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Nuclear Materials Research and Technology

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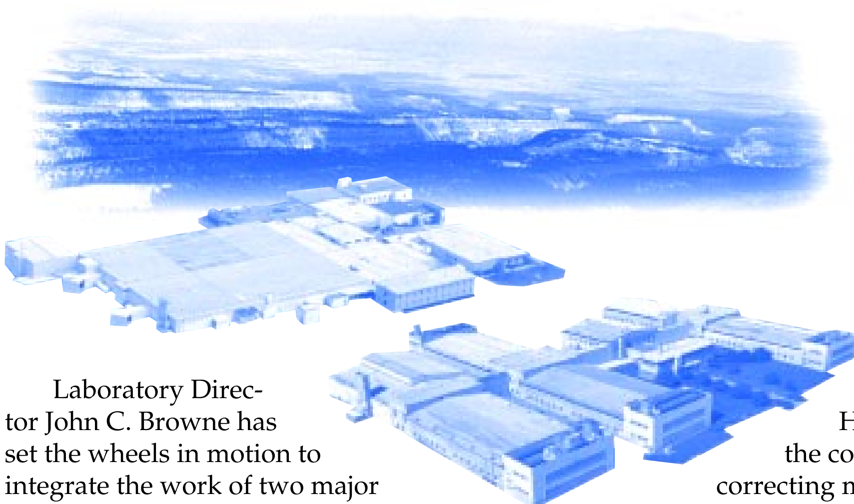
In This Issue

Actinide Research Elements at CMR Building Will Be Integrated Into NMT Division

Personnel affected by the integration of some parts of the Chemical Science and Technology (CST) and Materials Science and Technology (MST) Divisions into NMT Division have been briefed. This article addresses the larger picture for Actinide Research Quarterly's *broader readership including our customers and others who have a stake in our business.*



Laboratory Director John C. Browne has set the wheels in motion to integrate the work of two major nuclear facilities, the CMR Building and Technical Area 55—the Plutonium Facility—under a single management structure. When the integration is complete, the Laboratory will be better able to fulfill its mission as steward of the nuclear weapons stockpile and to reduce the global nuclear danger while successfully meeting the challenges of operating nuclear facilities in today's regulatory environment.

The Los Alamos National Laboratory is the only place in the nation now that can do weapons work for the Department of Energy's Defense Programs Office (DOE/DP) with plutonium, the basic material of the nation's nuclear weapons. Other facilities such as those at Rocky Flats and more recently at Livermore have ceased their work, other than basic research, with plutonium. It is therefore imperative that weapons-plutonium-related work at the Laboratory be accomplished to the highest standards to preserve that capability.

In the late 1980s and early 1990s the Defense Nuclear Facilities Safety Board (DNFSB) was charged by Congress with the oversight of the nation's nuclear weapons complex. The DNFSB, along with DOE/DP and the DOE Environment, Safety, and Health Office scrutinized the complex with the goal of correcting many of the problems the complex was confronting at the time. In 1994, under this scrutiny, the management of TA-55 voluntarily stood down operations at TA-55 to evaluate the facility's safety as it affected workers and the public. The short-term result was a drop in productivity, but the long-term result, once work resumed, was enhanced performance in all aspects of the facility operation. The improvements in efficiency, productivity, and safety are largely a result of following "formality of operations," including well thought-out planning for both research and production activities and adherence to carefully considered, approved operating procedures, balanced according to hazards. The Plutonium Facility is now recognized by the DNFSB as "best-in-class" for implementing integrated safety management in a nuclear materials research and development environment.

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Actinide Research Elements at CMR Building Will Be Integrated Into NMT Division *(continued)*

The experience of TA-55 in making these improvements will be brought to bear on operations at the CMR Building involving actinide materials. The building is 45 years old and suffers from a long-term lack of funding to maintain and modernize it to present standards. Around 1984 the Laboratory proposed a new Special Nuclear Materials Laboratory (SNML) to replace the CMR Building; however, the SNML project was put on hold indefinitely. Instead, a decade later, a decision was made to upgrade the CMR Building. The difficulties of identifying the building's deficiencies and estimating the cost to overcome them, as well as an evaluation of formality of operations in the building, has drawn serious criticism from the DNFSB, the DOE, and the University of California, and essentially a vote of "no confidence" that actinide work within the building could be done safely with long-term consistency. This was even after operations in the building stood down to improve formality of operations and then began to restart as a number of improvements were made. The DOE identified the management of multiple divisions and groups performing actinide R&D in the building as an impediment to the Laboratory's ability to sustain the necessary level of formality of operations. This opinion was shared by a group of external nuclear facility experts who have been providing a mentoring service to the Laboratory since the TA-55 shutdown.

