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ANI/MAELU ENGINEERING INSPECTION CRITERIA
8.3 ALARA

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ABSTRACT

The purpose of this criteria section is to provide guidelines for programs whose intent is to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

The success that has been achieved by applying ALARA concepts at nuclear power plants is clearly illustrated by the major reductions in the annual cumulative dose to workers at many sites over the last few years. This success is the combined result of the general maturity of the nuclear industry, the intensive study of dose reduction practices by industry groups, and the successful sharing of experience and practices among plants.

Source term reduction should be used as a primary ALARA mechanism. Methods which should be considered include: stellite and cobalt reduction, chemistry control, decontamination, submicron filters, zinc addition, hot spot reduction and permanent or temporary shielding.

Certain chemical control practices and operational activities can help to minimize the buildup of radioactivity on primary system piping and components. Specific ALARA practices should include the following:
failed-fuel action plans; consideration of increased exposure levels from hydrogen water chemistry (HWC) implementation; evaluations of "soft" shutdown techniques; and robotics.

The criteria presented in this section are derived by considering the parameters that affect dose, the variables that exist in station design and operation and the functions that can be addressed by station administrative actions. The Criteria are organized by the general areas or activities where ALARA practices can be effectively applied. These include:

- Management Commitment;
- ALARA Organization;
- Procedures;
- Goals;
- Work Planning;
- Feedback;
- Training;
- Engineering and Design;
- Source Term Reduction; and
- Specific Practices.

DISCLAIMER

BACKGROUND

The purpose of this criteria section is to provide guidelines for programs whose intent is to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

An effective ALARA program is, at its core, the practice of good health physics by all station workers and management. The health physics community has long recognized the prudence of avoiding unnecessary exposure to radiation and maintaining personnel exposures ALARA. The ALARA concept has evolved over the years. The concept during the early 1980's was at many sites a review function, separate from major plant activities. The relevant NRC Regulatory Guides 8.8[1] and 8.10[2] were generally prescriptive in nature, and were used in a "cook book" manner to determine the necessary elements, from a regulatory point of view, of an acceptable ALARA program.

The success that has been achieved by applying ALARA concepts at nuclear power plants is clearly illustrated by the major reductions in the annual cumulative dose to workers at many sites over the last few years. This success is the combined result of the general maturity of the nuclear industry, the intensive study of dose reduction practices by industry groups, and the successful sharing of experience and practices among plants.

The newly revised 10 CFR 20 Standards for Protection Against Radiation; Final Rule[3] published May 21, 1991, in the Federal Register established a requirement to formulate a program that would address ALARA for occupational doses and doses to the public. This requirement is stated in 10 CFR 20.1101 Radiation Protection Programs (b):

The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

The details of these procedures and engineering controls are left to the individual utility to develop and implement.

The new Part 20 defines ALARA in 20.1003 Definitions:

ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

The "Total Effective Dose Equivalent (TEDE) ALARA" concept is one of the more significant new features introduced in the new Part 20. For example, a prospective "TEDE ALARA" evaluation should compare the additional DDE (deep-dose equivalent) estimated to be received because of the assumed reduced work efficiency due to wearing a respirator versus the estimated CEDE (committed effective dose equivalent) that is likely to result from an assumed intake if a respirator is not worn. Other nonradiological work place conditions should be considered. Documentation of prospective evaluations should include quantitative guidelines for each task and job which exceeds the individual or collective DDE guidelines established by each plant.

The primary ALARA objective is to reduce occupational exposures as far below the specified limits as is reasonably achievable. "Reasonably achievable" should be judged by considering the state of technology and the economics of improvements in relation to the projected benefits from these improvements. "Reasonable cost" has not been determined fully in terms of dollars per person-rem: Appendix I of 10 CFR 50,[4] codified in 1975, established, the values of \$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) as a figure to be used in cost-benefit analyses. It should be noted that the Appendix I criteria are applicable to doses to the general population. In practice, individual utilities are defining their own cost-benefit analysis values. Cost-benefit and optimization analyses are effective ALARA decision making tools, but they are highly dependent on assumptions, including the magnitude of the critical dollars-per-person-rem value used by nuclear power plants.

