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"I Believe We'll Have Another Winner!"

Dennis Mangan, Chair
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"I believe we'll have another winner!" This is my thought as I reflect on the upcoming INMM 34th Annual Meeting, July 18-21, 1993, at the Scottsdale Princess Hotel, Scottsdale, Ariz. The meeting promises to be yet another excellent forum for hearing about the latest technical advances and to have those ever-important "conversations in the halls."

The technical program will be excellent. The Technical Program Committee, headed by Charles Pietri, met in Boston on March 9 and formulated 33 sessions comprising 235 papers.

Charles and his committee, which included each of the Technical Division Chairs, were forced into some difficult decisions. The most difficult decisions, as in the past, were centered on structuring the sessions to minimize the "competition" among them and to provide a program that is of continual interest to you who have varied interests. To help meet these challenges, the Executive Committee agreed with the recommendation of the Program Committee to move the Annual Business Meeting from its longstanding Tuesday afternoon time slot at 4:00 p.m. to a new slot on Sunday afternoon at 5:00 p.m. This change will permit the scheduling of full sessions (eight papers versus the previous four) on Tuesday afternoon, which gives the Program Committee more flexibility.

Another major change will be made in Scottsdale. Your Executive Committee meeting has customarily been held on Sunday morning. This year, as an experiment, the meeting will be moved up to Saturday afternoon, July 17, at 1:00 p.m. We have decided to try this experiment for several reasons. Perhaps the most compelling reason was to lighten the load on the INMM staff involved in the Annual Meeting. This year, for the first time, each of the Technical Division Chairs is planning to hold a division meeting on Sunday from 1:00 p.m. until 5:00 p.m. Behind the scenes, the Registration Committee, headed by Gary Carnival, will be busy preparing for your arrival. And last minute details will require the attention of Barb Scott and her staff.

We hope these changes will strengthen our Annual Meeting and, as always, we will welcome your comments. We hope attendance at the Annual Business Meeting, as well as at the Executive Committee Meeting, will improve. As you know, you are invited to both meetings. The Preliminary Program for the Annual Meeting is scheduled to be mailed on April 15, 1993. As you look it over, I hope you will agree that Scottsdale should be another winner.

Many of you may not realize that the INMM has agreed to cooperate with the International Atomic Energy Agency (IAEA) in Vienna in the organization and presentation of the 1994 IAEA Symposium on International Safeguards. The symposium will be held March 14-18, 1994, in Vienna.

There are many who feel the IAEA has to continue to play a major role, perhaps an even greater one, in facing the challenge of the proliferation of nuclear weapons worldwide. The IAEA's future, most certainly, will depend on the Nonproliferation Treaty (NPT) Review Conference to be held in 1995. Our Institute was proud to accept the IAEA's request for cooperation with their symposium. Cecil Sonnier, our International Safeguards Division Chair, who can be contacted at 505/844-2124, has the INMM lead in supporting this important symposium.

As always, please feel free to provide me with any comments. I look forward to seeing you in Scottsdale in July.

The Spent Fuel Dilemma

Every country that has nuclear power reactors is faced with the problem of what to do with the spent fuel. Some countries have decided that it should be permanently and safely disposed of. Others believe that most of it should be reprocessed in order to retrieve the remaining fissile and fertile isotopes for future use. Still others are trying to decide which policy makes sense for them. We have all heard the arguments for the different policies.

When the United States decided that its spent fuel should be buried and instructed the Department of Energy to perform this service in 1982, the INMM decided that this subject was relevant for nuclear materials management and that it had important safeguards implications. At the initiative of E. R. Johnson, the INMM has conducted a Spent Fuel Management Seminar every year since then. For several years, this issue of the *Journal* has reported on these seminars and published some of the papers, assuming that the subject should be of interest to others than those who are immediately involved in developing and trying to implement the policies, here and abroad.

Spent fuel is not considered an attractive target for theft by subnational adversaries. However, it does need to be protected from malicious dispersal. Internationally, spent fuel is considered to have safeguards significance because of the plutonium which it contains. The International Atomic Energy Agency (IAEA) devotes considerable effort to verifying that spent fuel is not diverted. Difficulties arise in designing practically achievable safeguards measures for spent fuel which is to be inaccessible for verification during long periods of dry storage and for ensuring that buried spent fuel will not be retrieved by a country at some later time.

One of the papers reprinted in this issue (Rudolf Weh, p. 37) discusses safeguards techniques which are being implemented in Germany to verify the contents of spent fuel storage casks when they are loaded and to develop highly reliable seals to provide assurance that they have not been reopened. Another paper (Bertrand C. d'Agraves, p. 31) describes the acoustic seals which Euratom has been developing.

Not surprisingly, the United States has found that almost no one wants to have the geological repository or the monitored retrievable storage (MRS) facility (to store some of the fuel until the repository is operating) located anywhere near him or her. In 1991, the Congress established a "negotiator" to attempt to find some state or other jurisdiction which would agree to accept an MRS. The United States Nuclear Waste Negotiator, David Leroy, reported on the progress he has made so far and on the prospects for the future. We reprint his address (page 14) because his philosophy appears to make sense for any democratic country that is trying to find a location for any nuclear facility of which the public is afraid. To put it simply, one has to take the time and the trouble to educate the public and to permit each locality to decide, after it has studied the subject, whether or not it should agree.

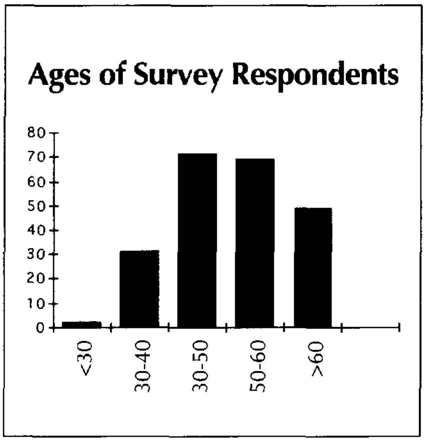
One of the new suggestions, as reported by N. Barrie McLeod (page 12), is that it may be more cost-effective to place several fuel assemblies into a multipurpose container for interim storage, transportation, and ultimate burial when they are to be removed from a reactor pool, rather than to use different containers for each purpose with the need to unload and reload containers. This proposal may have an important impact on the design for IAEA safeguards. If a procedure, such as that being developed in Germany, can enable the agency to verify what is placed into each such container, and if highly reliable and credible seals can be developed, it would not be necessary for agency inspectors to verify the several cask unloadings and reloadings as previously contemplated. It will still be necessary for the agency to keep track of the identified containers and to ensure that a repository, once closed, remains that way. We probably have a few years to work these out.

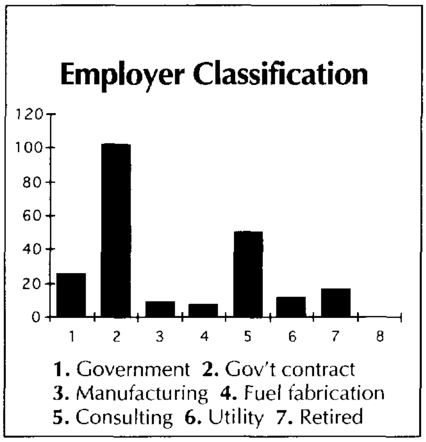
About a year ago, John Jennekins, the IAEA's deputy director general for safeguards, offered to have his people prepare several papers for the *Journal* bringing us up to date regarding the safeguards program. In due time, his busy people contributed five excellent papers. One was published in the last issue. Two are contained here, and the final two will be published in the next issue. Originally, we had hoped that we might publish all of them in one special issue. Unfortunately, that has not been possible. We are deeply grateful to the agency and its staff for their important contributions. The agency is continually making progress, in spite of the fact that its Board of Governors has kept it on a fixed budget for seven long years while its responsibilities have continued to increase significantly.

Dr. William A. Higinbotham
Brookhaven National Laboratory
Upton, New York, U.S.A.

