



INTERVIEW

## Examining the Missteps In Japan's Nuclear Crisis

*A leading U.S. expert on nuclear energy discusses some of the fundamental fail intensifying nuclear drama in Japan and looks at what might lie in store for n*

Michael W. Golay, professor of nuclear science and engineering at the Massachusetts Institute of Technology, expressed concern as the crisis at the Fukushima nuclear power plant has steadily worsened. While the earthquake and tsunami that crippled the plant were extremely rare, Golay says he was never surprised because operators had not taken some basic and relatively low-cost steps — most notably elevating buildings above sea level — that could have averted this slow-moving disaster.

In an interview with *Yale Environment 360*, Golay, an authority on nuclear power safety and security, said it's still too early to tell just how bad the situation may get at the Fukushima complex. Given the large amount of nuclear material at the site — in active reactor cores as well as spent fuel rods — a significant potential exists for a large discharge of radioactive material. But he remained hopeful that if plant operators can succeed in restoring electricity to the reactors, enabling them to pump water to cool the nuclear material, the worst can be averted.

As for the future, Golay believes that improvements initiated in response to the Fukushima crisis, such as passive safety technology that does not rely on electricity to shut down or cool reactors, will likely mean that advanced nuclear will play an important role in the low-carbon energy mix of the future. "I think we'll do what common sense has said, "which is that you take a pause, you examine what you've learned, and probably some changes will emerge... My view is that nuclear power is here to stay."

**Yale Environment 360:** Given Japan's long history of seismic activity, and given its sophisticated nuclear technology, how did this happen? It seems bizarre that in a country as advanced as Japan, an accident of this type occurred.

**Michael Golay:** It occurred because a historically very rare earthquake occurred, and it had not been fully recognized as being possible, but the people making decisions there had decided that the risks weren't going to protect against events as severe as those that occurred.

**e360:** When the sequence of events began to emerge that triggered the current emergency, it appeared to be some of the laxness of preparation, such as the fact that the auxiliary power was

**Golay:** I was surprised by some details, such as the vulnerability of the backup power, because certainly not necessary, because there were design choices that were alternatives when they were somewhat surprised that they hadn't considered doing fairly low-cost things which would provide protection, such as elevating the backup power sources, their fuel supplies, the switch gear.

**e360:** Elevating these things to a few hundred feet or less would have certainly done it.

**Golay:** Well, it's easy in hindsight to be critical. But you've got to take a look at that site. What — I've never been there but I've looked at the satellite photos — is that they've got a fairly narrow, somewhat low mountains. So building the plant up on the mountainside would have probably been a better proposition, which is I presume why they put the plant where they did. So what I was thinking

**The importance of having backup power has been very well recognized in the nuclear enterprise world for a long time."**

structures to elevate the domes above potential tsunami damage in the towns that, to what I can tell, to have involved two-story structures — res

— and things which are built to more civic and industrial standards of multi stories seemed to have survived. Now I'm probably only commenting on the ones that seemed to have survived and I'm not sure that didn't make it and were not visible. But, probably at modest cost, some greater protection could have been put in place in this area, and the importance of having backup power has been very well-recognized in the nuclear enterprise world for a long time and certainly the Japanese were aware of this. So one can speculate about their decisions. I'm telling you what would have been factors they could have considered, and I don't know what they didn't consider more deeply. Certainly they were aware of the hazards.

**e360:** And it really was the loss of backup power that has set in motion all of the subsequent

**Golay:** Well, it was two things. First was the loss of the [electric] grid, which probably happened itself. And that, coupled with the lack of backup power, is crucial. But it's really the loss of the

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survived, we wouldn't be having this phone call. The problem was not that the backup power was not well recognized and at this plant there were no structures to protect the towns along the coast. But they proved to be inadequate. They shouldn't lose track of the fact that this is really a very



The disaster at the Fukushima-Daiichi nuclear power plant has highlighted the importance of nuclear energy to Japan and the power long wielded by the nuclear sector. But that influence now is sure to wane, to the relief of opponents who have fought for years to check nuclear's rapid growth, writes Caroline Fraser.

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barrier like that, you always have the question, “How I what happened. But if you were to rewind two weeks a compelling evidence that you should double the height they could have well asked, “Well, why should I spend protecting people in Tokyo from an earthquake that c

**e360:** I'm going to assume that you are a supporter of

**Golay:** I think it should be part of our portfolio, yeah.

**e360:** Watching the event itself and this blanket media coverage, how have you reacted to the concerns about what this might mean for an expansion of nuclear power to meet our energy n

**Golay:** Basically, what to do about nuclear power is in the category of complex decisions that with, because they are complex and involve uncertainties, as well as personal values. And I an story is being handled because the nuclear story is being co-mingled with the story of the dire

**What to do about nuclear power is in the category of complex decisions that democracies have trouble with.”**

really struck on Monday b  
love the BBC, I think they'  
think there was anything i  
careless treatment, where  
all the things to be worri

breath they said something about 2,400 people are dead. But nothing in between to say, “Nov of the earthquake,” nor did they note that these people were killed by the earthquake and tsur be forgiven for thinking, “Gee, this nuclear thing has killed 2,400 people.” And that kind of th straight about these matters.