Recent ICRP publications have focused increased attention on the quantitative aspects of ALARA. ICRP 37[5] deals in detail with cost-benefit analysis and the optimization of radiation protection. The ICRP refers to the ALARA concept as the "optimization principle", which states that "all exposure shall be kept as low as reasonably achievable, economic and social factors being taken into account." ICRP 55[6] starts from the general concept of optimization of protection and shows how it can be implemented at different levels of decision and in different contexts using appropriate techniques, one of which is cost-benefit analysis. Optimization is the ICRP's term for ALARA. Some argue that they don't mean exactly the same thing, but ICRP disagrees:

It is now clear that *"keeping all exposures as low as reasonably achievable"*, *"optimization of protection"* and *"ALARA"* are identical concepts within the ICRP system, even though the acronym 'ALARA' is not used by the Commission [the ICRP].[7]

The principle of reduction of exposures to levels that are ALARA is normally implemented in two ways. First, it may be applied to the design of facilities and modifications so as to reduce, prospectively, the anticipated exposure to workers. Second, it may be applied to actual operations so that work practices are designed and carried out to reduce the exposure of workers.

NUREG/CR-4254[8] addresses an examination of high-dose jobs, reliable equipment selection, radioactive waste handling improvements, and ALARA incentives at nuclear power plants.

EPRI's Radiation-Field Control Manual - 1991 Revision[9] identifies the following techniques among others, performed during various phases of a nuclear power plant cycle, as highly cost-effective in reducing occupational radiation exposure:

- Before power raising (startup): For BWRs, replace cobalt alloys in control blades, electropolish recirculation piping surfaces, and control oxygen during hot functional tests. For PWRs, electropolish channel heads and control chemistry during hot functional testing.

- During operation: For BWRs, minimize feedwater iron input, improve reactor water quality, and use zinc injection. For PWRs, control pH and use early boration or peroxide addition at shutdown.

- Refueling: Use low-cobalt materials in replacement fuel and cobalt-free pins and rollers in BWR control blades; use Zircaloy grids in replacement fuel for both types of reactors.

- Maintenance: For BWRs and PWRs, replace valves being refurbished with cobalt-free hardfacing alternatives and improve valve maintenance procedures to maintain cleanliness and remove debris.

- Special maintenance and repairs: For BWRs, decontaminate old piping, electropolish new piping, and pre-condition or water prefilm replacement piping. For PWRs, decontaminate, electropolish channel heads, and use low-cobalt Inconel for replacement steam generator tubing.

Plant life extension: For BWRs and PWRs, decontaminate the complete primary system.

The criteria presented in this section are derived by considering the parameters that affect dose, the variables that exist in station design and operation and the functions that can be addressed by station administrative actions. The Criteria are organized by the general areas or activities where ALARA practices can be effectively applied. These include:

- Management Commitment;
- ALARA Organization;
- Procedures;
- Goals;
- Work Planning and Scheduling;
- Feedback;
- Training;
- Engineering and Design;
- Source Term Reduction; and
- Specific Practices.

MANAGEMENT COMMITMENT

Management's commitment to ALARA should be formally stated in Corporate policy and evident in the resources provided and in the day-to-day conduct of plant operations. Senior Corporate and Plant Management should strongly support the ALARA program by becoming personally involved in monitoring radiation protection performance and holding workers, supervisors, and line managers accountable for their ALARA performance. ALARA outage coordination should be organizationally established.

ALARA ORGANIZATION

An organization with sufficient responsibility and staffing should be established to ensure that management's ALARA commitment is met. ALARA reporting responsibilities should be clearly delineated and assigned to a qualified professional with the authority to coordinate the ALARA program development and implementation. An ALARA committee (or equivalent) to coordinate activities is suggested.

PROCEDURES

The ALARA program including all important ALARA functions and methods should be described in plant policies and procedures. Procedures should describe those ALARA records, including ALARA reviews, audits, and documentation, which should be retained in accordance with ANI/MAELU Bulletin 80-1A.[10]

GOALS

Goals are established and used to determine the degree of success and to ensure consistent performance to the ALARA philosophy. Management should establish and review the achievement of challenging quantitative goals for collective radiation exposure per year, for outages, and for major or repetitive jobs. Significant variations from goals should be evaluated by management. A summary of plant performance relative to the ALARA goals should be provided to plant and corporate management on an annual basis. Periodically, goals should be re-evaluated in light of developing industry experience.