INMM Membership Survey Results

I. Membership status
As of February, 1993, INMM has 664 members who have paid their dues. This time last year, the number was 619. INMM has gained approximately 43 new members since the 1992 annual meeting; approximately 100 members from last year have not yet paid their dues to extend their active membership. There are currently 415 active members in the United States (344 regular, 41 senior, 12 fellow and 18 emeritus). There are 156 paid members in the Japan Chapter, 45 in the Vienna Chapter, and 32 in other countries. Sixteen corporations are sustaining members.





II. Membership Survey Results
Two hundred and eighteen completed membership survey forms were received from U.S. members. The survey was mailed with the initial dues statement. No surveys have yet been received from Japan or Vienna, and few were received from the remaining non-U.S. members. The tabulated data include only the responses from the North American membership. The following are some of the conclusions extrapolated from the survey:

1. Senior and emeritus members responded to the survey in greater proportion than did the total membership (81% versus 50%); thus there may be a bias in the survey results with respect to the responses from the more senior members.

2. In order to become a senior member, a member must be more than 30-years-old and have been an INMM member for more than three years. Additionally, a member must have more than 10 years of experience (including education) in order to qualify. By correlation of these qualifications among the responses, approximately 80% of the membership is eligible for senior membership. Yet only 6% of the membership (18% of the survey respondents, correcting for the emeritus members) have become senior members.

3. Approximately 60% of the membership lives in areas with no regional chapter; approximately 25% of the membership lives in New Mexico, and another 25% lives in the Washington, D.C., area.

4. More than 50% of the membership is older than 50 years, 40% of whom are older than 60. Only 15% of the membership is younger than 40.

5. Approximately 60% of the membership works for the government or its M&O contractors; 23% of the membership works for consulting firms, many of which provide direct support to the government or its contractors.

6. About 30% of the membership works for corporations/facilities that are sustaining members.

7. Waste management is one topical area with less member involvement, but it is certainly one of the larger — and is the fastest growing — areas of employment in the nuclear-related fields, according to the American Nuclear Society.

The following questions were developed from these findings:

1. Why aren't more members applying for senior membership status?

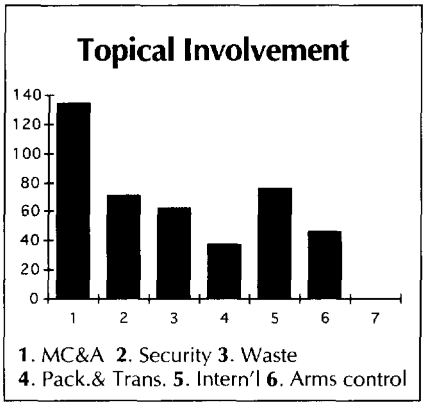
2. What efforts have been made to establish regional chapters in the East and in the Southwest?

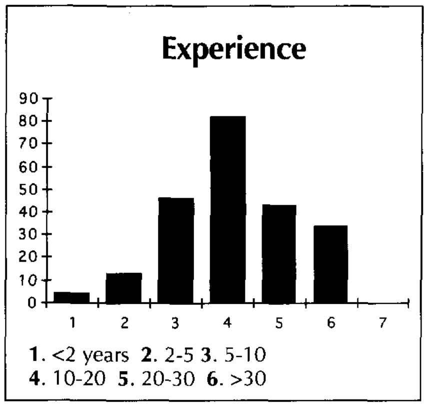
3. Does the large number of members older than 50 indicate a pending membership crises in the coming decade? What can be done to attract younger members?

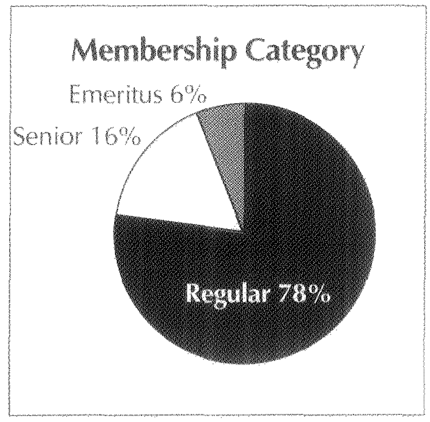
4. What can be done to attract more personnel from NRC licensees and their suppliers to become members of INMM?

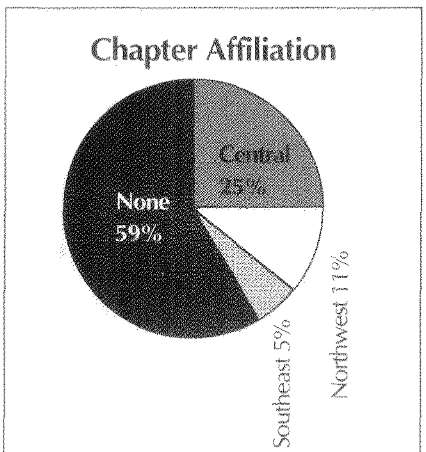
5. What can be done to attract more personnel involved in environmental restoration and waste management to become INMM members?

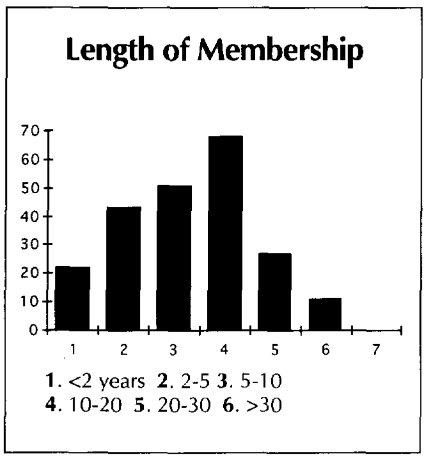
III. Senior Membership
Only a fraction of those eligible to apply for senior membership status have chosen to do so. The probable causes of this deficit are: The regular members are not aware of the senior membership level; they do not know how to apply for senior status; they do not feel that the benefits justify the 30% higher dues to become a senior member; or the level is not important to the membership. At present there are no benefits or recognition for being a senior member except eligibility to become a fellow of the Institute (an honor bestowed upon less than 2% of the current membership). The following

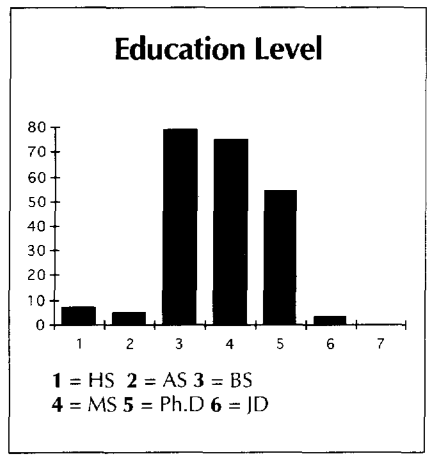












actions are recommended:

1. Make members more aware of the senior membership status through special recognition of senior members at INMM functions (e.g., special name tags or permanent name tags, or special tables at INMM banquets).

2. Increase senior-member benefits (e.g., sponsoring a senior member reception or lunch during the Annual Meeting, or special rates for Annual Meeting events).

3. Invite eligible members to apply for senior membership (e.g., all members of sufficient tenure as members and experience should be notified of their eligibility and invited to apply for senior membership every year in their dues notices).

4. Automatically submit the names of members older than 40 and with the requisite experience and length of membership for senior membership, subject to the member's refusal to accept the advancement.

5. Reduce the senior member dues to be comparable to the additional benefits received.

The Membership Committee supports the Bylaws Committee's recommendation to eliminate the requirement that Senior Members must be charged higher dues than regular members. This will allow the Executive Committee greater flexibility to establish the dues rate under existing responsibility. However, we do not recommend a decrease in the senior member dues until recommendations 1 through 4 above have been implemented and deemed to be unsuccessful.

IV. New Members

Actions are needed to attract new members to the Institute. The view has been expressed that safeguards is a graying field in which the professionals are maturing with the technology. In other words, few new professionals are entering the field. It has also been noted that newer INMM members who have not yet established reputations in the field are routinely ignored by the INMM members who are too busy networking with their peers. If INMM is to add new members, especially younger ones, it must become more aggressive in attracting younger professionals to INMM activities, and it

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Committees: Government-Industry Liaison

The Government-Industry Liaison Committee is responsible for providing an unofficial forum for nuclear safeguards information exchange focused on government policies and programs that impact or involve the private sector. The committee will sponsor a session open to INMM 34th Annual Meeting attendees on the morning of July 22, the day after the technical sessions. There is an active group of volunteers planning this year's meeting, which will include both speakers and discussion in a forum that is less formal than the main conference sessions.

