. One is the capability against the flooding, and the backup water-injection and related equipments, and the mobile power supply, and the monitoring of spent fuel pool, and the hydrogen monitoring and the controlling system, and the habitability and the function of emergency control center, and the radiation environmental monitoring and the emergency preparedness, and the dealing with external natural disaster.

The generic technical guidelines specified some conditions and requirements in implementing the improvements, mainly including: (1) In making waterproof and the blocking the blocked water level shall be evaluated under scenario in which design basis flood level superposed with the precipitation

once in 1,000 years, to ensure that one residual heated remove safety train is available before the mobile makeup water unit is connected.

(2) The capacity design for mobile makeup water units is based on the connection six hours after reactor shutdown, and the two units will be provided at multi-reactor sites.

(3) Two mobile power sources shall be provided with one of them sized to drive the low-pressure safety injection pump or auxiliary feedwater pump.

(4) Mobile makeup water units and mobile power source shall be stored at a place over five meters above the design basis flood level and away from safety building by over the 100 meters, and the storing structure shall be checked as per SL2. That's SSE in United States.

(5) Necessary level and the temperature monitor shall be added for spent fuel water pool.

(6) Amount of hydrogen in the containment shall be evaluated as reaction to the 100 percent active zone cladding zirconium with water.

(7) Structures of emergency control center shall be checked as per SSE. The inhabitability in case of a severe accident shall be evaluated on the

basis of 100 millisievert.

This some pictures that shows our improvements. That's the waterproof seal. Basically it's for pipe seal and the right is for cable seal. This is a waterproof door and some plate one by one. In normal operation you can rest all of the plate outside. This mobile diesel generator. This mobile diesel pump. This some the connection box and the quick plug. Right is the mobile diesel generator connect exercise. This some connection for feedwater, backup feedwater. Yes, the feedwater connection and the fast connect. Oh, this for monitoring system for spent fuel pool exercise.

Generic technical guidelines were prepared by incorporating the actual conditions of nuclear power plants in China taking into overall account the preliminary experience feedback from Fukushima accidents as far as possible. The generic technical guidelines will be amended and improved step by step while more progress being made and the more knowledge being acquired through the domestic and international research and studies on Fukushima accident.

Nuclear safety regulation action in China. We have the phase 2 actions. In phase 2 actions NNSA

required operating nuclear power plants in March 2012 to -- before March 2012 to perform further evaluation of the safety margin for beyond design basis external events in the station blackout to optimize and implement improvements actions proposed in comprehensive safety examination.

The events selected in the evaluation included the earthquake, flooding and SBO, station blackout. The evaluation covered accident response of nuclear power plants in extreme events, effectiveness of defense and the mitigation measures and weakness and the cliff edge effect possibly existing in nuclear power plants.

In seismic margin evaluation we adopt the EPRI SMA approach. In flooding safety margin the most probably flooding route was identified in nuclear power plants with the assumption that the systems gradually filled with the continual rising of the flood level until the core melt. In station blackout the time in which the unit can be maintained under control was evaluated in accidental conditions that the main unit parameters are monitor and the unit status is controlled only with the power from the batteries without restoring off-site power source and the emergency diesel generator.

NNSA entrusted the Nuclear Energy Industry Association to organize a peer review of the preliminary evaluation reports. Conclusions of peer review are: all operating nuclear power plants in China can pose the seismic margin of 1.5 times the DBE or above; they have the safety margin to cope with the BDF flooding; all power plants have adopted fairly complete counter measures against the loss of AC supplement and the batteries have the capacity to supply power for eight hours after the station blackout.

This is a picture, the Qinshan Nuclear Power Plant dam rebuild.

Nuclear safety regulation actions presently under way in China, phase 3. Further deepening the studies on experience and the lessons of Fukushima accident. We know that the research of experience and the lessons of Fukushima nuclear accident will be a long process, so improvement measures is based on the preliminary experience feedback of Fukushima accident, whether appropriate still needs further research to verify. NNSA has organized a special team to study the experience and the lessons of Fukushima national accident.

We carry out international cooperation to jointly learn experience and the lessons. We want to

further perfect nuclear safety code and update of safety standards. We want to strength nuclear safety culture. We want to formulate safety requirements for new nuclear power plants.

Okay. That's 10. I finished my introduction. Thank you very much.

MR. DEAN: Thank you, Mr. Tang.

(Applause.)

MR. DEAN: And now ladies and gentlemen, Mr. Philippe Jamet from the French Nuclear Safety Authority. Mr. Jamet?

MR. JAMET: Thank you. Wait, let me try to launch my presentation. Okay. Thank you very much, Chair, and thank you for giving me the occasion to make this presentation during the week.

