

# Research Reactors - Their role in ALARA reform and the post-Fukushima Nuclear Industry

## Address to:

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It is a pleasure and privilege to be here tonight and I wish to first thank Dr. Jay Kunze for having the courage to invite me to talk about this subject - ALARA Reform. I also want to thank the TRTR Organization, and the local committee, comprised of a number of individuals from the Idaho National Laboratory (principally Battelle Energy Associates and CWI) and the Department of Nuclear Engineering and Health Physics at Idaho State University where I spent the afternoon. It also could not happen without the support of the U.S. Department of Energy and its Idaho Operations Office, and the local Idaho Section of the ANS. All of these organizations here tonight have an impact on the future of nuclear energy in this nation and throughout the world. I hesitate to specifically name individuals who lead these efforts, for fear of omitting some important names. I merely want to say to all of you - keep up the good work and enthusiasm for nuclear energy. Only the strong will continue - do you have it in you?

I wish to share for your consideration my thoughts of potentially excessive and burdensome regulations related to ALARA, which stands for As Low As Reasonably Achievable, a fancy term for radiation exposures at atomic facilities. Last week I was in Japan so I will end this address with some remarks regarding Fukushima.

Tonight I will reach gently toward a political third rail. I want to make clear that my comments in no way reflect the current positions, interests, or policies of the American Nuclear Society, of which I have been a proud member for the last 23 years.

With that in mind I ask you to think of three colors of gamma rays: green, yellow and red. Green gamma rays come from natural sources, yellow gamma rays come from medical treatment and red gamma rays are emitted from nuclear fission (or the radioactive byproducts thereof). Green gamma rays are not regulated much. Yellow gamma rays cause some concern but we put up with the lead blanket at the dentist office. We regulate the hell out of the red gamma rays, however, coming from test reactors you all operate. Perhaps this would suggest that it is time to review what I see as regulatory "overreach."

My question - my premise - for your consideration: Is ALARA reform needed?

My answer is yes! Absolutely.

My premise is a reform in ALARA philosophy will realize continued radiological safety while reducing cost in operations of your nuclear facilities. The motivation to take on this sensitive issue is the confluence in my thinking of the following three points:

- First is the thought-provoking wisdom in an obscure 1981 paper titled "What is ALARA," written by two Oak Ridge National Laboratory employees, J.A. Auxier and H.W. Dickson. Last year your conference was in Knoxville; do you remember these people?
- Second is the wisdom of Ted Rockwell in his efforts to explain radiation hormesis.
- Finally is President Obama's challenge during his 2011 State of the Union Address and his speech last week to Congress to reduce unnecessary and burdensome regulation to make this country more competitive in the global market. Also last week he suspended new antismog standards.

The President's first challenge provided the spark, the spark to put pen to paper, to take on the sacred cow of ALARA. Let us, as professionals in the NS&T community, support our President's call to reduce regulation in our industry. If we don't sound this bell, if we don't explore this topic, if we can't discuss it, who will?

My three-part outline here includes the Historical Origins of ALARA, followed by General Discussion, ending with Recommendations for the TRTR community.

## **Historical Origins of ALARA**

My first recollection of ALARA is from right here in Idaho Falls. On my third day at the Navy nuclear reactor prototype AIW the students had a training drill simulating a spill of radioactive water. I had to shout "SPILL! SPILL! SPILL!" over and over again until the Senior Chief decided that I shouted loud enough and with sufficient fear in my voice. It was easy to summon fear because I had been warned that any amount of radiation multiplied my chance of getting latent cancer. This was a fear instilled in all of us in the classroom, well before we began actual reactor operations out on the desert 60 miles from this hotel.

The faint origins of ALARA can be found in the Manhattan Project, the first large-scale processing, manufacture, separations, enrichments, disposal, etc., of radioactive materials. During the Manhattan Project Dr. Robert Stone (THE Health Physicist of the day) used terms

like “avoid intake” or garner “as low an exposure as possible.” He was operating then – in the early 1940s – without the knowledge we possess today.

Recommendations from the National Council on Radiation Protection and Measurements (NCRP) followed in 1954, began use of the term “permissible dose” in preference to the previous term, “tolerance dose.” In 1957 the NCRP philosophy became that “radiation exposures from whatever sources should be as low as practical.”