Please look for additional information in the Preliminary Program, the next issue of *JNMM* and the Final Program, and plan to attend this summer's session. You may contact me with questions or suggestions at 505/845-8103; fax, 505/844-8478.

John C. Matter
Chair, Government-Industry Liaison Committee
Sandia National Laboratory
Albuquerque, New Mexico, U.S.A.

Committees: N14 Standards

The following is an update on the activities of the INMM N14 Standards Committee.

ANSI N14.1-1990 — *Packaging of Uranium Hexafluoride for Transport.* This standard was published.

Randy Reynolds, N14.1 chair, has sent a letter to the writing group with a list of proposed changes and has requested input on any additional changes. His preliminary schedule for N14.1 -1995 is:

- fall 1993, writing group meeting;
- early 1994, N14 balloting;
- mid-1994, resolve negative ballots; and
- late 1994, submit to ANSI for approval and publication.

ANSI N14.2 — *Tiedown for Transport of Fissile and Radioactive Containers Greater Than One Ton Truck Transport (in process).* Writing Group balloting was completed in December; however, there were a number of significant comments received. The Writing Group chair has incorporated these comments and resubmitted to the writing group for review and concurrence. The draft standard was received for N14 balloting on February 23; however, since that time, a couple of technical issues have been brought to the attention of the writing group chair. These issues need to be resolved before the N14 balloting can start. These items were expected to have been completed by mid-March, which would still have permitted N14 balloting to start by April 1, 1993.

ANSI N14.5-1987 — *Leaking Tests on Packages for Shipping.* The standard is due to be updated in 1993. If the international standard, which is in preparation, is acceptable to the U.S. regulatory agencies and the N14 Committee, it will be adopted in lieu of N14.5-1987. If not, N14.5-1987 will be updated. This decision will be made in late 1993.

ANSI N14.6 — *Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Material.* Comments are currently being evaluated and incorporated in the draft, after which it will be sent to ANSI for approval. The standard is expected to be completed in April 1993.

ANSI N14.7 — *Guide to the Design and Use of Shipping Packages for Type-A Quantities of Radioactive Materials.* Rick Rawl is currently reviewing a very rough draft to determine if it can be used as the basis for a new standard or if it will be necessary to start over. This determination will be made by April 1993. A high priority has been suggested for this effort.

ANSI N14.10 — *Guide for Liability.* The scope of this standard has been revised. The need for the standard is being determined. If needed, a writing group will be formed, and a draft will be prepared. Estimated completion date is June 1996.

ANSI N14.19-1986. A letter ballot to withdraw this standard was sent to N14 members with a closing date of April 1, 1993.

ANSI N14.23 — *Design Basis for Resistance to Shock and Vibration of Radioactive Material Packages Greater Than One Ton in Truck Transport.* A revised draft is currently being completed that was to have been sent to the writing group in mid-February for review and comment. A meeting of the writing group was planned for mid-March to resolve comments and reach a consensus. Assuming the writing group was able to reach a consensus at its March meeting, the draft was to have been available for N14 balloting by April 1, 1993.

ANSI N14.24 — *Barge Transport of Radioactive Materials.* A new chair of the writing group is still being sought. This standard was updated with editorial changes and sent to ANSI for reaffirmation. Planning on a revised standard is tentatively scheduled for completion by Jan. 1, 1994.

ANSI N14.25 — *Tiedowns for Rail Transport of Fissile and Radioactive Material Containers.* This project will start after N14.2 is completed. PINS will be submitted, including a schedule for completion.

ANSI N14.26 — *Guidance on Quality Control Activities as They Relate to the Inspection, Preventive Maintenance and Post-Incident Testing of Packages Used for the Shipment of Radioactive Material.* Work is continuing on preparation of a draft document for this standard. The draft is about 30% complete.

ANSI N14.27 — *Carrier and Shipper Responsibilities and Emergency Response Procedures for Highway Transportation Accidents Involving Truckload Quantities of Radioactive Material.* This standard will be reaffirmed with editorial changes in 1993. After reaffirmation, planning will start on an extensively revised standard. A new scope will be prepared and a new standard developed. Much recent effort has been devoted to collecting references and making editorial changes. Current plans are to submit this document to ANSI for approval by May 1, 1993.

ANSI N14.30 — *Design, Fabrication and Maintenance of Semi-Trailers Employed in Highway Transport of Weight-Concentrated Radioactive Loads.* This standard was approved by ANSI on Oct. 1, 1992, and was published in January 1993. It is now available for sale from ANSI for $40 per copy.

Numerical Model Development

The ANSI N14 subcommittee work for development of a numerical model for thermal evaluation of UF6 cylinders is in process and data is being obtained. Plans call for the first draft report to be available in June 1993.

Standard Matrix

Plans to revise the *Standard Matrix for Light-Water Reactor Spent-Fuel Transportation* are in progress.

N14 Procedures Manual

Work is continuing on updating the *N14 Procedures Manual.* A revised table of contents has been completed and updates of manual inserts are being drafted and collected. It is planned to have the updates mailed out to manual recipients by April 1, 1993.

N14 Membership

There are currently four people who have requested membership and who are awaiting balloting. In addition, recommendations to fill the vacancies for the American Institute of Chemical Engineers and the American Industrial Hygiene Association have not been received.

There are currently 80 members, including eight alternates. There are also 30 individuals designated "for information only" on the N14 roster.

John W. Arendt
Chair, ANSI N14 Committee

Membership Survey

Continued from page 7

must acknowledge and respect these newer and younger professionals when they do attend the activities. The following are recommendations for ways to attract new members:

1. Prepare a new membership brochure that is focused more on selling membership in the Institute than merely to present facts about INMM.

2. After the Annual Meeting and other INMM-sponsored activities, contact nonmember attendees by letter with an invitation to join INMM.

3. Recognize new and younger members of INMM by, for example, sponsoring a reception or lunch for members younger than 40 or with fewer than five years as members.

4. Encourage new and younger members to become involved in INMM committees and to participate in chapter activities.

5. Activate chapters in more regions to give younger professionals INMM activities in which they can feel more comfortable and to which they can contribute.

6. Pursue nonrenewals by having a members of INMM in the same geographical area make personal contact with the nonrenewing member. Determine the causes of nonrenewal and rectify them, if practical. (For example, it has been noted that a significant number of these member addresses are incorrect. If this is determined to be the cause of a nonrenewal, the situation could be rectified by correcting the address.)

7. Establish significant benefits of membership. Nonmembers have all of the benefits of membership available to them as do senior members, except a free subscription to *JNMM*, the ability to participate on the Executive Committee and become an INMM fellow. Employers pay registration fees for almost all member and nonmember conference attendees, so the member discount has no impact on most attendees. New members do not join so they can serve on the Executive Committee, become fellows or received *JNMM* free of charge. (These gain importance only after years of membership.)

Bruce W. Moran
Chair, Membership Committee

Progress in Spent Fuel Storage and Disposal

Among the papers in this issue of the *Journal* are two that were presented at the 10th INMM Spent Fuel Management Seminar, held Jan. 13-15, 1993, in Washington, D.C., just days before the inauguration of our new president. The backdrop to this seminar thus included the anticipation of imminent change associated with the new president, the changeover to a Democratic administration and a new Secretary of Energy.

An immediate precursor to the seminar was outgoing Energy Secretary Watkins' response to a December 10 request by Sen. Bennett Johnston, D-La., Chairman of the Senate Energy Committee. The secretary responded on December 18 with four new waste program initiatives that included the recommendation that federal sites be given priority for siting of facilities for the monitored retrievable storage of spent fuel (MRS). The suggested federal MRS siting recommendation was intended as a constructive step toward fuel acceptance in 1998.

Unfortunately, the secretary's response generated unintended reactions, and the new initiatives were seen by many as questioning the viability of the voluntary siting process before a fair test of its viability had been completed.