I will rush through my presentation and try to insist on the main points and the most original points in the French approach to European stress test.

First, just to remind you, the ASN -- ah, I will use ASN as the only acronym in my presentation. This means French Regulatory Authority. So please remind this one. I'll try to avoid all the others, but this one I can't.

Okay. So just after the Fukushima accident, like many other countries we performed all

-- the ASM required the campaign of targeted inspection. And then on a more deep level stress test of all the French nuclear facilities. It means about 150 installations. Among them 58 nuclear power plants. The stress tests were covering fairly classical subject: external and natural hazards, loss of ultimate heat sink, severe accident management. And of course this approach was complementary to usual improvement approaches we have.

The French stress tests were performed in the frame of European stress tests. This meant that all the European countries agreed on common terms of reference and there was a whole European approach including benchmark and peer review between the different European states. And all results were made available. I'm not going to go into this, but you have to be conscious that this was not only a French approach. It was an overall European approach. And this European approach, as the rest of my presentation, was only dealing with nuclear power plants.

So just what were the regulatory main milestones for the French stress test process? The first one was that ASN required from the utilities to perform the stress tests because they were performed under the responsibility of ASN. Then six months

afterwards there was a position taken by ASN on what were the main conclusion from those stress tests performed. Then ASN issued six months afterwards general requirements to the utility to increase safety. And finally, there were some complementary requirements that were formulated. I will go into the main points of all these four steps, all three steps in the future.

There is a common point between all these steps, is that systematically the utility EDF was required to propose and justify improvement solution responding to the lesson learned of Fukushima. And IRSN, the technical support organization of the regulatory authority was assessing those proposal, as well as our standing group of expert to provide a basis for the regulatory requirements.

So first step I'm going to talk about is the ASN position after the stress test performed by EDF.

The position had two sentences that you cannot disassociate. The first sentence was that the safety state was such that it was not required to stop or shut down immediately any installation. So we didn't require this. But as a complement that you cannot dissociate. ASN considered that there is a need to increase robustness to withstand extreme situation

beyond safety margins as soon as possible. So you can summarize it as a sort of conditional permission to go on. But all the words are important to what I'm saying.

And in January 2012 as a result of the ASN judgment on the stress test it was already said that main measures to be taken by EDF would be to implement hardened safety core, which is defined as a limited number of material and organizational disposition to guarantee safety function in extreme situation. Typically the one that were uncounted in Fukushima. And second, that also EDF should implement a nuclear rapid response force, which is actually an intervention team able to supply the local team and that should be fully operational into 24 hours. So this was the starting point.

Just to illustrate what we mean by the hardened safety core, I've made this simplified drawing. The horizontal axis represent increasing hazard severity. You have on the left the design basis that meets the safety analysis report criteria, all of them, with a conservative method that provide margin. So actually installation as margin and can sustain more severe conditions than the one formally defined in the safety analysis report.

The hardened safety core is a limited

number of safety system components that would avoid no massive -- massive release for a situation that an even more strengthening or more important than the margin you get through the design basis. So we are outside of the design basis and we are also outside of the margin provided by the design basis, But of course only to avoid massive releases.

Okay. So this was the initial position of ASN. After a few discussion with EDF there were general requirements issued by ASN on the implementation of all these. So there were first a general view that even though there was this hardened safety core, EDF should reinforce safety margins. So this was a general goal. And then we had two requirements that were more about the method. The first one is that -- the requirement was to implement new and robust safety measures rather than performing sophisticated analysis. In short, you could say we prefer improvements to paper. And the other one was that this should be done as soon as possible. We considered according to our position that improvements were urgent, therefore we were requiring that they were implemented as soon as possible.

In those general requirement there were also conditions about the safety goals of the hardened

safety core. There were three: to prevent and mitigate severe accidents. They are the two word important, that prevent as well as mitigate. So we had the two sides. And to mitigate large-scale radioactive releases and also to enable the licensee to perform its emergency duties, meaning that at this stage already we had said you have to have implementation of locals that would allow people to stay on site even in case of a severe accident to manage the accident. This was a positive lesson learned actually from the Fukushima accident.

At this stage also in June 2012 there were already the first description of the equipment that should be implemented. And I'm going to list them rapidly. An additional ultimate electricity generation set per reactor that was hardened, of course. This is complying with the safety core requirement. A diverse emergency cool-down water supply, so diversified water supply. New crisis management premises. This is what I just talked about, the local where people could stay to manage the accident like they did in Fukushima. Mobile equipment and means of communication, and technical and environmental instrumentation. There also you have to notice that the mixture of hardened fixed equipment and mobile

equipment is already required.