WORK PLANNING AND SCHEDULING

Appropriate planning for ALARA should be conducted for all work activities. Planning activities which should be considered include: surrogate (computer visual) tours, system walkdowns, pre-job briefings, shielding considerations, and interdepartmental interfacing with maintenance scheduling and planning, outage planning, and design and modification packages. Threshold levels should be established for cumulative and per-job exposures, above which ALARA planning should be conducted.

FEEDBACK

Feedback mechanisms should be in place to ensure that reviewing, commenting on and recommending changes to jobs and procedures based on lessons learned are routine station practices. Typical mechanisms are: ALARA program effectiveness and compliance audits, plan-of-the-day meetings and ALARA reports. Effective ALARA feedback provides the opportunity to benefit from experience in improving future performance. Job specific reviews include the identification and documentation of successes, problems, lessons learned, and specific recommendations for improvements identified in post-job debriefs.

TRAINING

Plant personnel should receive ALARA training appropriate to their position or job to ensure that management's commitment is met and that ALARA policies and procedures are implemented. Groups receiving targeted training should include, General Employees, HP technicians, operations and maintenance personnel, engineering and management. ALARA personnel should participate in industry ALARA meetings, as appropriate. ALARA training should include the use of dry runs and mockups as appropriate.

ALARA training is covered in Section 2 of ANI/MAELU Engineering Inspection Criteria.[11] The ALARA provisions which have been incorporated into the various sections of the ANI/MAELU training criteria are summarized below.

General Employee Training

- ALARA objectives and station ALARA policy
- Basic exposure reduction methods
- The manner in which the ALARA program is implemented at the station
- The importance and responsibility of individual workers to maintain their doses ALARA

HP Technician Training

- ALARA concepts
- ALARA program and procedures
- ALARA responsibilities
- Job review and coverage
- Dose reduction techniques and job/craft specific instructions to reduce dose

Operation and Maintenance Technical Training

- The ALARA concept and its purpose
- ALARA responsibility and incentives
- ALARA techniques such as planning and briefings, use of mock-ups and decontamination
- Importance of utilizing the technical services and advice of the radiation protection staff

Engineering ALARA Training

- Design review and design considerations including radiation exposure considerations in selection and placement of equipment (reliability, maintainability, accessibility)
- Dose reduction techniques including radiation exposure considerations in building layout, radiation zone control, ventilation control, operation and maintenance
- Cost effectiveness evaluation methods

Management Staff

- Importance and overall justification of the ALARA program
- Procedures for evaluating ALARA performance
- Importance of utilizing the technical services and advice of the radiation protection staff
- Management system for ALARA program implementation, goal development and measurement, and performance evaluation

ENGINEERING AND DESIGN

Design, both initial and in the form of plant modifications, plays an important role in maintaining personnel exposures ALARA. USNRC Regulatory Guide 8.8[1] provides guidance on design features which can contribute to ALARA.

USNRC Regulatory Guide 8.19[12] provides a mechanism to project, during the design stage, the estimated annual radiation exposure to station personnel. Person-rem estimation is also an important part of the overall, ongoing radiation protection review of dose-causing activities to reduce exposures. The dose estimation process requires a working knowledge of the principal factors contributing to exposure, and methods and techniques for dose reduction.

Programmatically, ALARA involvement in the design process should take two principal forms. ALARA specialists should be involved in the design/modification review process for the purpose of applying their specialized expertise towards the identification of design features which can be cost effectively incorporated and result in significant dose savings. Their involvement in this process sets up an ALARA advocacy. ANI/MAELU also believes that personnel with ALARA responsibility should take an active position with respect to design by proposing modifications and design changes which can result in cost effective dose savings.

Certain PWR plant modifications, such as main coolant RTD bypass piping removal, have been effective at removing so-called crud traps which increase radiation fields by allowing activated corrosion products to accumulate.