The second of the secretary's recommendations, the adoption of multipurpose canister (MPC) technology for storage, transport and disposal, gave policy-level recognition to both utility and DOE work and growing interest in this technology, which had been gaining momentum throughout 1992. Implementation of this technology would clearly impact the nature of future developments in spent fuel storage, as well as in the transport and disposal of spent nuclear fuel.

Representatives of the principal parties to these foregoing events participated in the seminar and interacted with each other and with the technical participants to make this an unusually stimulating and timely conference. An undercurrent of the meeting was the concern that even if an MRS host and site were identified in 1993, having an MRS operational for fuel acceptance in 1998 would be difficult. The sense of urgency that this situation generates has probably spurred the creation of an unusual number of ideas and proposals for short-term fixes that compromise long-term goals. A common characteristic of many of these is the premise that voluntary siting has not worked, when in fact only a fraction of the total time reasonably needed to test its viability has passed.

The types of difficulties that require time and effort for resolution during the voluntary siting process were clearly and eloquently articulated by Fred Peso of the Mescalero Apache Tribe. The Mescaleros have apparently passed internal checkpoints as to the siting of an MRS on tribal land under their Phase 1 MRS Feasibility Grant. They have also identified the next issue to be addressed: the concerns of their neighbors outside of tribal lands, and the necessity of having these neighbors go through the same type of evaluation that they have already been through, and they have requested a Phase 2 Grant to support that effort. The politics of an election year and the resulting change of administration have prevented DOE from making that grant.

The Mescaleros, who have entered and pursued the process in good faith, are now understandably perturbed because the process seems to have failed them and left them "twisting in the wind." In the broadest sense, the voluntary siting process is an experimental and evolutionary process that must be worked through. Congress established the voluntary siting process and the independent Office of the Nuclear Waste Negotiator in the Nuclear Waste Policy Amendments Act of 1987, and it has subsequently supported this political process. Should Congress allow the interim politics of the grant procedure to stop the experiment at this point without a constructive alternative, it would be a failure of congressional will. It would not be a failure of the voluntary siting concept. It would not be a failure of any of those dedicated groups, including the Waste Negotiator's office, the DOE and the DOE grant recipients, that are currently pursuing the congressionally prescribed process in good faith. It is highly probable that the Congress, which has supported this national program with insight and persistence, will continue to do so, but it will take time. There appears to be at least one prospective host for an MRS, but formidable concerns at the local and state level remain to be addressed.

The importance of the voluntary siting process and the need to protect that process from short-term quick fixes driven by arbitrary deadlines were among the points made by the seminar's luncheon speaker, David Leroy, the Nuclear Waste Negotiator, who is responsible for establishing and implementing the basic structure of the voluntary siting process. Leroy's speech is included in this *Journal* (see page 14) and should be required reading. His presentation is at least as good as his writing.

Mary Louise Wagner, a member of the Senate Energy Committee majority staff, noting the major progress of the past two years, summarized both positive and negative aspects of the nuclear waste issues facing Congress. She noted the need for an unperturbed transition period while new members of Congress and those who are new members of key committees get up to speed. Wagner also stressed the importance of continued progress during the transition period. John Bartlett, the outgoing Director of the Office of Civil Radioactive Waste Management (OCRWM), summarized the substantial physical progress now being made in the characterization of the Yucca Mountain candidate repository site and the recommendations being made to the new administration. Although Bartlett did not mention it in his talk, singular progress has been made in the three years since he took over a program that was stagnant and mired in litigation.

With regard to spent fuel storage, it was noted above that the prospective adoption of the MPC could have a significant impact on future spent fuel storage, as well as on transport and disposal. The recent DOE evaluation of the MPC was described by Jeffrey Williams of DOE. The currently favored approach is to use large unshielded canisters in conjunction with concrete overpacks for storage, reusable overpacks for transport and dedicated corrosion and shielding overpacks for final disposal. The use of fully shielded, sealed containers is also a possibility. While generally compatible with the current storage technologies described at the seminar, the MPC technology requires that transportation and disposal considerations be combined with storage considerations in the canister design. As a generalization, this requirement is likely to favor somewhat smaller packages, in the range of 16- to 21-PWR assemblies, in contrast to the 24-PWR sizes currently in favor in dry storage.

The status of current storage technologies was well described in presentations from both vendor and utility user perspectives. There were papers on vertical and horizontal concrete cask storage, metal-cask storage ("GNS Spent Fuel Experience," by Rudolf Weh, p. 37), vault storage, consolidation and offshore reprocessing as an alternative to storage. Consolidation continues to remain an option, but without the level of current utility interest that is evident in metal and concrete cask storage. Papers were also given on the DOE transport cask program, utility perspectives on that program and the status of Delivery Commitment Schedule submissions by the utilities to DOE. The topic of special papers included safeguards sealing ("Ultrasonic Sealing Techniques: A Possible Solution for Safeguarding the Containment or Storage of Spent Fuel in an Underwater or Dry Environment," by Bertrand C. d'Agraives, p. 31), verification testing on storage casks and long-term performance under dry storage conditions.

It can be observed that the thrust of current papers tends more in the direction of improvements in current designs, as contrasted to the addition of new designs that characterized earlier seminars. One of the prospective perturbations in storage technology relates to the timing and extent of possible MPC usage and the modifications that might be made as a result. Although this would drive a new round of changes, it can be observed that spent fuel storage is moving into an optimization mode, having demonstrated the viability of several alternative storage technologies. This gives assurance that there should be at least one storage technology available to fit the particular circumstances of each utility that requires and plans for supplemental spent fuel storage.

N. Barrie McLeod
E. R. Johnson Associates Inc.
Fairfax, Va., U.S.A.

Remarks of David Leroy: United States Nuclear Waste Negotiator

INMM Spent Fuel Management Seminar
Washington, D.C., U.S.A., January 14, 1993

For three years I have had the best job in America. I have had the chance and challenge to create a new federal agency from scratch, to hire and employ a talented staff, to present an opportunity for national heroism to governors and tribal leaders, to cajole the Department of Energy toward local sensitivity, to urge utilities to address public interests, and attempt to persuade the media to stop using the term "nuclear dump" in its articles and headlines.

I have come to feel that the negotiator process is the best positive education program for nuclear activities in America. Let me tell you why. In place after place where we have been, independent citizens' advisory groups, independent consultants and tribal governments alike have concluded and have reported that nuclear spent fuel can be safely transported and stored and does not constitute a public health hazard. This kind of self-directed, hands-on, learning-by-doing-and-seeing activity has been far more effective in eliminating nuclear fears, even in those localities that have ultimately turned down our offer, than legions of scientists swearing to the safety [of spent fuel have been]. If the volunteer process in America never sites a thing, it will still be the most favorable national nuclear interaction between government and people since the "Atoms for Peace" program in the 1950s. And because it shows, on its face, that responsible state and political leaders can seriously consider inviting nuclear facilities into their backyard and can convene public discussion about it, the volunteer process is worth having, worth keeping and worth enhancing.

Let me address the ultimate question: Will the negotiator process succeed in 1993? Today, we are releasing our second annual [1992] Report to Congress. It runs 79 pages with appendix. Some 19 months ago, we called for participation and dialogue from 623 jurisdictions, including 565 federally recognized Indian tribes and our 50 states. This annual report will summarize for you the responses to that call for action. They have fallen into two categories: those by jurisdictions which have applied for federal study grants to look at the feasibility of a monitored retrievable storage facility (MRS), some 20 in number, of which eight are still active; and those by jurisdictions which have not yet applied for federal funds, but may do so prior to the March 31 cutoff date for Phase II funding. One of the most recent developments occurred on Oct. 28, 1992. On that date, the Skull Valley Goshute Band of Indians in Utah applied for a Phase II grant. As to upcoming events, I believe other jurisdictions will apply for those grants prior to the March 31 deadline. We also have a request for regulation changes pending before the Department of Energy. Those would seek to supplement the Phase II funding available under our grants by an additional $200,000. This would make it possible to receive, under the grant process, an initial $400,000 to interact, study feasibility and begin community activities.