And finally, last request from June 2012 is that we stated more precisely what we were expecting for the nuclear rapid response force. Of course this nuclear rapid response force is to take over the personnel of the site affected by an accident. They should be able to deploy additional emergency response equipment. And we put the condition that for a four-reactor site they should be operational by the end of 2014, and for a six-reactor site; we have one of them, by the end of 2016.

Now, I'm going to go rapidly on complementary requirement we put in January 2014 after quite a few discussion with EDF. We precised the safety goal of the hardened safety core and we said that prevention of core melting should be done in priority by cooling by the steam generator, to be very correct. So they were a part of the hardened safety core. And the second condition is that we required to ensure performance of the containment. And that means by being able to withdraw residual heat from the containment without opening the venting. We have filtered venting on all our PWRs, but we wanted as an additional level of protection to have -- to be able to -- or we required that EDF is able to extract the

residual power without opening the venting.

And the other requirement was that EDF has to identify the system and components that are part of the hardened safety core. They can be of course new equipment that have to be designed according to the standard design criteria with respect to the level of the hazards that are taken into account, but they can be also existing equipment if EDF can demonstrate that they will stay functional in case of those extreme situation.

I'm going to skip the two following ones just to save some time. Just the two following one are precising what are the design level for the hardened safety core: Flooding, earthquake and so on. This will be available in the presentation, but I don' think this gives much adding value of these things.

This messy slide is just illustrating the time scale for implementation of the required improvement. And there are three phases on this one. I will only describe two phases.

As we said, it was urgent to improve our plants, so we had a first phase that was a short-term phase that was mainly relying on mobile equipment and the nuclear rapid response force. And so, this was already implemented to this, so this works. And this

was the most urgent part that would allow plants to be improved as fast as possible.

And now we are in the process of implementing the second phase, or second and third on this slide, which has basically implemented the fixed hardened equipment. And this of course takes a lot of time because you have a generator and so on. And this will go up to 2020, 2022. But this is important to see. We had urgent measures that were immediate almost, a few years. And then long-term measures dealing with fixed equipment.

Now, just to give you an idea of what will be done, this is principle scheme. This is very precise. This is what we have now. So we have the rapid nuclear response force. We have portable equipment: pumps and a tank of demineralized water. This is what we are expecting for the future. In addition to this we have premises on the site that will allow the teams to stay even in case of a severe accident. We have a diversified water makeup. We have a electricity generator that is hardened. And we have a system to cool down the containment so that it can withstand a severe accident without opening the vents.

Now, let me conclude now with five points.

First, we don't believe that the page of Fukushima can be turned soon. We believe that there are still many things to be learned from this accident, from the state of the reactor, as well as from the way it was managed, and we believe that altogether it will take 10 years before we can really draw all the lessons, at least.

The second thing is that stress tests were performed in Europe in the framework of the European approach and the European benchmarks are going on.

Then the third one is that the stress test leads to strengthen the robustness of NPPs for beyond design situation to prevent accidents resulting from extreme and unforeseen natural hazards and to limit their consequences.

The fourth one is in France we require, the DSN require two main modification or improvement: implementing of a hardened safety core and a nuclear rapid response force.

And as I said, we did this in two different steps, urgent ones so that we would have improvement of the safety of plants as fast as possible, and then long-term with a complementary fixed equipment to the mobile equipment.

Thank you very much for your attention.

(Applause.)

MR. DEAN: Thank you, Mr. Jamet.

And now Dr. Fuketa from NRA, Japan.

DR. FUKETA: Thank you and I thank U.S. NRC for giving this opportunity to address lessons learned from the Fukushima Dai-ichi accident and our responses in new regulatory requirements.

TEPCO's Fukushima Dai-ichi accident revealed the weakness of the foregone regulatory requirements; for example, insufficient design provisions against tsunami, impractical management measures under severe accident conditions, and insufficient provision for accidents far exceeding the postulated design conditions. Then we re-realized the importance of the defense-in-depth approach in design and preparations of countermeasures against beyond design basis accidents. We learned from the accident that we must evaluate in advance the potential and the consequences of a wide spectrum of internal and external initiators including earthquake, tsunami, volcanism, aircraft crash, fire, terrorist attack, and so on.

The Fukushima Dai-ichi accident revealed vulnerability of structures, systems and components against extreme loads and conditions caused by some specific internal and external initiators. The NRC

accordingly enhanced design requirements significantly. Due considerations are required for all the significant internal and external initiators. Due considerations are required for all the significant internal and external initiators.

