

Is ALARA reform needed?

Address to both

Eastern Washington and Trinity Sections of the American Nuclear Society
on
May 19 & 20, 2011

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Tonight I will reach gently toward a political third rail. Note, please, that I am now putting on my PERSONAL ME hat. I want to make clear that my comments in no way reflect the positions, interests, or policies of the American Nuclear Society of which I have been a part 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 coming from medical treatment and red gamma rays are emitted from nuclear power. Green ones are not regulated much. Yellow gamma rays cause some concern but we put up with the lead blanket at the dentist office. Now the red ones, coming from a nuclear power plants we regulate the hell out of. 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: Yes! Please allow me to explain.

I am bold to propose that a reform in ALARA philosophy will realize continued radiological safety while reducing cost in operations of 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 Health Physics division employees, J.A. Auxier and H.W. Dickson.

Second is the most current published wisdom of Ted Rockwell in the November 2008 Nuclear News article titled "Nuclear energy: Not a Faustian bargain, but a near - perfect providential gift."

Finally, President Obama's challenge during his 2011 State of the Union Address to reduce unnecessary and burdensome regulation to make this country more competitive in the global market.

The President's challenge provided the spark. The spark to put pen to paper. To take on the sacred cow of ALARA. I spent two months working on this address before the Fukushima events. ALARA reform is still needed. Let us, as professionals in the NS&T community, support our President's State of the Union call. If we don't sound this bell. If we don't explore this topic. If we can't discuss it. Who will?

I hope that this address will be the spark to start you the members of this local section thinking about and discussing my premise. When you - we - gather the specifics and the courage, I suggest we carry this premise forward for broader discussion within ANS and HPS, and then rule makers.

My three-part outline here includes the Historical Origins of ALARA, followed by General Discussion, ending with Recommendations for our NS&T community to consider.

Historical Origins of ALARA

My first recollection of ALARA is from my third day at work in a Navy nuclear reactor prototype. During 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 within the prototype.

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 - the early 1940s - without the knowledge we possess today.

Recommendations from the National Council on Radiation Protection and Measurements (NCRP) followed in 1954. They were initially published in a series of handbooks from the National Bureau of Standards Handbook 59 (today, by the way, we call it the National Institute of Standards and Technology).

Handbook 59 - a 1954 edition used the term "permissible dose" in preference to the previous term, "tolerance dose," because, as they put it:

"Since it seems well established that there is no threshold dose for the production of gene mutations by radiation, it follows that strictly speaking there is no such thing as a tolerance dose when all possible effects of radiation on the individual and future generations are included."

Another paragraph in Handbook 59 says:

"The present report deals primarily with the protection of persons occupationally exposed to ionizing radiation from external sources. An attempt has been made to cover most of the situations encountered in practice; however, it has not always been possible to make recommendations in quantitative terms. In such cases, the recommendations are intended to serve as practical guides. The recommendations are based on presently available information and cannot be regarded as permanent."

Three years later, in 1957 change extended this concept to somatic effects of radiation, and it reemphasized the NCRP's long-standing philosophy 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.

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), which itself was established around 1959.

In 1972 the National Academy of Science issued a report, Biological Effects of Ionizing Radiation, better known as BEIR I, which help formalize the Linear, No-Threshold (LNT) concept.

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!

Today ALARA regulation is imposed mostly by two Federal Codes: 10CFR835 "Occupational Radiation Protection" regulating ALARA in DOE facilities; and 10CFR20 regulating ALARA facilities licensed by the NRC as prescribed by 10CFR part 50, and Part 52 and Part 70 –

that's the commercial nuclear power plants, food irradiation facilities, medical facilities that handle radiation sources.

That concludes a brief historical context of the origins of ALARA.

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.

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 nuclear science and technology. We who work with the safest of all electricity production technologies 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 energy market. Let me provide three examples.