Thus, the decision was made to incorporate the major nuclear material and actinide analytical chemistry activities of both the TA-55 and CMR operations, which include some aspects of both CST and MST as well as NMT. Further, the NMT Division is now under the Laboratory's Associate Director for Nuclear Weapons. The resulting organization will be patterned around the most successful elements and technical capabilities in plutonium and uranium metallurgy, actinide chemistry, and actinide ceramics of each division to support stockpile stewardship, actinide R&D, legacy cleanup, nuclear materials management, environmental and waste management, nuclear materials disposition, and nuclear energy programs.

The overall guiding principles of the integration are safety first; efficient integration of people, projects, and capabilities; and operational excellence. The new organization should result in improvements to existing capabilities and performance, ensuring regulatory compliance and safe operations and fulfillment of opportunities to reduce costs and increase efficiency.

The CST and MST divisions will remain strong Laboratory divisions making significant contributions to the Laboratory's mission and programs. Actinide projects funded by Laboratory-Directed Research and Development funds will be coordinated through the Seaborg Institute (see Winter 97-98 issue of *Actinide Research Quarterly*, p. 9).

Under the reorganization, the CMR Building is expected to function as a multiprogram institutional facility capable of supporting Laboratory missions for the next ten years. As the work in the facility becomes more productive, it is expected to draw increasing program support and projects, which will, in turn, enhance the CMR Building's technical capabilities in actinde research. The integration will eliminate redundancies in infrastructure as well as in technical and programmatic activities. The goal will remain for the newly integrated NMT Division to provide on-schedule, in-budget delivery of projects to its customers.

"The combined materials and chemistry capabilities and the intellectual power housed in these two facilities (TA-55 and CMR) are essential for the continued success of DP's stockpile stewardship programs at Los Alamos."

Vic Reis, Assistant Secretary for Defense Programs, Department of Energy

Reported by **Ann Mauzy,** CIC-1.

Process Control and Instrumentation Can Improve Efficiency

The Plutonium Facility (Pu Facility) at Los Alamos National Laboratory is the premiere facility in the nation for process-scale plutonium research and development. The projects and processes ongoing at this facility require a wide variety of instrumentation and electronic configurations. Frequently, systems require some type of computer control or monitoring, sometimes a complete process control system. Instrumentation- and wiring-related problems occur, especially as equipment ages.

The Nuclear Materials Technology Division has a Process Control and Instrumentation (PC&I) Team that addresses these issues for the entire Pu Facility. This team provides electronics and instrumentation support, a vital part of keeping the facility functional. This support includes supplying and ordering parts, hardware, and software, wiring, electronic design and fabrication work, panel construction, electrical and electromechanical drawings (including those required for the facility), making and installing feedthroughs and cables, and responding to a wide variety of troubleshooting and repair scenarios. A significant amount of this work requires our workers to be certified to perform work on energized systems. The team also provides advice on electronics, instrumentation, electrical systems, instrumentation, electrical safety, computers, and computer networking.

The PC&I Team has developed a Windows NT computer network for the transfer of process and project data between the process facilities within the Plutonium Facility and the surrounding administrative buildings and has recently created an interface between this network and the popular Web browsers. The team provides a variety of computerized process-monitoring and control systems for various projects. The figure shows one such process, nitric acid evaporators, and the attendant process control screen. Data archival and tracking trends in real-time, along with the actual control of various aspects of a process, are very important because they usually lead to improved process efficiencies. These systems typically consist of programmable logic controller (PLC) hardware for data acquisition and control, software to program these controllers using "ladder logic" programming, human-machine interface (HMI) that provides the operators with an easy-to-use comprehensive interface to their sensors and process as a whole, and a personal computer that interfaces all the pieces of the control system together. The components are not the only important parts of a successful control system. Initially, what the customer wants in a control system must be interpreted and documented. In addition, the overall control system must be well documented for operators as well as for control system developers.