SOURCE TERM REDUCTION

Source term reduction should be used as a primary ALARA mechanism. Methods which should be considered include: stellite and cobalt reduction, chemistry control, decontamination, submicron filters, zinc addition, hot spot reduction and permanent or temporary shielding.

Cobalt Reduction

An aggressive cobalt reduction program involves minimizing cobalt impurity in structural materials; eliminating cobalt from in-core materials, particularly fuel and control rod drive mechanisms; and substituting cobalt-free hardfacing alloys for the "Stellites" typically used in nuclear plant valves. There have been renewed efforts to develop low-cobalt or cobalt-free alloys as alternatives to the cobalt-based alloys in order to reduce exposure of maintenance personnel to Co-60.[16]

EPRI NP-6708[16] addresses recent advances in radiation-field control techniques which contribute to reduced occupational radiation exposures. There are four aspects of radiation field control which correspond to the fundamental processes involved in activation, transport, and deposition of wear and corrosion products in primary systems. The most successful control programs feature at least three of the four methods listed below:

- Controlling the source,
- Controlling transport and activation,
- Controlling out-of-core deposition, and
- Decontamination

Chemistry Control

Water chemistry control has an indirect, multi-faceted and important impact on radiation exposures to workers. Good water chemistry is the key to minimizing the formation and release of corrosion products into reactor water. It is notable that there is a strong correlation between absence of radiation hot spots in crud traps in BWRs and good water chemistry. Minimizing impurities in BWR reactor water via feedwater, pH control, condensate polishing and Reactor Water Cleanup operation is essential to controlling radiation field buildup. For PWRs, pH control is crucial to minimize shutdown radiation fields.[16]

PWR shutdown radiation fields are primarily the result of cobalt isotopes 58 and 60. Co-60 is formed by neutron capture of naturally-occurring Co-59 which is found throughout PWR materials as impurities (steam generator tubes) and hardening alloys (valves). Nickel is a major component of alloy 600 steam generator tubes and, when activated, becomes Co-58. These elements are released to the primary coolant by wear and corrosion processes. As the coolant is transported into the core the elements are activated and then deposited throughout the reactor coolant system.

The higher the coolant pH in PWRs can be maintained the lower corrosion product release and transport rates will be. Lithium hydroxide is added to increase pH, but its effect is limited by boric acid used for reactivity control and restricted by the potential for accelerated fuel clad corrosion. In particular, raising the pH from the previously typical 6.9 to 7.1-7.4 (by increasing lithium concentration) has been effective. Swings in pH due to lithium fluctuations have also been observed to contribute to radiation field buildup, so precise controls are important.

During PWR plant startup and shutdown, coolant chemistry can also be controlled to enhance radioactivity release and removal. Hydrogen peroxide or other oxygenating agents are added to speed up the release of cobalt from the core. Without doing so, the release would occur when the vessel head is removed, leading to increased dose rates during refueling operations. Reactor coolant and purification system flow should be maximized to enhance corrosion product removal. Boron concentration should be increased to refueling concentrations as soon as possible to achieve acidic, reducing conditions which dissolves nickel and cobalt from non-core surfaces.

Close coordination at all times between operations, chemistry, radiation protection and outage planning personnel is necessary to ensure the success of chemistry regimes designed to reduce radiation fields. Radiation Protection personnel need to be especially aware of planned chemical injections which may change dose rates significantly until released corrosion products are removed.

EPRI has coordinated development of two consensus guidelines (*PWR Primary Water Chemistry* and *PWR Primary Shutdown and Startup Chemistry*) which incorporate the latest research results and plant experience necessary to develop a plant specific program.

Decontamination

Decontamination is gaining increased acceptance within the nuclear industry as a cost effective method to reduce out-of-core radiation fields. Considerable resources have been directed toward utilizing chemical decontamination techniques to reduce radiation exposures during special maintenance and ISI work. Decontamination technology has been successfully used in BWR recirculation system piping repair, PWR steam generator maintenance, and other partial system applications.

Beyond partial system application is chemical decontamination of the entire primary system. A full-system decontamination (FSD) qualification program is being developed by EPRI and several U.S. utilities. Once FSD has been qualified and demonstrated, it should help utilities achieve lower exposures.