Re-evaluation of external hazards is also requested, particularly for natural phenomena, based not only on historical records but also on expert judgment to cover very rare events. As for earthquakes, more stringent criteria are prepared for active faults, more specific precise methods are provided for design basis ground motion, and so on. As for tsunami, more comprehensive methods are required for defining design basis tsunami covering possible earthquakes or other natural hazards; for example, landslides in the ocean bed as causes of tsunami based on national and international experiences, and countermeasures such as coastal levee and watertight doors are required.

The new requirements extend design basis events and strengthen protective measures against natural phenomena and other initiators which may lead to common cause failures. They put particular important in due consideration to ensure diversity and independence; that is, shift of emphasis for

redundancy-centered. Diversity of operating mechanisms; for example, diesel and gas turbine generators, motor-drive and diesel-driven pumps, is important as well as physical separation.

In our new requirements safety-related system trains shall be located at different elevations and/or different areas, compartmentalized by installing bulkhead, or distanced enough from each other. Mobile equipment shall be stored in different locations which are not easily affected by external initiators including intentional aircraft crash, and easily and surely connectable to the target system by preparing spatially-dispersed multiple connecting ports.

In the new requirements by the NRA the definition of some DBAs are changed. Design provisions is now required against prolonged station blackout and loss of ultimate heat sink. Also required is provision against some beyond design basis accidents involving multiple failures including anticipated transient without scram, loss of core cooling and loss of reactor depressurization. The new require requires licensees to validate the effectiveness of countermeasures against beyond design basis accidents.

In the Fukushima Dai-ichi accident many

attempts to activate the accident management measures were unsuccessful to the aggravated plant conditions such as loss of power, loss of control air, aftershocks and high radiation. The feasibility and effectiveness of accident management measures are now strictly examined in licensing processes. Containment cooling and depressurization system to be used in severe accident conditions; for example, a filtered venting system, shall be installed to prevent the containment failure due to over-pressurization and to minimize the radioactive consequences.

And then emergency preparedness. The guideline existed before the accident primarily and excessively relied on code predictions on source terms and radionuclide diffusion. Projected dose and dose that has been received are not measurable quantities and cannot be used as a basis for quick actions in an emergency. The new guidelines by the NRA accordingly introduce operational criteria. They are values of measurable default quantities or observables such as the emergency action level, EAL, and the operational intervention level, OIL, as a surrogate for the generic criteria for undertaking different protective actions and other response actions. The new guidelines also define requirements on roles and functions of off-site

emergency response centers, execution of nuclear emergency drills, and so on.

The amended Reactor Regulation Act stipulates licensees' responsibility for safety improvement and requires licensees to conduct self-assessment for safety improvement periodically. This framework strongly encourages licensees' initiatives towards continuous improvement of safety by requesting licensees to prepare the final safety analysis report which provides as-built or as-is plant description and to update it when major design modifications or procedural changes take place.

Licensees are also requested to carry out the periodic safety review, PSR, to incorporate the state of the art knowledge into the plant design, operation and maintenance activities. In addition, it is required to conduct level 1 and 2 probabilistic risk assessments, PRA, periodically for both internal and external initiators including hazard re-evaluation to demonstrate the effectiveness of the plant modification.

So, this is my last slides. In the light of the Fukushima Dai-ichi accident the NRA developed the new design requirements and established the new regulatory framework to ensure the nuclear power plant

safety. The NRA continues to address the lessons learned from the Fukushima Dai-ichi accident, keeps updating regulatory requirements where appropriate, and never becomes complacent.

That's all for my presentation. Thank you for your attention.

(Applause.)

MR. DEAN: Thank you, Dr. Fuketa.

And now last but not least, Mike Johnson from the NRC.

MR. JOHNSON: Thanks, Bill. Good afternoon, everyone.

I want to first acknowledge the actions that have been taken in certainly Canada and France, also in Japan and China, and by regulators around the world and operators around the world to learn lessons from the tragic accident at Fukushima. I think one thing that you've heard in the panel has been certainly I think we share among the regulator community is a steadfast determination to make sure that we never repeat those lessons again.

I'm going to shorten my presentation, not because it's not important, not because as I look in the room and see folks who I know who have worked day and night on lessons learned in this country, both in

terms of the NRC staff and managers, but also in terms of licensees -- and I don't want to devalue your efforts on this, but I do also note that these topics have been well-touched on. In fact, the chairman touched on topics related to Fukushima as did many of the Commissioners, all of the Commissioners actually, and our executive director for operations. So I don't feel like I've giving this topic short shrift if I move quickly through the slides, so I'll do that.