The following are examples of control system projects completed by the PC&I Team. A new furnace controller system has been developed for use in the Pu Facility. Furnace controllers are widely used for various operations that require heating of material or objects to high temperatures (e.g., 800˚C). Historically, the Pu Facility has used a wide variety of furnace controllers. Some of these are old and are in frequent need of repair. There are also some newer furnace controllers, but unfortunately they are typically difficult to configure and operate.

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Nitric acid evaporators showing a process control screen in the foreground. The Process Control and Instrumentation Team provides a variety of computerized process-monitoring and control systems for this and various other projects.

This article was contributed by **Howard Nekimken,** NMT-2.

Laboratory Demonstrates Success in Managing Nuclear Materials Inventory

When the Cold War ended in 1991, the Department of Energy (DOE) stopped its historic practice of producing plutonium for nuclear weapons. Facility missions were changed and budgets were dramatically reduced. Tons of plutonium destined for warheads were left in place, much of it in forms and facilities not suited for long-term storage. For the past three years and under the auspices of the Defense Nuclear Facility Safety Board (DNFSB) Recommendation 94-1, the DOE has been addressing the potential environmental, safety, and health hazards posed by this legacy nuclear material. The recommendation recognized the imminent safety concerns associated with stored nuclear materials whose condition, packaging, and storage situations may no longer meet current safety guidelines. It was especially focused on specific liquids and solids containing fissile and other radioactive materials in spent fuel storage pools, reactor basins, reprocessing canyons, processing lines, and the various buildings once used for chemical processing and weapons manufacture. In essence, the recommendation stated the following:

NMT-7 employees Davy Sparks and Charles Lehman cement evaporator bottoms produced from a nitric acid evaporator. "At risk" materials are stabilized by processing through aqueous recovery lines. The resulting spent nitric acid is processed through the evaporator and the cement process as part of final acid disposition.

> On a high-priority basis, a program plan will be formulated to convert high-vulnerability items to forms or conditions suitable for safe interim storage within two or three years. And within a reasonable period of time (such as eight years), all storage of metal and oxide will be in conformance with the DOE criteria for the safe storage of plutonium metal and oxides (DOE-STD-3013).

Throughout the history of the Los Alamos Plutonium Facility, the operational strategy has been to recycle both primary and secondary plutonium residues through aqueous recovery operations for actinide separation and recovery. With the mission of the 1980s to increase the amount of pure plutonium metal feed sent to the Rocky Flats weapons manufacturing program, it was simply not feasible to take the time to recover plutonium from lean process residues. In addition, research and development activities supporting technology transfer programs also produced numerous lean residues that were not slated for immediate plutonium recovery. As a result, when the Cold War ended, Los Alamos had a total transuranic inventory of some 9,300 residue packages containing a plutonium inventory of ~2,600 kg. Out of this total, about 8,600 residue items were subject to the stabilization requirements of Recommendation 94-1. Approximately 90% of the item count was plutonium, with the remainder consisting of plutonium-contaminated depleted and enriched uranium, uranium-233, curium, berkelium, californium, neptunium, and isotopes of americium.

The approach we have taken to respond to Recommendation 94-1 is to prioritize the legacy residue inventory based on real or perceived worker-safety risk and then utilize our actinide separation and processing capability to stabilize these materials, especially those “at-risk” material categories with demonstrated material instabilities or packaging defects. For us, stabilization is the separation and recovery of the nuclear material for either programmatic use or for packaging to meet the DOE long-term metal and oxide storage criteria, DOE-STD-3013. After separation the matrix material associated with the nuclear material in the residue is declared a waste and is packaged as transuranic waste for ultimate transfer to the Waste Isolation Pilot Plant.

For the past three years we have stabilized certain “at-risk” material categories, as well as other categories posing some risk to the worker, and we have packaged plutonium metal and oxide for either programmatic use or for long-term storage. Because the "at-risk" material categories have a history of demonstrated material instabilities or packaging defects, they take the majority of our stabilization emphasis (see figure at left). To date, we have stabilized over 3000 items out of a legacy inventory of over 8500 items, we have prepared over 500 kg of plutonium metal and over 100 kg of plutonium oxide for long-term storage, we have prepared over 100 packages meeting the DOE-STD-3013 storage standard, and we have recovered over 200 kg of plutonium (as oxide) from residue sources (see figure at right).

Because this is a long-term program, it became evident very early that understanding the aging phenomena of our inventory would become a very important tool in prioritizing material for stabilization and in being able to anticipate any safety risk to the worker when handling these materials in the vault or in other areas outside of glove box lines. We have taken advantage of ongoing programs, and we have initiated new programs to gather data to fill gaps in our knowledge about how packages age, to validate our processing priorities, and to continue increasing the margin of safety afforded our plutonium workers.