Mechanical decontamination methods are applied when the exposed surfaces are easily accessible. Some examples are:

- High pressure jet spalling;
- Abrasive blasting (e.g. ice, carbon dioxide, plastic bead);
- Ultrasonic cleaning;
- Liquid honing;
- Strippable coatings; and
- Vacuuming (wet or dry).

Submicron Filters

The use of fine, absolute rated filters to reduce corrosion product transport in the primary system can be effective in the decrease of out of core radiation fields. A substantial fraction of activated corrosion products exist as sub-micron particles. Submicron filtration increases the removal of radioactive corrosion products or the removal of corrosion products prior to activation. The 20 micron (nominal) pore size of early days of PWR operation has given way to pore sizes as low as 0.2 micron in systems such as Chemical Volume Control System, Seal Water, Boric Acid, Spent Fuel Pool/Reactor Water Purification Systems and Radwaste.

Zinc Addition

The addition of zinc to the primary system of BWRs may reduce the cobalt plate- out on primary piping and, therefore, reduces dose rates from the piping.

Specific Practices

Certain chemical control practices and operational activities can help to minimize the buildup of radioactivity on primary system piping and components. Specific ALARA practices should include the following:

failed-fuel action plans; consideration of increased exposure levels from hydrogen water chemistry (HWC) implementation; evaluations of "soft" shutdown techniques; and robotics.

Failed Fuel

Care should be taken to prevent fuel damage by proper primary chemistry and by an aggressive program to prohibit any loose parts or foreign objects from getting into the primary system during maintenance and refueling operations.

HWC

Several BWRs have implemented HWC to protect reactor piping and vessel internals from stress corrosion cracking with a subsequent increase in radiation field dose rates. An evaluation should be performed to address the increased radiation field intensity resulting from HWC implementation.

"Soft" Shutdown

The nature and magnitude of activated corrosion product spiking following shutdown of a BWR are functions of a plant's specific water chemistry as well as shutdown procedures and subsequent steps during an outage. The U.S. BWR industry experience has shown that a "soft", controlled shutdown which minimizes boiling in the core and maximizes cleanup is effective in reducing plant radiation levels. Guidelines for reducing the concentration of activated corrosion products in reactor water during refueling outages have been suggested. These corrosion products and associated activities can affect outage work adversely in several ways. For example, they can:

- Increase dose rates on the primary system and the refueling floor, increasing personnel exposure;
- Delay refueling activities by reducing water clarity and, therefore, visibility; and
- Contaminate reactor cavity walls and/or other components in the pool, requiring decontamination at the end of the refueling outage.

To reduce the exposure to maintenance personnel during outages, it is suggested that to the extent practicable, the U.S. BWR industry consider the suggested guidelines when planning shutdowns.

Robotics

Robotics, automated equipment, and remote reading instrumentation should be used where practical such as for steam generator channel head entries, reactor coolant pipe welding, decontamination, and surveillance in high radiation areas.

CRITERIA

Management Commitment

8.3.1 Management's commitment to ALARA should be formally stated in Corporate policy and evident in the resources provided and in the day-to-day conduct of plant operations.

ALARA Organization

8.3.2 An organization with sufficient responsibility and staffing should be established to ensure that management's ALARA commitment is met.
8.3.2.1 ALARA reporting responsibilities should be clearly delineated.
8.3.2.2 An ALARA committee (or equivalent) to coordinate activities is recommended.
8.3.2.3 Outage coordination should be organizationally established.

Procedures

8.3.3 The ALARA program including all important ALARA functions and methods should be described in plant policies and procedures.

8.3.3.1 Procedures should describe those ALARA records, including all ALARA reviews, which should be retained in accordance with ANI/MAELU Bulletin 80-1A.[10]

Goals

8.3.4 Management should establish and review the achievement of challenging quantitative goals for collective radiation exposure per year, for outages, and for major or repetitive jobs. Significant variations from goals should be evaluated by management.

Work Planning

8.3.5 Appropriate planning for ALARA should be conducted for all work activities.

8.3.5.1 Threshold levels should be established for individual, cumulative, and per-job exposures, above which ALARA planning should be conducted.

Feedback

8.3.6 Feedback mechanisms should be in place to ensure that reviewing, commenting on and recommending changes to jobs and procedures based on lessons learned are routine station practices.