The bottom line in this report, as you will read and as I will say now, is that the negotiator process will succeed or fail in calendar year 1993. This year, we will see whether or not among those initial 20 to 30 applicants and interested parties, there are any that show sufficient promise or sufficient energy to make it appear as if somewhere in America there is a jurisdiction that can stay the course and complete the voluntary program. Remember, the price of getting any one jurisdiction to say "yes" in voluntary siting is giving every jurisdiction the right to say "no." I remain very optimistic that in 1993, somewhere in this country, the political conditions are right to allow a MRS proposal to be made by a willing host to a waiting Congress. I'm realistic. It won't be easy to produce that negotiated proposal. However, our aggressive, best efforts have turned up more than 30 potentially interested localities. Also, I believe that it is possible that others, not yet known, may initially step forward during this year.

Today, I want to share with you two sets of ideas. First of all, there are five lessons we're learning in the Negotiator's Office, which I wish to highlight for the nation, about voluntary siting and about nuclear energy and nuclear waste in this country. Then, also, I want to make five recommendations for action. These are recommendations to the incoming Clinton Administration and recommendations to the nuclear community as it is assembled in this room. I believe that 1993 is a precious opportunity which cannot and should not be lost in terms of advancing the cause of solving the waste problem, even during a change of administration.

Among the lessons we learned during the last two years in the Negotiator's Office are these:

First, a nuclear energy program properly run as a safe and environmentally responsible activity is a feature of the future for every worldwide industrialized nation. Nuclear power may be delayed here by a confusion of policy if we don't clarify our focus in the United States. The economics may be out of adjustment here. Regulatory concerns and bureaucratic interaction between the Nuclear Regulatory Commission and the utilities may raise additional issues. However, the fact remains that nuclear energy is moving forward in the rest of the world. It will be a future feature of industrialized democracies all over the world. I believe it will also be with us in the United States.

Second, spent reactor fuel wastes can be and are being transported, managed and stored safely, once again, worldwide. Several thousand movements have been made without a single release or radiation accident. Spent fuel is safely stored at 75 reactor sites in the United States. The problem really, and almost purely, is political rather than technical. The only exception might be the Eastern Bloc nuclear reactors and waste management, where technical concerns exist. Even so, it is prior political weakness that has sponsored those technical weaknesses of today. Thus, it is fair to say, worldwide, from an objective study, that reactor fuel wastes are safely managed and can be so handled in the future.

Third, voluntary siting is the only method by which controversial nuclear facilities will be sited in the 21st Century. Let me say that again: Voluntary siting is the only method by which controversial nuclear facilities will be sited in the 21st Century. Voluntary programs come in many forms, but volunteerism has become a worldwide norm and standard for nuclear facility siting. In the United States, through the Office of the Negotiator, we are advancing a rather pure form. We make an honest call for volunteers who can opt out of the siting invitation at any time. In Japan, the sites are still targeted by the national government, but there is a heavy commitment to negotiating for agreed mitigation and benefits with local and neighborhood leaders. In France, after two years of inactivity, in mid-December the appointment of a nuclear negotiator along the lines of the U.S. model was confirmed to restart a siting program for their intermediate repositories.

Because of litigation, because of public hearings, because of the ability of any citizen to easily delay or to deny the forward progress of a controversial facility which they do not want in their backyard, voluntary siting has become a must in one of its forms, in many of its forms, or in all of its forms all over the world and in this country. In England, as they say, the influence of "a single outraged garden club with a mimeograph machine" can stop the siting of a nuclear facility. Decide, announce, defend — the old way of doing business — for the Department of Energy or other federal government entities, for state governments, and for major industrial corporations in this country, is dead on arrival in the 21st Century. A public not consulted is a public not persuaded. A public uninformed is an insurmountable barrier against a nuclear facility in the modern world.

Fourth, good theory alone will not accomplish voluntary siting. It is a practical job. Every locale is different, and whatever the conditions in New Mexico or Wyoming, or anyplace else today, they will be slightly different tomorrow. We have, underlying the negotiator process in the United States, a fine theoretical structure. We've had the luxury of designing our program completely anew by studying the best of philosophy, psychology and public polling. We dissected the "Not in My Back Yard" (NIMBY) syndrome to understand the importance of listening to fears and needs. We've stressed the independence of the agency. We work with eight basic principles including the notion that the process must be purely voluntary. The host can drop out at any time for any reason, or for no reason at all. We begin all of our discussions with "safety first" and get to benefits last, if ever. The process must be one of full and open participation which welcomes the involvement of opponents equally with that of proponents.

But, the [eight] principles notwithstanding, it's a tough business. In North Dakota, the voters were offended that county commissioners didn't consult them even before applying for federal grant funds, and recalled the commissioners. In Wyoming, Governor Mike Sullivan did not trust the federal government to keep its promises, and opted out for Fremont County. We have representatives of the Mescalero Apaches and representatives of communities from New Mexico here with you today. The Mescaleros, as Tribal Secretary Peso advised you yesterday, remain extremely interested in moving forward, but they are surrounded by neighboring communities, the Governor's Office, and congressional delegates that are very negative toward this process.

The fifth finding is this: Voluntary siting is working in the United States, but it can't be rushed. There are many "maybes" so far, but no "yeses" yet. It is a local, deliberative process involving skeptical public leaders and vigorous opposition. Completion dates cannot be mandated from Washington.

When asked how long it will take to complete a voluntary siting, I always give just one answer. It's this: It will take until one jurisdiction says "yes," or it will take until every jurisdiction says "no," or it will take until Congress tires of counting the yeses and nos. This is a process that demands a constant and continued show of official support from Washington to build awareness, respect and trust. The definition of "working," when I say the voluntary process is "working" in the United States, does not include a guarantee that we will produce a sited facility. Instead, "working" means the potential of hosting a waste storage facility willingly remains under serious and legitimate public deliberation. We cannot guarantee either a willing host or a site in the volunteer process; however, we can continue, as I hope you will, with me, to nurture and guard the process of searching.

These five findings that I report to you have developed within the last year under our current political situation in the United States. There will be changes, however, in the next few months. With a new administration, it is widely assumed that the Clinton team will be less than pro-nuclear, or at least less pro-nuclear than was the Bush Administration. But it is dangerous to assume too much about simplistic shifts in national nuclear energy policies. As new ideas and new people build on last year's work, I think it is extremely useful to recollect the example of Sweden. That country, a few years ago, also experienced a national policy shift about which a number of major anti-nuclear assumptions were made. In the case of Sweden, the assumptions were extremely negative about the future of nuclear energy, and ended up being totally inaccurate.

In the 1980s, Sweden elected a Social Democrat coalition government that was absolutely dedicated to the elimination of nuclear power. In the 1988 election, a nationwide ballot measure called for the closure and phasing out of all nuclear power plants within 10 years. The Swedish electorate adopted and passed that national referendum. I just returned from Sweden in October. In contrast to their supposed political position, I found a vigorous nuclear energy industry. As I toured in that country, I saw the KLAB facility at Oskarshamn, which is an MRS for high-level waste, and found three operating reactors. I toured the SFR facility at Forsmark, which is a repository under the sea for intermediate and low-level waste, with waste now being emplaced, and found two operating reactors there. Last year in Sweden, some five years after that referendum, 52% of their electricity was produced by nuclear means. I also found in my survey of Swedish institutions and officials that there is absolutely no plan to terminate the operations of any reactor, unless and until alternatives are found. Significantly, neither government, nor industry, nor the population itself assumes that any viable alternatives would be found in the near term.

Thus, one can examine the astounding example of Sweden and ask how they got from a policy of closure in 1988 to a situation in 1993 of having among the most complete and progressive nuclear systems in the entire world. What happened in Sweden? How did this nationally ordered cycle of nuclear elimination become something quite different?