To gain relevant knowledge about the aging phenomena of our legacy inventory, we have instituted a sampling plan whereby on an annual (or more frequent) basis we randomly sample vault items for inspection as well as inspecting the package condition of the materials currently undergoing stabilization. The inspection consists of evaluating the condition of the inner package inside the container stored in our vault. We are primarily interested in failed "bagout" bags (contamination on the inside of the outer container) or some condition of the inner package that causes us to suspect that the item or that the entire material category is unsuitable for continued storage in the vault as is. To date, we have an inspection database of over 2500 items, and after analysis and modeling, we feel we have significantly reduced the uncertainty in our conclusions about worker-safety risk and also have used these data to validate or change our material stabilization and processing priorities. Since the overall response to the DNFSB Recommendation is long-term (eight years or longer), this continued inventory evaluation and any resultant schedule reprioritization is necessary to continually understand and improve the margin of safety afforded our plutonium workers.

Beginning in FY98, as a result of diminishing DOE budgets and expanding Departmental programmatic requirements, the formal response to Recommendation 94-1 underwent a dramatic change. It underwent an evolution from a program addressing only legacy inventories to one with a more integrated approach to managing the entire nuclear material inventory at the Laboratory—both the legacy and the newly generated residue inventories. Very recently, the DOE approached the DNFSB with this integrated plan for managing the nuclear materials inventory at the Laboratory. Because of our demonstrated success over the past three years in stabilizing residues and packaging metal and oxide, and because of our demonstrated success in understanding the worker-safety risk of our aging inventory, we were successful in obtaining a schedule extension from 2002 to 2005 for stabilizing the legacy materials.

This new schedule is important for several reasons: it allows us to increase staff at a manageable level, it allows us to perform much-needed maintenance and replacement of aqueous processing equipment and other elements of the project infrastructure, it allows us to focus resources on the selective processing of materials currently occupying premier vault storage locations, and it provides us the ability to support more effectively the other programs at TA-55 while still reducing to zero the worker-safety risk surrounding the legacy inventory. Most importantly, however, it allows the DOE Defense Programs Office to use our Plutonium Facility effectively for many of its programs that affect national security.

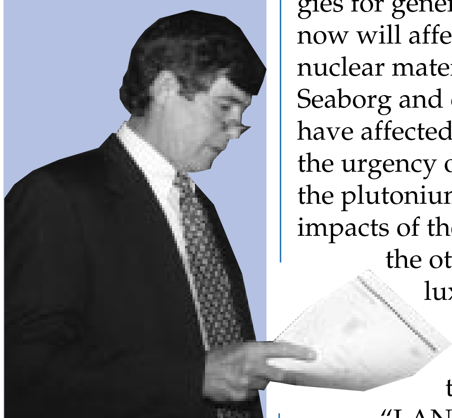
Materials stored in the vault, such as these cans of residue, are sampled on a regular basis to assess the stability of the material and the inner and outer containers. Such sampling provides a database for analysis and modeling that can assess the reliability of storage assumptions, methods, plans, and priorities.

This article was contributed by **Keith W. Fife,** NMT-2.

Editorial

Institutional Constancy Guides NMT's Future

Part 1



Bruce Matthews, NMT Division Director

In the rush to meet today's challenges, it is easy to forget that we are establishing the future directions of nuclear materials technologies for generations to come. Our activities now will affect future tasks and capabilities in nuclear materials just as the activities of Glenn Seaborg and other scientists fifty years ago have affected our tasks and capabilities. Given the urgency of their mission, it is doubtful that the plutonium pioneers stopped to think about impacts of their actions on the future. We, on the other hand, not only have that luxury, we have the obligation to look to the future. Political scientist Todd LaPorte reminded us of this responsibility in his editorial, "LANL Faces Institutional Challenges in its Nuclear Future," published in the Fall 1997 *Actinide Research Quarterly.* Planning for the long-term future is an awesome obligation to which NMT and the Lab have paid insufficient attention, primarily because we are not expected to predict our impacts on the future; we are not funded to make such predictions, nor are we held accountable for them. In my opinion, this is not a valid excuse for neglecting one of our most important responsibilities, so I thought I would record my thoughts on how we are preparing for future impacts and how today's actions might appear in 2010.