The main message I want to start with is really one that I think Philippe mentioned, and it was really something that showed up in the executive summary of the Near-Term Task Force report that set the context for how we proceeded with respect to Fukushima lessons learned activities in our country, and basically I've lifted off or summarized what is in that Near-Term Task Force report. And summarizing, they recognized the seriousness of the initiating event and the resulting accident, but they also concluded that continued operation and licensing in this country does not pose an imminent risk to public health and safety. That was a fundamental finding of the Near-Term Task Force.

And I should tell you that several months later when the Fukushima Steering Committee was stood

up and we looked at the recommendations, we reaffirmed that perspective; that is, that there wasn't an imminent danger as a result of operation and licensing and so that we could continue. That sets an important context, because you can imagine how things might have been different if we weren't able to reach that particular conclusion.

That said, the Near-Term Task Force did point to areas that needed improvement. In fact, the majority of the executive summary of that report summarizes those activities. They talked about five area. Two of those areas relate to clarifying the framework and improving NRC programs. Another three areas however talk about things that we can do to bolster the capability of plants by using a defense-in-depth approach. And they recommended ensuring protection from external events that could lead to core damage, enhancing mitigation of consequences of such accidents should the occur with a focus really of preventing and spent fuel damage and uncontrolled releases of radioactive material, and finally strengthening emergency preparedness to mitigate the effects of radiological releases.

So I'm going to touch on those three, not the two, activities clarifying the framework and

improving NRC programs, although we have also taken action in those areas.

This slide is well-used. We pull this out frequently because it sort of shows the broad scope of the actions that we've undertaken, we have taken; that is, we have required, the Agency required concrete actions in plants that put those actions in place, and the plants are in fact safer as a result of that.

In this picture from the storage building for materials for mitigating strategies equipment that you see at a facility, the strategies equipment that you see in the industry's response center in that bottom left corner, to the center of that drawing where you see a flood door used to prevent migration of flood waters within the facility, to instrumentation in the upper right corner of the spent fuel pool level, and the bottom right which shows sort of a depiction of how seismic events can affect a nuclear power plant. All of that shows the range of activities that we've undertaken as a result of the lessons learned from Fukushima.

We had guiding principles as we sought to do our work. Those guiding principles were that we do not distract from operational safety. I want to come back to that theme maybe as a closing thought when I

see the one-minute or the two-minute mark being held up. I got time? Good. That we don't displace more safety-significant work. We recognize that Fukushima is important, but it's not the only thing that is important. And we don't want to displace that important work.

We took a tiered approach; that is, that we prioritized, that we sequenced, that we integrated all of our activities to make sure that they were integrated. And as we worked through the individual lessons that we're taking on we want to make sure that we maintained that integration and that we continue to learn. We are employing a discipline screening of additional issues. We will continue to learn. We want to make sure that we're very disciplined about that as we move forward recognizing that we don't want these activities to carry on indefinitely. And finally, we want to do it right the first time. We want to make decisions based on sound judgment.

So the next several slides just detail the actions that we've taken. Again, I'm going to just touch on these very quickly because a number of them have been mentioned. We did what our fellow regulators have done immediately following the accident; that is, licensees walked down their facilities. We verified

those walkdowns because we wanted to make sure that protections that were currently required to be in place in accordance with the current licensing basis were in fact in place. We found some areas where they weren't -- licensees put actions in their Corrective Action Program and are implementing those actions. We're reevaluating the seismic and flooding hazards. And you heard mention of that. I think Commissioner Baran mentioned that most recently. Licensees are completing that work and we're looking to see in fact what changes need to be made potentially in the currently licensing basis based on that work.

In order to not distract ourselves, to be able to focus on seismic and flooding, we're going to look at the other hazards, external hazards, but we're going to sequence those after seismic and flooding. And in addition to that we're going to look at periodically revisiting, or whether we need to periodically require that we reevaluate those hazards. That's a tier 3 activity or a follow-on activity, if you will. So all of those things on this slide really go at ensuring protection from external events.

As I indicated, we also in a defense-in-depth approach are looking at strengthening or enhancing mitigation from beyond design basis

events. We recognize the importance of mitigating the consequences of beyond design basis events should they occur with a focus of preventing core damage and spent fuel pool damage and minimizing the potential for uncontrolled radioactive material in the environment.

You've heard mentioned thus far in the RIC an order for mitigating strategies. Those orders or the implementation of those orders are coming due in the 2016 time frame. We're following that up with a rulemaking to capture, some could say codify, some could say make generically applicable. I'm smiling as I look at the rule makers and the folks who are heading our activities in terms of that work. We sometimes debate whether we are codifying or we're making generically applicable that work. Sort of an inside that you'd have to be here to understand or appreciate how much energy we spent on that topic.