The 1988 referendum produced a chain of events. First, because the environmental groups and political figures who led the charge against nuclear power assumed they had killed nuclear power, it became easier to site waste facilities and to open and operate them. Because waste facilities existed, nuclear power became more viable, predictable in cost, attractive and reliable. Because the voters had chosen to make a theoretical closure decision that would have practical consequences, they had to begin to learn, as those consequences loomed closer, the real facts about the absence of energy alternatives, about the threatened loss of jobs, about projected higher costs and those practical things that impact everyone in their lives. As they learned these things, people became displeased. In reaction to that displeasure, responsive politicians had to begin to create interpretations of law and regulation that actually fostered and continued nuclear power instead of killing it. In other words, Sweden forced itself to face its energy future and found nuclear there. Instead of eradicating nuclear power in Sweden, the 1988 referendum vote had the unintended result of catapulting it forward. The negative national vote was, for that country and for nuclear technology in that country, a defining moment!

I ask you today, in January 1993, can there be any doubt in your mind that the United States of America faces a similar defining moment for nuclear power in 1993? I think this is a defining moment in our country, and, an exciting crossroads, with a singular opportunity as well. Why shouldn't the new "pro-environment, pro-jobs" Administration of Bill Clinton and Al Gore make the case, and make it in a way that is believable to the public, for a responsible nuclear power option? Why shouldn't the next administration continue or even accelerate the Bush policy for the environmentally correct management of spent nuclear fuel? Among the politically delicate challenges of the next administration will be to keep its own natural constituencies, some of which may be anti-nuclear in preference, happy and content. Perhaps the administration will be tempted to do this with a benign neglect of nuclear programs and research areas.

However, no administration can ignore *all* nuclear programs. On waste, the next administration must continue to go forward. You see, if you are pro-nuclear, we have a spent fuel management problem in the United States. If you are anti-nuclear, we have a spent fuel management problem in the United States. For every political leader and every citizen, we have a spent fuel management problem in the United States. In the next six years, 16 more of our reactors will run out of fuel storage space for their ongoing operations. By the year 2010, more than 60 reactor locations will not have sufficient capacity to store on-site their continuing production of spent reactor fuel.

There are other reasons to solve the nuclear waste crisis in the United States. As we make progress on waste solutions, it becomes possible for this administration and the industry to more openly, more honestly and more clearly evaluate the true cost and future viability of the nuclear energy option for America. There is no alternative for the new administration or any political administration in this country in this century, but to demonstrate a continuation of the orderly nuclear waste program process. For that reason, I would like to make five recommendations to everyone concerned with this program. Some might counsel that this is the wrong time to make recommendations. Instead, I suggest that this is the time to act.

Recommendation number one would be to the new Secretary of Energy and to the incoming president: Stay at work on the continuing characterization studies at Yucca Mountain, but reach out to build a sensitive local dialogue which recognizes Nevada's fears and addresses local needs. It would be a great mistake to impose some kind of vague political moratorium or stop characterization tests by issuing a general call to "study the studies." That loss of momentum, that loss of focus, by some dramatic halt of ongoing operations would be unfortunate for all parties and ultimately even for the state of Nevada. Instead, a new reality, which reaches out to recognize the sovereignty and backyard concerns of the state of Nevada is required. The approach could commence by sponsoring a round of listening, such as we do in the volunteer process. One way to start that dialogue might be to propose state roles in a phased licensing approach. An incremental licensing approach at Yucca Mountain might set up mutually agreeable and definable stages and steps for progress, construction and management, instead of assuming that the federal government and the state can now or ever agree on a single irreversible 10,000-year commitment. Thus, my first recommendation is to continue Yucca, but do so with a new sensitivity and a new approach.

Second, I would recommend that Congress and the Office of Management and Budget (OMB) should keep faith with electrical utility rate payers and strengthen the federal government's own appearance as a faithful custodian by taking the nuclear waste trust funds "off budget" in the federal budgeting process. The Department of Energy (DOE) had requested this in its letter of Dec. 18, 1992, to Sen. Bennett Johnston, D-La. It is the right result so that these funds are not held hostage in forthcoming budget balancing arrangements. It is appropriate that these dedicated-purpose, non-tax-dollar nuclear waste trust funds not be counted incorrectly in the general fund accounts. Nuclear waste trust funds should go off budget.

Third, all interested players should continue to conceptualize what a useful, cost-effective MRS looks like, or whether it will "look" at all. During my confirmation process in 1990, I found that since 1978 there have been at least 17 different concepts of and acronyms applied to a monitored retrievable storage facility. A couple more aren't going to hurt us, and a couple more aren't going to help us either.

However, it is essential to have some agreed parameters of acceptability in a volunteer process in which we expect a host initially to conceptualize in its proposal the size, location, technology, benefits and costs. It is essential that utilities, vendors, the DOE and the OMB separately make their own best bottom-line judgements and identify "drop dead" disqualifiers for a viable MRS. Somehow the negotiator must discern whether a national MRS is necessary or unattractive at this price or at that price. All of that data must be accumulated so that if we do get to the stage of negotiation, we will have a realistic set of parameters of reasonableness upon which to work with Congress and with which to advise prospective hosts. All parties should continue to define a realistic, useful and cost-effective MRS.

Fourth, it is essential that this nation and its leaders recommit to and feature the voluntary process for controversial facility siting. Perhaps I am a bit close to it, but I think that our adventure into domestic diplomacy has been one of the most exciting and useful interactions by the federal government in this half of the century. The volunteer process needs a strong, early reaffirmation from the new Secretary of Energy. We have had her predecessor's support for the last two years, and I am hopeful that Secretary Hazel O'Leary will consider using the opportunity of her confirmation hearings to make that same reaffirmation. The National Governor's Association, its regional affiliates, and several individual governors have been a bit concerned in the last couple of weeks about what the new DOE policy on the directed siting of waste facilities at existing federal sites might mean for their states. The governors ought to recommit to the voluntary process for creating nuclear waste storage sites because it assures them a voice and a vote in what is done and whether it is done at all.

The National Association of Regulatory Utilities Commissioners (NARUC), which collects the nuclear fund money, should also jump in and say by resolution how it feels about the MRS and our voluntary process. Industry should again and again state its position. Environmental and public interest groups that are committed to democratic means and environmental ends should make that same reaffirmation.

Finally, my last recommendation would be to challenge industry to resume its legitimate role of greater and not less responsibility for achieving long-term nuclear waste solutions. Utilities should not become falsely comfortable behind promised 1998 fuel acceptance dates or any "quick fix" negotiations with the DOE about what the government itself will do to solve these problems.

Nuclear waste solutions have become collaborative consultations beyond the control of even highly centralized or autocratic national governments in this world. It is my view that Sweden's accomplishments in the advancement of its waste management program are in large part due to the fact that the utilities insisted on keeping for themselves a private responsibility in that country for siting and constructing and operating waste facilities. They left the Swedish government in its most legitimate role of overseer, regulator and licensor. There, industry proposes to turn over those facilities to the national government only after the waste is fully emplaced and they are ready for closure. In my view, the U.S. needs more of that rebalancing through a greater role for industry and less delegated responsibility to government for creating solutions in the interim management of spent fuel waste.

In closing, I suggest that 1993, with the change in administration, is a time for action and a time of opportunity. I think it can be an exciting challenge to use the new administration's romance with and responsibility to the American people to push for nuclear waste solutions. That new opportunity should not be squandered on programs and activities less vital or complex than our national energy policy and future. I am very hopeful that with your advice, the new administration will focus, early and effectively, on spent nuclear fuel issues as a top priority.

David H. Leroy was appointed the United States Nuclear Waste Negotiator in 1990 by President George Bush. Leroy, a former prosecuting attorney, has served as Idaho's lieutenant governor and attorney general, and in 1986 he ran unsuccessfully as the Republican gubernatorial candidate. Leroy chaired the energy committee of the National Association of Attorneys General from 1980-82 and was chair of the NAAG Western Conference from 1981-82. Leroy earned his B.S. and J.D. from the University of Idaho, and earned a master of law degree in trial practice and procedure from New York University.

IAEA Safeguards Criteria

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Abstract
The development of and early experience with a unified set of criteria covering International Atomic Energy Agency (IAEA) safeguards implementation and evaluation activities for the period 1991-1995 is presented. The scope, structure and use of these criteria are described, as are the general principles behind IAEA verification requirements. Experience with these criteria in 1991 and 1992 is reviewed, in particular with respect to the increased use of certain procedures (e.g., zone approach, dual C/S) but slower-than-anticipated implementation of other procedures (e.g., randomization applied to domestic transfer verification).