LaPorte introduced us to the importance of "institutional constancy," which in my terms means providing the elements of a sustaining foundation to enable scientists and engineers to manage nuclear materials regardless of political, social, and institutional changes affecting that mission. The basis for that mission is simple: the high-energy content, long half-life, and radioactive properties of plutonium simply cannot be ignored; the limited-term applications and goals may change, but the mission to manage plutonium will outlive us all. The maintenance of institutional constancy is made all the more difficult by the vagaries of the political, social, and institutional world that constantly challenge the basis of our need for an unchanging foundation. Who of us humble scientists and engineers could have predicted—much less influenced—events such as the end of the Cold War, the sudden shutdown of Rocky Flats, the Comprehensive Test Ban Treaty (CTBT), commitments in the Strategic Arms Reduction Talks (START) treaties, Presidential directives on spent fuel recycling, International Atomic Energy Agency inspection of weapons materials, creation of the Defense Nuclear Facilities Safety Board, Department of Energy openness initiatives, annual budget cycles, and changes in political leaders. Yet all of these have profound influence on our day-to-day activities and technologies. More importantly, who of us can predict with any accuracy the next event that will impact our mission? All the more reason for maintaining some sort of constancy. But what is this thing that social scientists call "institutional constancy"? It is "the faithful adherence to an organization's mission and its operational imperatives in the face of institutional changes," as LaPorte suggests. What does it require? In addition to "steadfast political will," LaPorte urges persistent attention to establishing an infrastructure of constancy, several elements of which include the following:

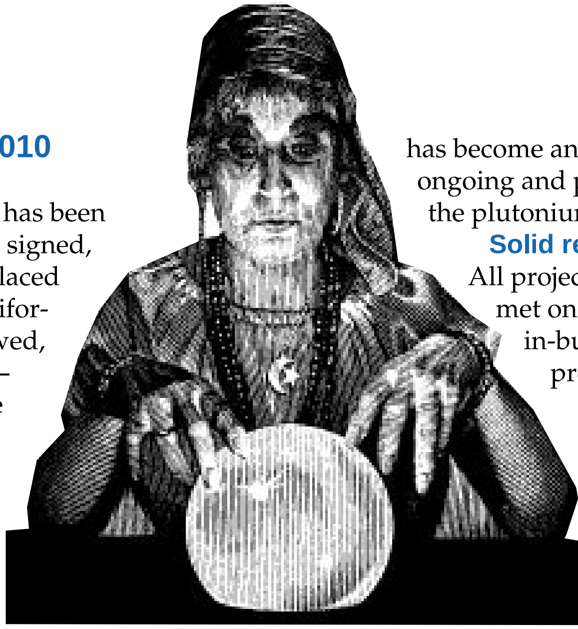
- capabilities aimed at carrying out constancy-assuring activities,
- transfer of institutional and technical knowledge to the next generation,
- future impact analysis, and
- detection and remedy of failures that threaten the future.

Sounds impressive, but the lofty words need to be translated into actions that ensure institutional constancy. In terms of NMT Division, I believe that our constancy-assuring capabilities and activities include

1. **Skilled people,**
2. **Excellence in actinide science,**
3. **Safe and compliant operations,**
4. **Solid record of delivery, and**
5. **Stakeholder involvement.**

The remainder of this editorial, Part 1, will address where we should be with respect to institutional constancy in 2010 from the standpoint of these five elements.

Looking Back from 2010



OK it's 2010: the CTBT has been ratified, START II has been signed, external regulation has replaced DOE, the University of California contract has been renewed, and I'm retired in Hawaii—what kind of legacy did we leave? What does the NMT Division of the future look like?

Skilled people: A new generation of scientists and engineers is running NMT Division. The knowledge of the previous generations is passed on though formal mentoring programs. Universities are graduating actinide scientists, nuclear facility engineers, and trained nuclear material handlers. The NMT workforce is highly qualified, skilled, compensated, and diverse.

Excellence in actinide science: The Seaborg Institute is an internationally recognized center for excellence in actinide science. Numerous publications from NMT Division clearly demonstrate our profound knowledge in the fundamental properties and behavior of actinide metals, solutions, compounds, and ceramics. Plutonium manufacturing practices are based on fundamental metallurgy principles, advances in actinide molecular science have defined new separation and waste minimization technologies, alloy theory has defined the aging mechanisms of plutonium, and performance of mixed-oxide fuels is predictable from first principles.