We're implementing also the order for severe accident capable hardened vents. We are well into those activities, two phases. Phase 1 wet well venting; Phase 2, dry well venting. And in addition to that we're proceeding with containment protection and release reduction rulemaking. Previously we talked about where that rulemaking was really a -- filtration strategies I think was the title of that

rulemaking where we continued to look at that work. There will be a proposed rule in 2016 and a final rule in 2017.

And then finally we are improving spent fuel pool safety. We're building on the work that we did following the post-9/11/2001 activities that really added the mitigation capability in the plants, specifically in the -- also for the pools. We're developing implementation strategies, implementing strategies I guess I should say, with respect to maintaining and restoring spent fuel pool cooling in accordance with that mitigating strategies order that I talked about. So that activity continues and we'll capture that in the rulemaking.

And then finally with respect to on-site emergency activities, we are coordinating severe accident management guidelines and on-site emergency procedures because we want to make sure that we appropriately integrate and build on our on-site emergency capabilities.

And then finally with respect to that third item that I talked about, we are strengthening emergency preparedness. One thing certainly that again the accident at Fukushima reinforced is the knowledge that on that truly bad day and the extremely

unlikely circumstance in which protection and mitigation aren't sufficient, it really is important that we have a capable emergency response ability to ensure adequate protection of public health and safety.

We've done some things with respect to requesting information on staffing and on communications as it relates to emergency preparedness capabilities, particularly keeping in mind that large scale event that causes extended loss of alternating current power and that could potentially affect multiple reactors at a site.

We are consolidating a number of emergency preparedness issues within our mitigating strategies rulemaking. We are in fact capturing periodic training and exercises. You know it's important not just that we have that capability, but that also facilities can train on it, that they exercise it to ensure that should it be necessary to exercise those capabilities they are in fact able to exercise those capabilities. We want to make sure that EP equipment and facilities are sufficient for dealing with multi-unit and prolonged station blackout scenarios.

Licensees have established abilities to do multi-unit dose assessments. We think that's important. That was an important recommendation and

we've actually pulled that one up and actually that capability is in place today.

And finally we've replaced existing modems used to transmit emergency response data with a virtual private network device, which in fact improves that capability. So a number of activities on that third area of strengthening emergency preparedness.

With respect to our consistency with the international community, I guess I would just say that hopefully as you've listened and you've been able to pick out some differences, you've been able to pick out many more commonalities with respect to the things that we've done. We do truly have a comparable focus on the areas in which we are making improvements and we are achieving I believe similar results. That is as a result of a number of active engagements that we have on the international front through organizations like the International Atomic Energy Agency and the Nuclear Energy Agency, and just a host of activities among regulators to strengthen those activities.

So in conclusion I do want to just note that we have made great progress, as I indicated. That progress is not accidental. It was in fact a result of a concerted effort on the part of the industry and NEI and INPO, the NRC of course, in terms of coming up

with the requirements that needed to be implemented. We've had active external stakeholder engagement. We think that enriches the conversation and the insights that we've had going forward. And we also, as I've indicated, have been actively engaged in the international community.

We've got more work to do of course, as you well know, and so we need to continue to do that work. I think Mr. Jammal said that we can't let this drag on forever. I would agree with that. I would also say that we can't let again -- we can't let, as important as these activities are, those activities distract us from day-in/day-out operational safety and security focused on plants. And ultimately we've got to make sure that we don't introduce unintended consequences, new safety problems, as we rush to fix the problems from Fukushima.

So with that, I'll conclude my remarks and turn it back to Bill. Thank you.

(Applause.)

MR. DEAN: Okay. Thanks, Michael.

First of all, I want to thank all the panel members for I think doing a tremendous job in terms of trying to condense a fairly substantive topic area into a manageable time period. So I appreciate everybody's

indulgence in trying to be timely in that.

We have a lot of questions. We're not going to get through them all, but there are some questions that I think are pertinent for the entire panel to consider and answer. And then there are some that might be more specific to an individual country.

So I sort of want to start off with this question, because it's a good one, and it's one that I worry about: So with an increasing emphasis on mitigation, can that lead to a reduced focus on prevention? So with an increasing emphasis on mitigation as a result of Fukushima, can that lead to nations taking a reduced focus on prevention?

So, maybe we can start with Mr. Jamet.

MR. JAMET: Thank you for this very simple question.

(Laughter.)

MR. JAMET: Well, of course there can be a risk. This is for sure. What I would just say that even in our approach for Fukushima we are mixing prevention and mitigation, because we are trying to cool down the core before it melts. So this is one thing. And it's true that you have to preserve the equilibrium, what was settled. So in terms of equilibrium between the day-to-day control of safety

and dealing with several very unprobable accident is also an equilibrium you have to maintain. And we're trying to.