8.3.6.1 Post-job debriefs should be conducted whenever ALARA planning was conducted or whenever an unexpected exposure or a significant problem was encountered.

8.3.6.2 ALARA program effectiveness and compliance audits should be conducted.

Training

8.3.7 Plant personnel should receive ALARA training appropriate to their position or job to ensure that management's commitment is met and that ALARA policies and procedures are implemented.

8.3.7.1 ALARA personnel should participate in industry ALARA meetings.

8.3.7.2 ALARA training should include the use of dry runs and mockups as appropriate.

Engineering and Design

8.3.8 Engineering designs and modifications should be reviewed for the purpose of identifying cost-effective changes which would result in reduced personnel exposures.

Source Term Reduction

8.3.9 Source term reduction should be used as a primary ALARA mechanism.

8.3.9.1 Source term reduction methods should include: chemistry control, stellite and cobalt reduction, hot spot reduction, and chemical decontamination of systems.

8.3.9.2 An operational reactor coolant chemistry control program should be developed which minimizes the release, activation, transport and deposition of corrosion products which lead to increased dose rates.

8.3.9.3 A plant-specific shutdown and startup primary chemistry control program should be developed which maximizes the release and removal of radioactivity.

8.3.9.4 Primary system filtration and ion exchange system improvements to enhance radioactivity removal should be evaluated.

- Ensure purification systems are reliable and maintained on line to the fullest extent within operational constraints.
- Evaluate the use of improved filter designs, submicron filters and ion exchange to enhance the removal of corrosion products.

8.3.9.5 Radiation Protection should be notified before performing chemical transients which could change dose rates.

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Author Biography

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DISCUSSION

Uchida: The career and personal exposure record, along with health inspection record, are they available using a person's social security number or something like that?

Schneider: ANI has an engineering information bulletin (80-1A) that deals with records retention. Before the new part 20, all records - Form 4, "Occupational External Radiation Exposure History; Form 5, "Current Occupational External Radiation Exposure;" and termination reports were obtainable by request from the utilities or the NRC. Under the new part 20, plants are not required, except for planned special exposures, to obtain the total previous lifetime exposure of individuals, although ANI still suggests that it be done and maintained. We have a bulletin that really addresses all the things that we want there, and I will make that available to you.

Crouail: Did you break any contract of insurance with utilities because of nonobservance of ALARA guidelines?

Schneider: No, we have not since the implementation of the pools in 1957. In the U.S., to do that under the Price-Anderson Act and the federal regulations (10 CFR part 140), the utility would have to shutdown and look at either self-insuring or getting some other avenue of insurance. Right now, we provide the only nuclear liability insurance. To terminate a policy would result in a highly political situation, and we have had good success when needed to really achieve what we wanted without having to do that. That avenue would be available.

Baum: A related question -- how are the statistics on litigation? Are we getting many cases per year, and how many are being fought?

Schneider: We just received our 166th claim. I'm sure you've heard about the claim at San Onofre, what we call the "Tang case." A female NRC inspector brought a suit against our insured, and that was the 165th claim. What I'm going to say on this is that those of you who can make it to the joint BWR-PWR Owner's Group Meeting in July in Denver can hear Jerre Forbes, who is our Technical Director of Liability Claims make a presentation on litigation claims. I'm not authorized to say a lot about the claims ends of things. Roughly all but 30 of the 166 claims have been closed since the inception of the Pools in 1957. Actually, we had fewer than 40 claims through TMI in 1979, and we've had this rise to 166 since. The following does not represent ANI's position, but I personally feel that it's going to get tougher, and that we are going to see more claims without a lot of technical merit, but we will have to see what emerges.

Miller: Thank you, Leland. I would say even though his criteria are only guidelines, they are very helpful for the ALARA person in the field because you can reference those guidelines as requiring RP to be notified when major changes occur. Although I would also clarify that he normally would not cancel you, but as a customer, he can add a surcharge above the average $500,000 base premium for a typical unit plant, based on nine engineering parameters. We call them penalties. They can raise the premium approximately $50,000 or $60,000 per year. Eight of the nine subfactors are radiological or dose-related items.