Safe and compliant operations: The Nuclear Regulatory Commission has licensed TA-55, the Nuclear Materials Storage Facility is operational, construction of a new nuclear chemistry and materials building is nearing completion, external auditors accept NMT's self-assessments to find and correct operational deficiencies, and NMT's safety record exceeds the best in class. Waste minimization has become an integral part of all ongoing and potential activities in the plutonium facility.

Solid record of delivery: All project commitments are met on-schedule and in-budget. Today's projects in surveillance, manufacturing, dismantlement, disposition, residue stabilization and nuclear materials storage programs are at steady-state. New programs have started in fuels for space and terrestrial nuclear energy, accelerator transmutation of wastes, stabilization and storage of residues at facilities in the Former Soviet Union, decontamination and environmental restoration of weapons complex sites, modeling of actinide materials in storage sites, and advanced reprocessing of spent fuels.

Stakeholder involvement: Local stakeholders—and by this I mean the public, particularly the Northern New Mexico public—are involved in helping to define NMT practices and missions. A process for developing mutual understanding of diverse opinions is established. Communications are frequent and positive, and the consensus opinion of both local and national stakeholders is supportive of NMT's management of nuclear materials.

In the next issue of *Actinide Research Quarterly* I will take a critical look at where NMT Division is in terms of the five elements of institutional constancy as we continue on our way to meeting the vision I have outlined for 2010.

Bruce Matthews

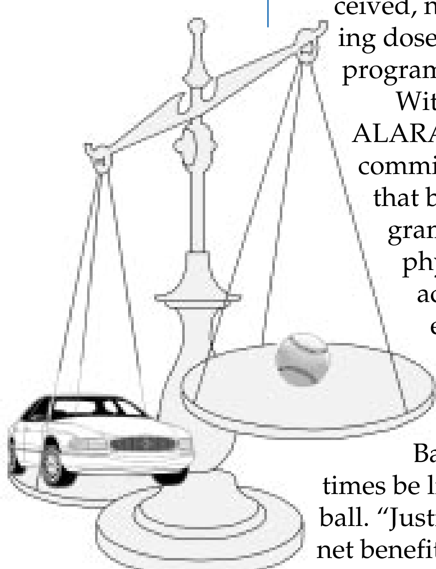
The recommendations in this editorial are mine; they do not represent the opinion of Los Alamos National Laboratory, the University of California, the Department of Energy, or the U. S. Government.

ALARA Program Protects Workers and the Public

"In implementing an ALARA program, management gives the workers confidence that every reasonable effort is being made to keep them safe."

The *Code of Federal Regulations* cites a radiation dose limit of 5 rem per person, per year. The University of California contractual agreement says 2 rem per person per year. The Laboratory's goal, however, is to keep radiation dose levels lower than that if possible, as low as reasonably achievable (ALARA); this goal is a lot more meaningful than just one more regulation. In performing radiological work we accept the obligation to make the workplace safe with regard to radiation dose and considering the programmatic need.

The assurance that we are performing radiological work as safely as we can is set out in our Justification, Optimization, and Dose Limitation Program. The program's objective is to make sure that our radiological work is performed with the least amount of detriment to our workforce, our programs, and the public. The "linear-no-threshold" approach to radiation protection supports our current regulatory standard and is the guidance we use throughout our radiation protection program. Loosely translated, this approach assumes that there is a detrimental effect from *any* dose received, no matter how small. Thus, limiting dose is part of the planning of programmatic activities.



With the formation of our first ALARA committee in 1985, we made the commitment to engage in work practices that balance worker safety and programmatic needs in a single philosophy, "ALARA"(as low as reasonably achievable). The ALARA concept encompasses justification, optimization, and dose limitation to form our overall radiological work-practice philosophy.

Balancing these concepts can sometimes be like balancing a Buick and a baseball. "Justification" asks, Is there a positive net benefit? "Optimization" says that all doses shall be kept as low as reasonably achievable, economic and policy factors taken into account, and "dose limitation" says that the dose equivalent to individuals shall not exceed the limits recommended for the appropriate circumstances. These concepts applied out of balance are at least wasteful and can be damaging to a program. Applying them in balance, however, can benefit projects.