As I read it, our early philosophy for radiation safety was based on the dynamics of new and fast-changing recommendations of limits and thresholds, permissible doses versus tolerances (with very conservative assumptions). Realize at this time the first nuclear submarines and surface ships were being designed with inputs from ORNL, Brookhaven, Westinghouse, GE, etc. to design shielding to ensure that sailors who live next to reactors on ships are safe.

In 1970 the Atomic Energy Commission (AEC) proposed an amendment to Title 10 of the Code of Federal Regulation Parts 20 and 50 for assuring that reasonable efforts are made by all licensees to keep exposure to radiation, and releases of radioactive effluents, as low as practicable. This amendment was based on a recommendation from the Federal Radiation Council (FRC).

In 1972 the National Academy of Science issued a report, Biological Effects of Ionizing Radiation, better known as BEIR I report, which sadly helped formalize the Linear, No-Threshold (LNT) concept. This concept means that there is a linear relationship, down to zero, for radiation effect even neglecting some natural and minimum necessary radiation to which everyone is exposed.

Five years later, the term in 10 CFR 20.1(c) changed from “as far below the limits specified in this part as practicable” to “as low as reasonably achievable.” Why? The Federal Radiation Council stated:

*“In accordance with recommendations of the Federal Radiation Council, ... persons engaged activities under licenses issued by the NRC ... should, in addition to complying with the requirements set forth in this part, make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted area, as low as reasonably achievable.”*

1977 - ALARA became the law!

## General Discussion

Let's now get back to the primary reason why I reached for that political third rail and raised this issue tonight to reform ALARA in the TRTR community.

The primary economic challenge for the United States of America today is that our government is too involved in too many things, and spends too much money on the wrong things. Milton Friedman argued that the "real cost of government - the total tax burden - equals what government spends plus the cost to the public of complying with government mandates and regulation ... anything that reduces that real cost - lowers government spending."

ALARA as implemented today, on red gamma rays, imposes unnecessary and burdensome regulation and unnecessary cost on the business of test reactors, be it the ATR just west of us or a TRIGA on a university campus. We who work in the safest of all industries must realize that if we don't find a way to reduce some of our counterproductive bureaucracy - that's right, counterproductive bureaucracy - we will be priced out of the research market. Let me provide two examples.

What if your job was to ensure that your organization complies with this ALARA requirement?

"Conformity with the guides on design objectives of Section II shall be demonstrated by calculation procedures based upon models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated, all uncertainties being considered together."

Then end your work day complying with this ALARA requirement:

"The characteristics attributed to a hypothetical receptor for the purpose of estimating internal dose commitment shall take into account reasonable deviations of individual habits from the average."

Now, this provokes an interesting question: do you assume that a radiation worker or someone who tours your facility will occasionally take a swan dive into the reactor pool on a hot day?

Regulatory ALARA "guidance" for Federal (DOE and DOD) facilities, commercial utilities and test reactors are real costs.

Let us not forget these two points:

- It takes an acute dose of 50,000 mrem to produce detectable changes in human blood chemistry. Is tracking 2 to 10 mrem on a routine job worth the effort?
- Whole body dose LIMIT is 5,000 mrem/yr.

Radiation hormesis proponents would point out that real human data disproves our current LNT regulations environment under which ALARA operates. Hormesis is a topic about which ANS member and Fellow Emeritus, Dr. Ted Rockwell has spoken and written volumes.

If one accepts the linear dose-effect relationship – and I don't, by the way – the risk incurred in a population of 10 people in this room, each receiving 1,000 mrem, would be identical to the risk incurred if the dose were distributed in any random manner – such as one of you getting 9,100 mrem and nine others in the back table getting 100 mrem each. Does this make sense when, according to the Nuclear Regulatory Commission, “The average American is exposed to approximately 620 mrems of radiation each year from natural and manmade sources?” How, then is collective dose a meaningful metric?

Yes, I have read the executive summary of the BEIR V report that warns us “at least with respect to cancer induction and hereditary genetic effects ... the frequency of such effects increases with low-level radiation as a linear, non-threshold function of the dose.” And, I still don't agree with that.