I. Introduction

Safeguards implementation by the IAEA has evolved, over the past 25 years, from relatively simple beginnings into its current high level of technical sophistication, and it continues to evolve today. IAEA safeguards must have as high a degree of credibility as possible and must, therefore, have a sound technical basis. It follows, then, that certain standards or criteria (safeguards criteria) are required which define the type and depth of activities performed (safeguards implementation) and against which the results obtained can be judged (safeguards evaluation).

In the early 1980s, the IAEA placed increasing emphasis on the formalization of safeguards criteria for use in the evaluation of safeguards implementation for its annual Safeguards Implementation Report. In the mid-1980s, in order to provide an agreed understanding on the expected future development of safeguards, longer-term criteria were drafted. After extensive review, these were transformed into long-term guidelines, which *inter alia* are taken into account in the agency's Safeguards R&D program.

In the spring of 1988, the Department of Safeguards initiated a project to develop and document unified criteria to govern all safeguards implementation and evaluation activities. In the ensuing two-and-a-half years, a major effort was dedicated to developing these criteria, primarily involving IAEA staff but incorporating relevant advice from the Standing Advisory Group on Safeguards Implementation (SAGSI), and including informal reviews by a number of IAEA member states. This effort benefited from a wealth of practical experience. In January 1991, these criteria went into effect as the Safeguards Criteria 1991-1995. They are to be valid for a period of five years, with a midterm review for updating as required by new developments. This paper reviews the development of the safeguards criteria and the experience with the first years of safeguards implementation and evaluation under these criteria.

II. The Safeguards Criteria

Safeguards activities are governed by the safeguards agreements between states and the agency. Under such agreements both the states and the agency take on obligations and responsibilities. The activities considered by the agency Secretariat as necessary for fulfilling the agency's responsibilities are incorporated into the safeguards criteria.

The IAEA safeguards system, in essence, translates safeguards objectives contained in the agency's statute and in safeguards agreements into inspection goals and procedures applicable to the wide range of situations to which IAEA safeguards are applied. The safeguards criteria cover a major part, but not all, of the agency safeguards system, namely:

- safeguards approaches,
- technical capabilities,
- facility practice,
- safeguards measures,
- inspection procedures and
- effectiveness evaluation.

The safeguards criteria do not touch state systems' activities or IAEA inspection statements to states.

The safeguards criteria are used for the planning of safeguards implementation activities in the field and at agency headquarters for all facilities and locations outside facilities covered by safeguards, as well as for the evaluation of safeguards implementation at facilities and at the state level. While the criteria cover safeguards measures at all facilities and locations, the evaluation of individual facilities for presentation to the IAEA Board of Governors in the form of the safeguards implementation report (SIR) is performed only for those with an inventory of one significant quantity (SQ) or more.

The safeguards criteria define for all facilities and locations the normal frequency of inspection; additional inspections may be performed in particular circumstances. However, any limitation on the frequency of access incorporated in a safeguards agreement is taken into account.

The criteria cover safeguards performed with both INFCIRC/153-type and INFCIRC/66-type safeguards agreements, as well as agreements with nuclear weapons states ("voluntary offer"). Differences incorporated into the criteria account for differences in the obligations and undertakings of states and the agency under INFCIRC/66-type agreements as compared to those under comprehensive safeguards agreements, i.e., under INFCIRC/153.

Important examples are the criteria introduced for non-nuclear material, facilities and equipment covered by a safeguards agreement.

The safeguards criteria currently consist of sections for 11 facility types, for locations outside facilities and for entire states. Each section contains up to 17 paragraphs, as listed below, which detail all safeguards implementation activities relevant to that facility type:

- auditing of records and reports,
- physical inventory verification (PIV),
- verification of domestic and international transfers,
- verification of other inventory changes,
- verification at other strategic points,
- confirmation of the absence of unreported production of direct-use material,
- confirmation of the absence of nuclear material borrowing
- material balance evaluation,
- verification at interim inspections for timely detection purposes,
- anomaly follow-up,
- verification of design information,
- verification of operator's measurement systems,
- confirmation of transfers,
- verification of small inventories (<1 SQ),
- activities related to non-nuclear material under safeguards,
- activities related to equipment and facilities under safeguards and
- activities related to inventories and lists of information.

Most inspection activities are related to nuclear material. The criteria distinguish nuclear material in three ways: by categories, types and strata.

Nuclear material categories are unirradiated direct-use, irradiated direct-use and indirect-use material, which are used primarily in specifying detection probabilities and timeliness goals.

Nuclear material types are plutonium; uranium containing 20% or more of the isotope U-235; uranium containing less than 20% of the isotope U-235 (including natural and depleted uranium); U-233; and thorium. These types are used in defining significant quantities (SQ) — the approximate quantity of nuclear material from which a nuclear explosive device could be manufactured. The necessity to perform activities and the allowable limits for not performing certain activities are based on SQs for a nuclear material type.

Strata are groups of items or batches having similar physical and chemical characteristics. They are used in agency verification activities and for its reporting. Standardized main strata, e.g., UO_2 powder, are utilized in the specification of inspection activities.

For a facility type and a specific inspection activity, the criteria specify for each stratum the necessary and sufficient verification measurements. The specification includes the detection probability to be achieved and the type of measurements (called defect tests) to be performed. The requirements for defect tests are based on credible diversion scenarios; practicality or intrusiveness are taken into account where appropriate. An example of a criterion is: *For natural UO_2 powder at a physical inventory verification (PIV), verification measurements must be performed with medium detection probability for gross and partial defects.*

That criterion applies to an INFCIRC/153 state; in an INFCIRC/66 state, high detection probability is required.

Attached to each section of the criteria is a table which connects the verification measurements required for each stratum of nuclear material and the recommended instruments to be utilized to perform the measurements at that facility type. This provides inspectors with guidance for the selection of instruments. The recommended instruments are those most commonly used from the instruments currently authorized by the agency for the specific measurement. An alternative instrument may be used from among the authorized instruments for economy, convenience or other reasons. A facility operator's instrument may be utilized provided appropriate authentication is performed. To keep these tables up to date, they are reviewed annually and new or improved instruments are included as they become available. The first such update was done early in 1992, and the second update will be done early in 1993. In these updates, several newly approved instruments have been added.

There are eight annexes to the criteria which present definitions and special criteria. One annex addresses how containment and surveillance measures (C/S) are to be applied and what the requirements are for remeasurement and reverification of material which is covered by C/S. Other annexes present special criteria for confirmation of the absence of borrowing of nuclear material between facilities and for difficult-to-access fuel items. The latter is one example of a number of cases that require specific approval, namely for the designation of fuel items as difficult-to-access and for the dual C/S system applied to those items.

Table 1

Values of Detection Probability

	Not Under C/S		Under C/S					
			PIV		Transfers		Timely Detection	
Material Category	*PIV and Tansfers*	*Timely Detection*	*Nuclear Material*	*Seals*	*Nuclear Material*	*Seals*	*Nuclear Material*	*Seals*
Unirradiated Direct-Use	High	Med./High	10% remeasured	Med.	High	Med.	......	Low/Med.
Irradiated Direct-Use	Med./High	Low/Med.	10% remeasured	Low/Med.	Med./High	Low/Med.	......	Low
Indirect Use	Med./High	......	10% remeasured	Low/Med.	Med./High	Low/Med.	......	......

High = 90%
Med. = 50%
Low = 20%

A/B { A = INFCIRC/153; B = INFCIRC/66 }

The objective of the IAEA in meeting its obligations under safeguards agreements is to provide a high level of assurance that member states are complying with their obligations under those agreements, e.g., that the nuclear material under safeguards has remained in peaceful uses. Providing that high level of assurance does not translate into a requirement for a high detection probability in all cases. Rather there is a graded set of requirements which take account of the ease with which the material could be misused and whether the agency's conclusion relates to a potential diversion over a material balance period or to a timely detection of abrupt diversion. For this purpose, three levels of detection probability are used.