One thing we believe, at least in France, about Fukushima is that you can say about Fukushima this was a tsunami problem. And then you can say many plants obviously will not have any tsunami problem. Okay. This is one way to look at it. The other way to look at it is to say there are uncertainties about many things, and in particular external hazards, and it's very difficult to imagine the scenario that will actually occur. And what I'm saying is especially valid for external hazards, but it's also valid for many others, you know?

And if you assume that you will have sometimes a very severe situation; maybe not as Fukushima, but very severe situation, I would say that by definition you don't know what the scenario will be. And then the only thing you can do is mitigation. And this is one part of the lesson we draw from Fukushima. It was not foreseen that this was possible in Fukushima. Nobody said it before. If there is one day an accident, the scenario is unknown today, and therefore mitigation is the last barrier you can mobilize because of this.

MR. DEAN: Mr. Jammal?

MR. JAMMAL: I'd just like to compliment Philippe's answer. If I read this question, if the person who's posing the question is asking are we going to do lot of -- spending time on crunching numbers in the name of mitigation to the point that you're going to put resources crunching numbers, modeling and so on and so forth to the point we forget what prevention is all about, well, the answer is no. It's a balance between the two. It's a comparison. You cannot have one without the other. So they both complement each other. And as I mentioned the defense-in-depth principles takes into consideration both prevention and mitigation. But we cannot ignore the fact that we have to change the philosophy that we have to be ready for the accident to occur and the mitigation principle, the response element.

Again, I wanted to compliment Philippe's answer. The key point here is education to the public for them to know what to do, because the response itself is mitigated by educated public. And I'm going to just on one element, because we can crunch all the numbers we want, if the public does not know what to do with respect to rehabilitation, capacity to return, with respect to having quality of life during the accident, after the accident or in recovery.

I'm going to challenge our colleagues, or my colleagues that regulate around the world, because there is a huge ambiguity right now around the world between the health limits versus regulatory limits. Everybody talks about regulatory limits being one millisievert and the public expect us to clean up, do things because it's one millisievert, but everybody is not addressing the fact that there are health limits that can provide quality of life as part of the mitigation measure and the response to an accident. But I will stop at this point.

MR. DEAN: Thank you, Mr. Jammal.

Mr. Tang?

MR. TANG: I think after Fukushima accident was difficult for us. Difficult, yes. We cannot have consider simply the Fukushima scenario for other sites, but what's a suitable scenario for other sites? You cannot identify yourself the scenario. You cannot identify the provision or mitigation measures is suitable. That's difficult for us up to date.

MR. DEAN: Okay. Thank you. Dr. Fuketa?

DR. FUKETA: Well, our new regulatory requirements do not highlight or emphasize one specific level of protections, so to avoid SSE's failure to avoid

-- to prevent common cause failure, prevention of core damage mitigation of severe accident and also emergency response are all important and we re-realized the importance of defense-in-depth. And one of the important lessons learned from the Fukushima Dai-ichi accident is we should think about all the spectrum of the accidents sequences.

So what happened in the Fukushima Dai-ichi accident is not only important. We should think about -- we had the accident due to that tsunami, but the future -- well, I don't want to say this, but if we have another accident, that accident caused by very different initiators, so now we have not only the severe accident countermeasures, but also we put the important efforts on fire protection, so all those kinds of things. I hope this would be an answer.

MR. DEAN: Thank you. And Michael?

MR. JOHNSON: Yes, just briefly I agree with all of the previous speakers. It's important obviously not just prevention, but also mitigation.

One of the lessons that I think we learned from the Fukushima accident was at Daini, for example, Fukushima Daini, that I think one of the things that enabled them to perform as well as they could was that there was an installed plan of capability that was able

to survive the initial tsunami, the tsunami and the earthquake. And it was that in-plant capability that was preserved, protected, along with strategies that could be brought to be, was the combination of those things that I think saved the day.

So going forward we owe it to the public to make sure that we provide for protection. In fact in the mitigating strategies we want to make we are protecting the installed plant equipment, but we're also ensuring that we have strategies should there be a hazard that we haven't anticipated, should there be something that we haven't expected such that we can again ensure that the plants remain safe.

MR. DEAN: Okay. Thank you, Michael.

The next question will be for the panel. This time, Philippe, I'll start with Michael so you can --

(Laughter.)