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

"As an interim measure and until establishment and adoption of better values (or other appropriate criteria), the values \$1000 per total body man-rem and \$1000 per man-thyroid-rem (or such lesser values as may be demonstrated to be suitable in a particular case) shall be used in this cost-benefit analysis."

After you proved compliance with that requirement, then implement 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 will occasionally take a swan dive into the spent fuel pool on a hot day?

Regulatory ALARA ‘guidance’ for both Federal (DOE and DOD) facilities and commercial business are real costs for nuclear sciences and technologies.

Let us not forget these two points:

- It takes an acute dose of 50,000 mrem to produce detectable changes in human blood chemistry. The probability of such a dose accumulation approaches zero during routine operations and maintenance in our well-established industry. 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 rem would be identical to the risk incurred if the dose were distributed in any random manner. Such as one of you getting 9.1 rem and nine others in the back row getting one-tenth rem each. Does this make sense when, according to the Nuclear Regulatory Commission, “The average American is exposed to approximately 620 mrems, or 0.62rem, 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, still wearing my PERSONAL ME hat, 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 to approaching ZERO. I ask you – how safe is safe? Could that “extra” 10 millirem have been used to check a safety system better?

The workload burden and cost of monitoring ALARA regulations is pervasive. At the DOE Pantex Plant, for example, where this nation's nuclear weapons are maintained or disassembled, there are 60 employees dedicated to ALARA operations or monitoring other ALARA staff operators. To me, with my outsider view, having never worked there, this seems an excessive number of employees – with excessive cost - complying with ALARA regulation for contained products, most of which are alpha emitters.

I have been told there are three or four ALARA employees per nuclear power plant. With 104 operating plants in the U.S., that's about 350 professionals devoted to ALARA regulatory compliance. And I have no measure of the industrial and nuclear medicine ALARA staffs, nor the national laboratories' ALARA staffs.

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

Where 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 and contrary to my initial point that 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 our mature industry to say 'Stop!' Stop trying to drive our worker exposure levels forever downward without scientific evidence that proves that low level exposure to radiation is unsafe. Plant safety requires maintenance, inspection, operation, etc. that does result in exposure. That's why we have trained volunteer radiation workers.

Let's back up and operate to the 10CFR LIMIT of 5 rem per year. Or change our limits to Europe's limit of 10 rem 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?

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."

Should the mandated pursuit of lower and lower ALARA goals continue to burden nuclear science and technology work practices and restrict the growth of the peaceful use of this technology? Yes, I understand the regulations haven't changed for many years. It was three-and-a-half decades ago that ALARA goals were mandated to make our operations work much safer. Show me one NS&T workplace that puts profits or production ahead of reactor safety, and I contend that that utility will not be in business for long. Let the Safety Conscious Work Environment govern behavior.

Here is my call to ANS members:

Start the internal discussion within ANS about the best way to structure a reexamination, a reform of ALARA regulation for radiation workers. With our scientific rigor and collaboration with stakeholders, we address just one question:

Can we move to just enforcing the 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.

None of this will be easy. Many will quickly demonize any reduction of nuclear power plant regulation as a devastating "cut" in public safety of plant operations. So my remarks tonight focus only on ALARA for the trained nuclear workforce. The ALARA release limits are off the table for this address.

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 nuclear science and technology activity.

Here are some specific operational suggestions to also start the dialogue if my single question to ANS members is too broad:

- 1) Enforce the radiation exposure limits.
- 2) Dedicate a work-force to cleaning for contamination control, and allow workers to clean up before the body scanner. Internal dose cannot be cleaned with soap so what is the point of setting off the monitors? Workers are fearful of contaminations in the U.S., not from the exposure but from being written up (an ALARA 'speeding ticket').
- 3) End the Radiation Department ALARA power with simple job brief on where the high radiation levels are. Review recent contamination events and how they occurred. Educate and don't dictate.
- 4) Eliminate the dose goals or contamination-event tallies. Make work efficiency the priority (reduce exposure time); productivity improves our country's ability to compete on a world scale.
- 5) For ALARA reform, a dialogue with the radiation workers most of whom are not ANS members is required. They will have the best ideas on how to reform ALARA.