In implementing an ALARA program, management gives the workers confidence that every reasonable effort is being made to keep them safe. In addition, an ALARA program can provide management with a focal point for gathering dose information. For almost every new program that comes along, the customer wants to know what the doses will be before the program starts. By looking at dose data from similar programs in the past, we can make some basic assumptions about the doses that can be expected from new programs. We can draw conclusions between experimental processes and production processes. We can also make optimization determinations (cost-risk-benefit analysis to determine whether processes should be changed or left alone with regard to dose avoidance) from available ALARA program information.

Reporting activities and tracking trends are also functions performed by the ALARA program. We can track doses and trends on a scale all the way down to individuals or for each process, team, or group. This ability helps us make informed decisions with regard to if and/or where to spend money to minimize dose levels.

Worker participation is also crucial in meeting ALARA goals. ALARA committees provide a forum available to all employees to express concerns, submit dose-saving ideas or request information about dose. Work that meets specific dose criteria is reviewed for dose optimization before it is performed. The ALARA program assists in design reviews for new processes and can assist in the optimization of established processes. The ALARA program does all of this and provides audit information for the numerous review processes as well. If the ALARA program is healthy, if it is functioning throughout an operational program, and if it is a good program, the impact is a positive one.

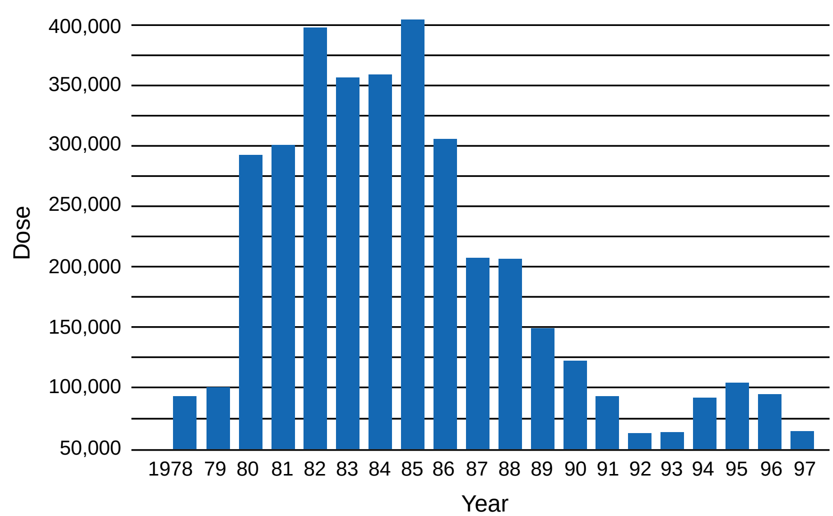
A good place to begin reducing exposures is an area where doses are in the intermediate ranges. We can look for things such as radioactive material loading and housekeeping and try to find shielding opportunities that are within the dollar constraints allowed. Activities in pursuit of the ALARA goal do not have to include buying something new, reengineering, or making major programmatic changes; they can be as simple as looking at a process to make sure that nothing else can be done to minimize dose levels in that process. Examples of effective ALARA measures include a preventive maintenance program that looks at stopping dose-related problems proactively or a housekeeping policy that removes some of the sources of radiation. ALARA-driven activities that will be most beneficial aren't those of large spending or large programmatic change, but those of spending time and money where it will be most effective. The following is just an example of how small dose changes could be contributing to your facility dose: A background increase of 0.05 mrem per hour for a working year can deliver 100 mrem per year to an individual. If a group has 40 people in it, that dose is equivalent to 4 person-rem to the group in a year. Reasonably large dose-avoidance could be gained from seemingly small changes.

We also need to look at the cost-risk-benefit aspect of the ALARA program. That is, we look at the facility dose in terms of the dollars we can spend to avoid components of that dose. The guidance we use to determine what amount of money we can use to avoid dose is Laboratory Procedure (LP) 107-16. In LP 107-16 there is a section that refers to the value of a person-rem. This guidance states that if individuals in a group have doses under two-thirds of the prestated, facility-wide, administrative control level, we can spend, on further dose-reducing measures, up to $2,000 per person-rem of dose avoided. Or if individuals in the group have doses greater than two-thirds of the administrative control level, we can spend up to $10,000 per person-rem of dose avoided.

When beginning to apply ALARA approaches to a program, it is important to monitor the results. The record keeping in ALARA activities is important for audit purposes as well as proving whether the changes were worthwhile. Another important reason to monitor changes is to share successes with similar processes. A good thing to remember is that changes should be made that most constantly follow the natural course of work. Dose-saving measures that are contrary to normal work routines can be counterproductive.