So that's going on, and I'm sure that enthusiasm for using nuclear energy, as opposed to other probably be set back for a time. If the past is any guide, it will probably recover. That's what's events. But this thing isn't over. We don't know how bad it's going to be.

**e360:** Let's assume that the worst doesn't happen and there's not a Chernobyl-like explosion

**Golay:** It's not, but there could be a big release. In terms of the damage to the reactors it's m Three Mile Island. Three Mile Island involved one reactor. They melted a fair chunk of the co contained and only a very small amount of radioactive material got out of the plant, and nobo except perhaps for mental health effects. And Chernobyl was huge, where much of the core w

and Western Europe. So I would put this in between the two in terms of the offsite consequences appear likely to occur. But the amounts of radioactive material involved in this event are large Chernobyl — that is, potentially. There's a lot of radioactive material at this site in different locations being an event putting more radioactive material into the biosphere even than Chernobyl, but have a basis for fearing that.

What we had at Chernobyl was a violent steam explosion driven by heating from fragmented fuel rods we know. Most of the radioactive material [at Fukushima] is in fuel rods that have been removed a long time — years, is what I mean — and then we have smaller numbers, but still large amounts

**My view is that nuclear power is here to stay, regardless of what our attitudes in the U.S. are towards it.”**

fuel rods in the reactor core that have been recently removed. So you have to deal with them and what they contain, and you have to get them cool. And you get into a difficult situation if the plant operators are doing

a really difficult situation because they don't have electric power, they don't have much instrumentation going on in the plant. So it's very difficult. On the other hand, the thing to really pay attention to is the electricity. Once they get electricity back, they have the potential to stabilize things much more than they must be working very hard to do that, although nothing's being said about it, either in terms of providing backup power.

**e360:** If they get the electricity, are their pumping capabilities to get water into these rods an

**Golay:** Well, they would have the ability to pump. Right now they're using fire engines to do that, that's a pretty crude improvisation, and it will give you some idea of how many options they do have. Whether contamination would make it difficult or impossible for personnel to go into regions they need to get to in order to provide hoses and things like that to get the water to where it's required, we know what the story is on that.

**e360:** In terms of moving forward from here, if your desire is to try to ensure that nuclear power is part of a low-carbon future, what do you think needs to be done now from the point of view of the nuclear industry? And what steps would you like to see be taken in the U.S. and globally to try and get this nuclear renaissance back on track?

**Golay:** I'm not worried about the nuclear renaissance now. It was off track before this, and we know. We in America tend to think that we're the most important player in all this, and we're not. Nuclear power is here to stay, regardless of what our attitudes in the U.S. are toward it. And it may not

Conditions in the U.S. are not friendly to enterprises like nuclear power. They're not friendly to actually. So in looking to the future you really should separate what happens here from what happens in the U.S., my take in watching this for many decades is that American attitudes are based primarily on how much of the nuclear enterprise has stayed out of the media. And that means having been boring. They've done a pretty good job of that. And my guess is that if they continue doing that and that the U.S. we'll decide to keep nuclear power as part of our portfolio.

**e360:** You were saying it was off track, particularly in the U.S., given that we've had no construction

**Golay:** Well, we have four units that are moving forward. By that I mean construction preparation licensing approvals are being obtained, and there are something like 28 applications for licensing. After the downturn in 2008, the momentum for lots of ambitious enterprises slowed, and the nuclear industry recovery hasn't yet occurred, and who knows what will happen with these recent events? But there are investors who want to make a profit on this kind of thing, and with nuclear, the uncertainties

**e360:** Are these plants that are being designed or underway, both in the U.S. and elsewhere, more advanced than the plant in Fukushima, Japan?

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As utilities seek to build new nuclear power plants in the U.S. and around the world, the latest generation of reactors feature improvements over older technologies. But even as attention has focused on

nuclear as an alternative to fossil fuels, questions remain about whether the newer reactors are sufficiently foolproof to be adopted on a large scale, journalist Susan Q. Stranahan reports.

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**Golay:** They actually do offer improved performance in terms of electric power for both shutdown and cooling. They cost less. And there are a couple being built now in China, and that's a typical of future nuclear power plants worldwide. It's a Westinghouse design, but the order actually came from

**e360:** Looking ahead, where do you think this is going? Do you have some tremendous release of radioactivity?

**Golay:** I think we'll do what common sense dictates, and you examine what you've learned, and probably some things will emerge. That tends to happen after one of these dramatic nuclear or otherwise, and then you go forward. That's

seems to make sense to me.

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**ABOUT THE AUTHOR**

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