MR. DEAN: So this question is actually probably a little bit of a simpler question, and that is are there estimates for the costs incurred per nuclear power plant sites for the modifications and enhancements made so far post-Fukushima? In other words, basically how much has been expended per plant on average? This is obviously a ballpark. It varies

from plant to plant. But do we have some sort of ballpark figure in terms of thus far what has been spent?

Mike, let me start with you.

MR. JOHNSON: Yes, actually there is an estimate. I've heard that that estimate is about $40 million per site. Per unit. Per unit. Forty million dollars per unit. I'm getting a bunch of nods, I think. And in addition to that there's an estimate associated with the response centers that is approximately $40 million for each of those response centers. So that gives -- with respect to what we've spent so far, what the industry has spent so far, what the estimate is.

MR. DEAN: Okay. Thank you.

Dr. Fuketa?

DR. FUKETA: My answer is I do not know, but it must be very different in different site. For example, design basis earthquake and the design basis heights of the tsunami are very different in different site. So I'm sorry, I do not have any answer.

MR. DEAN: That's an acceptable answer.

(Laughter.)

MR. DEAN: Mr. Tang?

MR. TANG: No comment.

MR. DEAN: No comment?

MR. JAMMAL: I can speak of Canada's perspective. I'll give you a ballpark figure. It's in the hundreds of millions. But I like to go on with the answer. I know that question is probably coming from industry. The key point here is the cost has a limitation, but at the same time think of the actual cost of the cleanup. So the enhancements are in order to protect the public. And I can speak from Canadian perspective. When we put the enhanced filtering in place to the point that there is quite a bit of absorption retention of any of the source term released material, to the point that if you're spending $15 million on a filtered venting, and you're preventing a town or a village or a city or several millions to be displaced, just look at the correlation between the cost. So billions to decontaminate, mobilize and pay back for the public versus a one-time off for the enhancement. Again, it's going to be a balance between the two, but my biggest point here is the cost of cleanup and recovery far exceeds the enhancements.

MR. DEAN: Mr. Jamet?

MR. JAMET: I will not give you a number either, because one of the reason is that evaluating cost is not part or the relation between the regulator and the utility. So this is the first thing.

What I can say from the -- and what is the balance is -- more the balance of the discussion would be or the -- how much discussion we have. What I have to say from this point of view is that EDF basically didn't disagree with the fact that some very serious modification had to be made after Fukushima. Of course I'm not saying that discussions were easy, they were accepting everything, and so on. But basically within normal discussion we had a utility that was on the basis convinced that some important modification had to be done.

Another reason why I will not give cost is that we are also engaged in a discussion with EDF to allow them or not to go beyond 40 years of operation. And in order to go beyond 40 years operation, probably fairly important modification will be required by the regulatory authority. And then there is a sort of coupling between what has been done for Fukushima and what should be done for the going beyond 40 years, which is again a decision that was not taken and that is under investigation in France.

MR. DEAN: Thank you, Mr. Jamet.

Mike, you wanted to add?

MR. JOHNSON: I just wanted to make one other comment. So with respect to the orders the

Commission decided, for example, for the mitigating strategies order and the spent fuel pool instrumentation order that those were -- the mitigating strategies order was required for adequate protection. The order affecting severe accident capable vents or hardened containment venting capability for Mark I and Mark II containments were adequate protection orders. And so we did not consider the cost in terms of whether to require those.

Other things in our regulatory scheme where there is a substantial increase, we do look to make sure that that increase is substantial and improvement of safety is substantial and that the costs are justified. We didn't do that, did not do that for the order. So I didn't want to leave you with the impression that the price tag was -- had any way shaped what we chose to do with respect to making sure that plants are safer as a result of Fukushima.

MR. DEAN: Thank you, Michael.

We have time for one more question, and I'm going to actually send this your way, Philippe, because of the fact that I got several questions on the same topic. And it has to do with the nuclear rapid response force that you talked about. And basically several people were interested in how are they trained and how

do they practice?

MR. JAMET: To be a bit more specific, there are four centers inside France where there are centers where those rapid response force are grouped with the corresponding equipment. One thing that is important is that they are themselves operators. So they don't want for the accident. They are operating the plant, so they get constant contact with the plant. And, of course, they have specific exercise to check that -- in case of very, very severe situation they would be able to do what they have to do.

MR. DEAN: Okay. Thank you.

So first of all, I'd like to thank Kevin Witt over here who worked mightily behind the scenes to help pull this panel together, which is, as you would imagine, very challenging in working with many different countries. So, Kevin, thank you for that.

If I can have a round of applause for our panelists for this great panel.

(Applause.)

MR. DEAN: So, thank you, everybody. That concludes this session. We have a half-hour break, thank you.

(Whereupon, the above-entitled matter went off the record at 3:00 p.m.)