Let me be clear, I fully embrace and support the Safety Conscious Work Environment at all nuclear facilities.

In closing, I am very proud to be a part of the American Nuclear Society. And I again remind you that I exercised my 1st Amendment rights to vent my frustrations, speaking as a private citizen, NOT as a representative of ANS opinions. 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 best benefit.

Thanks are in order.

I thank our outgoing Executive Director Jack Tuohy and his staff who serve our 11,500-member volunteer organization.

I thank the leadership of our Chairs of the 21 ANS standing committees, from Accreditation Policy and Procedures all the way to Student Sections.

I salute the Chairs of the 22 Divisions from Aerospace Nuclear Science and Technology to Young Members Group for their dedication. Our Divisions and technical groups are the heart and soul, or home and sanctuary for all our nuclear professionals.

And, yes, I thank this local section for keeping the atomic fire going.

I wish you all skill and some luck as you continue to advance the peaceful benefits of nuclear science and technology.

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.

requirement." Thus, the court concluded that ALARA had to be considered in evaluating the defendants' conduct, and developed a tri-level analysis. First, because Appendix I sets out emission levels that conclusively demonstrate that a nuclear operator is maintaining emissions at the ALARA level, defendants cannot be liable if the releases were below that level. Second, if the releases were above the levels specified in 10CFR20.106, the defendants had breached the "negligence standard." Third, if the release was below the section 20.106 limits but above the Appendix I levels, defendants would have to demonstrate that they used their "best efforts" to keep the levels ALARA. The court concluded:

If Defendants can prove that emissions levels were kept below those prescribed by the ALARA limits, they have met the applicable standard of care and, therefore, will be immune from liability for actions premised on the release of emissions. Moreover, if Plaintiffs can prove that Defendants' emissions exceeded those levels set out in §20.106, Defendants will have violated the relevant standard of care and will be held liable, provided Plaintiffs are also able to satisfy the causation and harm elements of their claims. If the evidence indicates that emissions levels fall between the two standards, Defendants may be held liable if Plaintiff can prove (along with the causation and harm prongs) that Defendants did not use their best efforts to reduce radioactive emissions.

The trial court's decision was appealed to the United States Court of Appeals for the Third Circuit. On appeal, the defendants argued that the lower court's decision effectively eviscerated the federal dose limits by

ALARA as a standard of care. In reviewing the development of the radiation protection standards and the ALARA concept, the court said that the Atomic Energy Commission (AEC) enacted regulations "to establish standards for the protection of [nuclear plant] licensees, their employees and the general public against radiation hazards." The dose limits for persons in unrestricted areas (i.e., the general public) of 10 percent of the dose permitted to workers was "in accordance with present knowledge, [and provided] a very substantial margin of safety for exposed individuals." Even when the dose limits were lowered, upon recommendations from the Federal Radiation Council and the National Council on Radiation Protection and Measurements in 1960, the court noted that this reduction was not based on health concerns:

Recommended limits on exposure, based upon extensive scientific and technical investigation and upon years of experience with the practical problems of radiation protection, represent a consensus as to the measures generally desirable to provide appropriate degrees of safety in the situations to which these measures apply. While the numerical values for exposure limits established in this regulation provide a conservative standard of safety, the nature of the problem is such that lower exposure limits would be used if considered practical. At the same time, if there were sufficient reason, the use of considerably higher exposure limits in this regulation would not have been considered to result in excessive hazards.

With respect to the ALARA concept, the court noted that early on, a general purpose of the AEC's regulatory policy was to ensure that "radiation exposures to the public should be kept as low as practicable." While the 1975 addition of Appendix I defined the "as low as practicable" admonition, the court stated that the criteria "were not to be considered 'radiation protection standards.'"