All ALARA programs by their nature seek improvement year after year. If this year after year “improvement” - read decrease in dose received - is allowed to continue we engineers and scientists who have taken calculus know that ultimately the improvement series becomes an asymptote approach to ZERO. I ask you – how safe is safe? Could that “extra” 10 millirem have been used to check another safety system better?

What are the ALARA regulations for heavy metal exposure at a coal plant?

What are the ALARA regulations for benzene at an oil refinery?

...at a solar shingle factory?

...for the transportation sector regarding vehicle speed?

Where are ALARA regulations for lifting limits – mass and frequency – for household moving employees?

Other safety disciplines don't have ALARA ...they have only LIMITS! Am I recommending that ALARA regulations be developed for the examples I just provided? Of course not; it would be ridiculous. Our government intrudes too often and too much.

Bureaucratic agencies seem to redefine ALARA - without scientific evidence - to meet whatever political or social ends they wish to serve. Yes, we even do it ourselves to show we are tough on ALARA. We can now detect radiation to micro levels. Does this mean we want

to drive occupational exposure to micro-levels by expending more of our finite resources chasing infinitesimally lower ALARA goals? I ask again – how safe is safe?

The time has come for TRTR community to say ‘Stop!’ Stop trying to drive your workers’ exposure levels forever downward without scientific evidence that proves that low level exposure to radiation is unsafe. Plant safety requires maintenance and inspection that do result in exposure. So does research.

Let’s back up and operate to the 10CFR LIMIT of 5,000 mrem per year. Or change our limits to Europe’s limit of 10,000 mrem over five years. So how safe is safe? Here is a quote from the renowned economist at George Mason University, Walter Williams. As I read it aloud, in your mind substitute ‘speed limit’ or ‘airplanes’ with radiation dose limits:

*“We could save tens of thousands of lives by lowering the highway speed limit from 65 mph to 5 mph. Additional lives could be saved by a Federal Aviation Administration regulation mandating that airplanes not come within 200 miles of each other and requiring only one plane to be taxiing at a time.”*

Imagine the unnecessary and burdensome impact if the ALARA principles were applied to a sector that kills and seriously injures thousands of people each year – transportation. How many workers’ lives did ALARA save last year? How many did you save at your facility?

## **ALARA REFORM RECOMMENDATIONS**

It is my opinion that much has changed on the nuclear regulatory front since the Manhattan Project of the 1940s when the development of radiation protection standards began in this country. Our knowledge about health effects from exposures to radiation has grown from our overly cautious views of the ‘40s to the more informed and scientifically defined views of today. I appreciate Dr. Robert Stone’s conservatism, which was based on limited knowledge at the time. But with all we have learned since then about low level radiation effects, and our safe-work culture environment, it is time to frame the ALARA question along the idea that “When the reason for a law ceases, the law itself ceases.”

Here is my call to TRTR members:

Start the internal discussion about the best way to structure a reexamination, a reform of ALARA regulation for radiation workers, with just one question:

Can we move to just enforcing the current exposure “Limits?”

J.A. Auxier and H.W. Dickson, in a 1981 paper titled “What is ALARA?,” summed it up best when they stated, “Trends which use ALARA as a ratchet regulation, as a justification for

inflated expenditures, or as a basis for dose limits, are misguided at best.” I absolutely agree.

But the politics of the day are changing regarding government fiscal responsibility and regulatory impact on business cost. Regulation is a major player. Please understand what I am trying to say: it’s about following the legal reasonable LIMITS, not chasing one-millirem reductions for every research reactor. Your theme this year of, “Using Today’s Reactors for Tomorrow’s Renaissance,” is symbiotic with why ALARA reform is needed.

## **FUKUSHIMA**

Let me shift subjects and spend some time on Fukushima and your role at your facilities, with your knowledge, on how you can help.

Last week I was in Japan where I meet with the leadership of Atomic Energy Society of Japan: President Tanaka, the three Vice Presidents Mr. Sawada, Dr. Nomura, and Dr. Horiike, and the Secretary General Mr. Tsuzuki. They are working hard. Many believe that our nuclear future must be redirected in light of the earthquake and tsunami tragedy in Japan; perhaps shut down the facilities that you operate now. While we will learn much from this event, I have not diminished my support for nuclear power which must remain a key component of any rational national energy policy; therefore, the TRTR community supporting basic informational needs is part of the solution.