In summary, ALARA is a work practice philosophy that is intended to bring a balance between programmatic needs and radiological safety. ALARA is not intended to inhibit programmatic work; rather, it is intended to assure that the work is performed within the most dose-effective and cost-effective manner possible. When applying the ALARA philosophy to a specific task, it is necessary to look not only at the specific task but also to look globally at how changes will effect the entire system. The figure shows historical dose data for the Operations Group.

This article was contributed by **Bob Stokes,** ESH-1.



Operating Group dose data from the commissioning of the Plutonium Facility to the present. The ALARA committee was established in 1985. Today dose optimization methods used to lower exposures are taken for granted: shielding, automation, process improvement, and the inclusion of ALARA goals in project planning.

Process Control and Instrumentation Can Improve Efficiency *(continued)*

The NMT-2 Process Control and Instrumentation Team developed this furnace control system to be easy to operate, flexible, reliable, and capable of modifications for specific applications. It allows for the control of up to 16 furnaces.

The first furnace controller system the team developed was a box that contained all the necessary components to carry out simple, semimanual furnace control. This system was much easier to configure and operate, and it was much more compact in size. The newer furnace control system (see photo at left) uses a combination of PLC hardware and HMI software to create an easy-to-operate, yet flexible furnace control system. The approach was to develop a generic, core-control system that will be usable for virtually every furnace control scenario at the facility. The system allows for the control of up to 16 furnaces and up to 16 temperature steps for each furnace. Furnace operation can be controlled unattended for more than four days. Application-specific needs and requirements can be incorporated in addition to the core system.

Another example was a control system developed for nitric acid evaporators. This process distills nitric acid from a brine solution leaving a concentrated, contaminated salt residue. This control system also consists of PLC hardware and HMI software. For more efficient operations, a PID (proportional, integral, and derivative) control loop is utilized to ensure tight control of the liquid level within the evaporators automatically. Control of the level helps ensure higher-quality nitric acid distillate. Further, PLC ladder logic was written to prevent the abrupt "foaming-over" of bottoms solution into the clean overhead line. Foaming-over sometimes occurs when salts become excessively concentrated in the evaporator. When initial signs of foaming-over are detected the system shuts down automatically in an orderly fashion.

The PC&I Team also developed a control system for the facility's waste monitoring system. Liquid waste from the Pu Facility is sent to another facility for further processing once the radioactivity of the waste solutions is low enough. Gamma radiation levels are monitored in sanitary, industrial, acid, and caustic waste lines to help ensure a radioactive release does not occur. For the latter three waste lines, waste solution flow rates and temperatures are also acquired. Temperature- and flow-rate data are used to track the dates and times when solutions are dumped. Enough sensors are present also to help to determine where the waste originated within the Pu Facility. This system has networking/Internet browser capabilities systems (as do the previously mentioned control systems) that allow the various data to be tracked from another location within the Pu Facility or from one of the administrative buildings.

The PC&I Team has completed many other projects, and is currently working on several control systems: electrorefining, cementation, the new gamma monitors for the ion exchange process, nitric acid distillation, the hot bake oven, video monitoring of the Pu Facility basement, and the 40-mm launcher.

As the mission of the Pu Facility evolves, the mission of the PC&I Team will also evolve to meet the facility's needs. This team is currently working on integrating process control operations, where appropriate. The future may also dictate that we increase our efforts in areas such as process automation and robotics, more advanced control strategies for better process optimization, and the development of a more-encompassing process database to better follow the intricacies and trends of process batches.

Publications, Presentations, and Reports (January 1998–March 1998)

Journal Publications

D. L. Clark, S. D. Conradson, D. W. Keogh, P. D. Palmer, B. L. Scott, and C. D. Tait, "Identification of the Limiting Species in the Plutonium(IV) Carbonate System. Solid State and Solution Molecular Structure of the $[Pu(CO_3)_5]^{6-}$ Ion," *J. Inorganic Chemistry,* in press.

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NEWSMAKERS

■ **Jon Hurd** (NMT-4) received from the 1998 Measurement Science Conference, held in Pasadena California, February 5–6, 1998, a certificate of appreciation and the Algie Lance Best Paper Award for his paper "Nondestructive Assay Techniques for Vitrified Waste Forms."

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