After reviewing the history of the regulations, the court held that 10CFR20.105 and 10CFR20.106 constituted the federal standard of care, and rejected ALARA as a standard of care. The court reasoned that the

language establishing ALARA compelled the conclusion that ALARA is a guide that was not to be construed as a radiation protection standard. Also, the specific numerical dose limits, and not ALARA, are sufficient to protect public health. "[A]ny biological effects that might occur at the low levels of these standards have such low probability of occurrence that they would escape detection by present-day methods of observation and mea-

surement." Most important, the court realized that it was inappropriate for lay jurors to perform the cost/benefit analysis that must be considered in making ALARA decisions. The court stated:

Adopting ALARA as part of the standard of care would put juries in charge of deciding the permissible levels of radiation exposure and, more generally, the adequacy of safety procedures at nuclear plants—issues that have explicitly been reserved to the federal government in general and the NRC specifically. . . .

Adoption of a standard as vague as ALARA would give no real guidance to operators and would allow juries to fix the standard case by case and plant by plant. An operator acting in the utmost good faith and diligence could still find itself liable for failing to meet such an elusive and undeterminable standard. Our holding protects the public and provides owners and operators of nuclear power plants with a definitive standard by which their conduct will be measured.

The implications

The *James* and *In re: TMI* decisions highlight the fundamentally different approaches a court can take on the ALARA issue. ALARA can become a millstone around the neck of utilities by acting as a basis for imposing liability for exposures that are otherwise deemed permissible, or ALARA can function as a professional philosophy of excellence by serving to encourage utilities to find ways to operate a plant with lower exposures to workers.

The implications for the *James* decision are far-reaching, and if applied on a national basis, could be devastating to the nuclear industry. If the vague ALARA requirement becomes the legal standard of care for a utility, every exposure, no matter how small, can be analyzed and criticized with the benefit of hindsight. In virtually every instance, it would have been "possible" to have reduced that exposure to that one worker even more, especially when one doesn't consider the effect on all the other workers. Unfortunately, a lawsuit always places the attention on the plaintiff as if he or she were the only worker at the plant and the health physics department can devote all of its resources to reducing that one worker's dose as low as is reasonably achievable. More can always be done for one person, but more cannot always be done for all workers. An "expert" witness can always testify that the plaintiff's dose could have been lowered if the worker's stay time had been reduced, if more shielding had been used, if long-handled tools had been provided, or if more people had been given a larger collective dose in order to reduce the individual's dose. An expert can always apply a cost-benefit analysis focused on just one worker and testify that such steps would cost only a few dollars while greatly reducing his dose. Plaintiffs can then argue that because the utility chose to violate ALARA by "trading dollars for lives," liability ought to be imposed on the utility. These arguments are applicable whether the dose in issue is 1000 mrem or 100 mrem. Thus, with ALARA

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placing in the hands of a lay jury the complex scientific judgments that had already been made by the federal regulators. That is, if a jury is allowed to decide whether a utility used its "best efforts" in keeping radiation releases ALARA, the jury could substitute its own judgment of how a nuclear plant should be run in place of the federal regulator's judgment.

In direct contradiction to *James* and the *TMI* trial court, the Third Circuit rejected

as a standard of care, actual plant efforts to reduce doses to all workers do not effectively reduce the likelihood of litigation. ALARA as a standard of care acts to undermine ALARA efforts in the nuclear industry.

Imposing ALARA as a standard can force almost any case to a jury trial because the court would not be permitted to summarily dismiss the case, even where the plaintiff's dose was *de minimis*.

This can lead to absurd results. For example, the plaintiff in *James* had a cumulative whole body dose of 31 mrem while working at San Onofre for about three years. His dose from natural background radiation for the same time period was between 900 and 1080 mrem. Thus,

if his leukemia were caused by radiation—a proposition that is questionable at best—it is more likely that it was caused by the much greater amount of radiation received from natural background radiation than by the radiation received at San Onofre.