President Tanaka shared with me the following messages:

*“It is incumbent upon us to humbly reflect upon our shortcomings, identify what needs to be done, and play the expected role as a group of experts to urgently bring the accident site back to a normal state, restore the environment at the site and beyond, and ensure the safety of nuclear energy.”*

And,

*“Furthermore, use of radiation has led to significant technological progress in the fields of medicine and basic science. It is also the duty of AESJ to promote advances in scholarship and technology concerning the use of radiation and nuclear energy, so as to contribute to society.”*

I support his messages and look forward to supporting AESJ going forward.

The major lesson we learn from the Fukushima event is the power of water: a wall of sea water transformed a coast line into a multi-billion dollar clean-up. The nuclear plant buildings suffered damage, but the hardened structures stood while enormous swaths of other infrastructure, industries and homes were swept away. Many, many suffered much.

But Japanese society will recover. AESJ has written an excellent document titled “Lessons learned from the accident at the Fukushima Daiichi Nuclear Power Plant,” that provides both long-term and short-term proposals for improvement. I recommend you read it with the lenses of your facility to learn what you can improve.

What I also observed during my week in the land of the rising sun:

- At the Naka coal plant two workers died during the earthquake falling from the smoke stack on which they were working.
- Mr. Matsumura, a rice farmer refuses to leave his farm near the site despite government orders. The 53 year old is the only one left from a community of 16,000. “If I give up and leave, it’s all over,” he said. “It’s my responsibility to stay. And it is my right to be here.” He has been to Tokyo a couple of times to tell the politicians why he is staying. At issue is that the evacuations were done by convenient geometric rings, now the real data should be used to fine-tune the exclusion zones. Dispersal is a function of changes in the wind direction and topography.
- Prime Minister Noda ties atomic power recovery to economic recovery. This was a difficult message to deliver in Japan, but that’s what leaders do. He was quoted in the paper to say, “We will build a framework so we can restart reactors shut for maintenance after ensuring they are safe following stress tests and gaining the understanding of local residents. It’s important for us to prepare for restarts.” In my opinion this country’s leader understands reliable energy input is required for any modern economy.
- Each day in The Japan Times they have a map showing the radiation levels in micro sieverts per hour in Japan. With the exception of Fukushima prefecture, they all are below 0.08 micro sieverts, background, however in the litate village 40 km northwest of Fukushima the level is 2.43 micro sieverts per hour.
- Seven Japanese high school girls in a synchronized dance group called “Uniform Improvement Committee,” are singing a very strong anti-nuke message.

That is just some of good news and bad news I saw in Japan.

How do we come to closure on Fukushima? We absorb the blow, learn its lessons, and move on. This adversity will make us better, and our plants stronger. Accidents improve safety, by pointing at the needed improvements of not only the engineering design but the collective thinking of humans. Accident does not mean stop, rather it is “something that happens by chance,” that we learn from and continue.

In closing, I am very proud to be an American Nuclear Society member. And I again remind you that I exercised my First Amendment rights to vent my frustrations about ALARA. Should gamma rays be treated as three different colors, green, yellow and red? I suggest we live in a sea of green gamma rays, and moving forward color blind would be to our benefit.

I wish you all skill and some luck as you continue to advance the peaceful benefits of nuclear science and technology at your research reactors, the front lines of the NS&T community, in the post-Fukushima world in which we now live.

Only the strong will continue do you have it in you?

## References

J.A. Suxier and H.W. Dicksen, "What is ALARA?" President at Edison Electric Institute's Health Physics Committee Meeting, September 10, 1981, Hartford, Connecticut.

U.S. Nuclear Regulatory Commission, Regulatory Guide: "ALARA LEVELS FOR EFFLUENTS FROM MATERIALS FACILITIES"

10 CFR Part 50 Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water Cooled Nuclear Power Reactor Effluents.

Theodore Rockwell, "Nuclear energy: Not a Faustian bargain, but a near-perfect providential gift," Nuclear News, November 2008, page 34-38.