Further, applying ALARA as the standard of care would undercut the very stability that the regulations were designed to provide, because utilities could be held liable for allowing a dose that the regulations specifically labeled as a permissible dose. Such a result would also allow different standards to be imposed throughout the country, depending on a jury's own personal balancing of the ALARA cost/benefit analysis. A jury in California could determine that 300 mrem was too much, a jury in New Jersey could determine 30 mrem was too much, and a jury in Florida could determine that 3 mrem was too much.

In re: TMI stands in great contrast to the *James* decision. In that case, the court correctly reasoned that adopting ALARA as a standard of care "would put juries in charge of deciding the permissible levels of radiation exposure and, more generally, the adequacy of safety procedures at nuclear plants." While jurors are normally well suited to deciding issues that are within their knowledge and experience, in cases dealing with complex scientific issues and where the federal government has already set the permissible dose limits based on the best available scientific evidence, a jury should not be permitted to interfere with the government's decision. This is especially true where, because of widespread misunderstanding of the scientific principles regarding the relative risks of radiation, and the prejudices held by the general public, allowing lay jurors to set the safety limits would unfairly prejudice the case of utility defendants.

Moreover, for those utilities that are operating nuclear power plants within the jurisdiction of the Third Circuit and the Seventh Circuit,² there will be some degree of pre-

²The Third Circuit's jurisdiction covers New Jersey, Pennsylvania, Delaware, and the Virgin Islands; the Seventh Circuit's jurisdiction covers Illinois, Wisconsin, and Indiana.

dictability regarding legal liability for radiation exposures to the work force, or to the general population. For these utilities, the rationale of the *O'Conner* Court—quoted at the beginning of this article—is applicable. Thus, as the Third Circuit stated, "Our holding protects the public and provides owners and operators of nuclear power plants with a definitive standard by which their conduct will be measured." No

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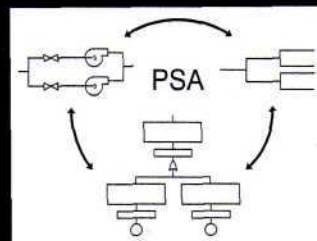
longer should an "operator acting in the utmost good faith and diligence... still find itself liable for failing to meet such an elusive and undeterminable [ALARA] standard."

The *In re: TMI* decision comports with what most professional health physicists have known for years: ALARA is not, and was never intended to be, a tort standard of care. It is a professional philosophy of excellence and a programmatic requirement. As a professional philosophy, all health physicists should strive to achieve ALARA in their work. This means that just like good students strive to obtain and maintain an "A" average, all health physicists must have an ALARA program that strives for an A average on individual and collective doses. If a student receives a B, C, or even a D on a particular test, that does not mean he has failed the course or even that his A average has been destroyed. Thus, when a worker receives 200 millirem, but could have received 100 millirem in some specific instance, this does not mean the utility fails ALARA or is negligent. It only means that excellence was not achieved in that instance.

Utilities are required to have a program to pursue the ALARA philosophy. The NRC has the regulatory authority to impose sanctions and fines for failure to maintain an ALARA program. That is as it should be. Highly technical decisions about excellence in nuclear safety should remain in the hands of the federal regulators who have that particular expertise. Conversely, because juries lack technical knowledge and may be easily swayed by passion, they are particularly bad at policy-making analysis. Thus, it would be improper for a jury to decide policy, such as ALARA.

The role of ALARA in radiation litigation is one of the most important issues in this developing field of law. The erroneous *James* decision illustrates the harm that can be done by a wrong application of ALARA. The *O'Conner* and *In re: TMI* decisions illustrate the benefits to be realized by a proper understanding—and application—of ALARA. As more cases are litigated in this new field of law, it is hoped that courts will follow *O'Conner* and *In re: TMI* while rejecting *James*. ■

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