The values of detection probability specified in the criteria are summarized in Table 1. As mentioned above, nuclear material category is used as the classifying characteristic. The table also distinguishes material not under C/S and under C/S. The three levels of detection probability used are high (90%), medium (50%) and low (20%). In addition, a 10% detection probability applies to remeasurement of material under acceptable C/S at a PIV; this remeasurement is performed to increase the assurance provided by the C/S system after it has been in use for a period of time. General requirements for the defect tests specified in the criteria are summarized in Table 2. Again, material category is a primary classifying characteristic. There are three types of defect tests that may be required: gross, partial and bias. Again, a graded set of requirements is introduced, ranging from performance of all three defect tests on bulk unirradiated direct-use material down to only gross defects (in the case of remeasurement of spent fuel under acceptable single C/S, item counting is accepted as sufficient). This takes account of the attractiveness of the material for diversion and whether the material balance, timely detection or remeasurement of material under C/S is involved. Special situations are also considered, e.g, the lack of availability of a suitable instrument results in the requirement for only gross defects to be performed on spent fuel being transferred. Credible diversion paths have been taken into account in not requiring bias or partial defect tests for fuel items made with natural or low-enriched uranium.

A general principle used in the criteria for both detection probabilities and defect tests is to require one level less for timely detection than for the PIV. This reflects the fact that primary emphasis is placed on the conclusion reached after each material balance period, and lower emphasis is placed on individual conclusions for timely detection. However, since the verifications for timely detection are repeated, e.g., every month for separated plutonium, there is also an accumulation of assurance which can be considered to increase the confidence level of timely detection conclusions.

Table 2

General Defect Test Requirements

	Defect Tests — Material Not Under C/S		Remeasurement — Material Under Single C/S
Material Category	*PIV and Transfers*	*Timely Detection*	*PIV*
Unirradiated Direct-Use	**G, P, B***	**G, P***	**G,P***
Irradiated Direct-Use	**G**	**G**	**I**
Indirect Use			
LEU	**G, P, B***	...	**G, P***
Natural	**G, P***	...	**G**
Depleted	**G**	...	**G**

G = Gross **P** = Partial **B** = Bias **I** = Item Count * = Not required for fuel items

III. Experience with Implementation of the Safeguards Criteria in 1991 and 1992

The introduction of these criteria has resulted in increased uniformity of safeguards implementation at facilities around the world where that is appropriate, while retaining or even increasing the options for inspection activities wherever possible or necessary.

Development of the Safeguards Criteria 1991-1995 provided the opportunity to formalize trends in safeguards approaches that had evolved in previous years and to introduce some new approaches. The most significant are:

- one PIV per year for each facility (previously two PIVs were performed per year at certain facilities);
- further emphasis on verification activities on direct-use material (separated plutonium and HEU), including verification of all receipts and shipments of such material; and
- possibility for applying a dual C/S system for all material to reduce remeasurement and reverification requirements.

The safeguards criteria also provide incentives for the use of certain procedures, in particular for the use of:

- a zone approach as an alternative to verifications of transfers of material between facilities included in a zone and
- randomization procedures for verification of domestic transfers of indirect-use material, in particular at natural uranium and LEU fabrication plants.

Arrangements to introduce the criteria began early in 1990 and involved both internal agency preparations and training as well as providing information to and making arrangements with states. Although much had been done by the time the criteria came into effect in January 1991, it is not surprising — given that safeguards are implemented at close to 500 facilities in more than 50 states — that in some cases additional time was required to complete preparations.

Thanks to a cooperative attitude from states, the introduction of the safeguards criteria has in most cases gone well. Following is a summary of experience in some areas.

Direct-use (plutonium) conversion and fabrication plants. Approved facility-specific procedures for in-process material verification for timely detection purposes have been implemented at three facilities. Several procedural changes have been made involving pellet sampling, plutonium isotopics verification and indirect-use material transfer verification.

Zone approach. Four zone approaches have been approved and implemented as more efficient alternatives to meeting the requirements for domestic flow verification. Three of the approaches cover natural/low-enriched uranium fuel fabrication for domestic reactors. The fourth involves a large nuclear research center handling all types and categories of nuclear material.

Dual C/S. In order to meet the requirements of the criteria in the most efficient manner, 14 applications of dual C/S in nine states (some applying to several similar facilities) have been approved and implemented. Many of these dual C/S systems are applied to spent fuel in storage at reactors or at separate storage facilities and involve the use of two functionally independent seals based on different physical principles. Dual C/S is also being applied to unirradiated direct-use material, utilizing seals and optical surveillance systems.

Randomization applied to domestic transfer verification. The preferred approach in the criteria for verifying domestic transfers is a randomized inspection scheme. This approach has not yet been implemented at any facility. The establishment of workable arrangements with facility operators is more difficult than originally envisaged. It is hoped that progress can be made after successful results of a test in preparation are available.

PIVs at LWRs. The standardization of the verification requirements for PIVs at the more than 130 LWRs of different types under safeguards has required more time than anticipated but is now largely complete.

IV. The Safeguards Criteria and the Evaluation of Safeguards Effectiveness

The annual evaluation of safeguards effectiveness on a facility and state basis for the purpose of the safeguards implementation report (SIR) is based on the safeguards criteria. Full attainment of the inspection goal at a facility requires completion of all the applicable activities during each material balance period. The completion of the activities required for timely detection at a facility is evaluated separately. Certain parameters which cannot be evaluated at the individual facility level are evaluated at the state level.

Procedures for evaluating safeguards effectiveness have been modified to be consistent with the safeguards criteria and used for the preparation of the SIR for 1991. Evaluation of the material balance component is now based on the material balance period, while the evaluation of the timeliness component continues to be based on the calendar year.

In the effectiveness evaluations for 1991, it was found necessary to take account of delays in implementation arrangements by temporarily relaxing for that year a few criteria requirements in ways which did not significantly affect the agency's conclusions. Consequently, the effectiveness evaluation for 1991 was quite similar to that of previous years. The agency's inspection goals were fully or partially attained for the same percentage of facilities as in the prior years, although a few less full and a few more partial attainments were recorded. It is expected that the percentage of facilities at which full attainment is achieved will return toward its former level.

V. Conclusions

A major effort by the agency has produced a comprehensive set of safeguards criteria which are forming the basis for the planning, implementation and evaluation of safeguards activities during the period 1991-1995. This action has been carried out in the context of the requirements for adaptability and flexibility of the agency's safeguards as they would evolve throughout the first half of the 1990s, maintaining the all-important requirement of credibility through practical and consistent safeguards practices.

The considerable efforts made by the agency and by states to implement the safeguards criteria into inspection practice have been largely successful. The evaluation of safeguards effectiveness for 1991 has confirmed that the requirements are being met in most cases and pointed out the areas where further effort has been directed in order to achieve full implementation.

In previous years, safeguards criteria were revised annually to take into account improvements in safeguards practices and procedures and technology. Although justifiable, these annual revisions gave the impression that the agency safeguards was a moving target, which was, for the agency, member states and facility operators, an undesirable basis on which to plan and manage their respective activities. These concerns are addressed by the Safeguards Criteria 1991-1995, which are expected, by and large, to be adequate and sufficient for a five-year period, due to their comprehensive and detailed nature. It is anticipated that this will enable the agency to enhance in certain areas the effectiveness and consequently the credibility of its safeguards program. Improvements in efficiency are also occurring, as the best alternatives in the criteria are selected and implemented.

Nevertheless, to maintain credibility, safeguards cannot be frozen in time. Therefore, a midterm review of the criteria is planned at which time modifications or fine-tuning of some requirements will be considered if the implementation and evaluation experience dictate a need. At that time there will also be an opportunity to introduce changes coming from current efforts to strengthen and improve the cost-effectiveness of IAEA safeguards.

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Status and Trends of Safeguards Equipment Development

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Abstract

Meeting the technical and logistical challenges of international safeguards instrumentation has been a major concern since the first safeguards inspection in the early 1960s. This concern and the related activities have been pursued vigorously since the inception of Member State Support Programmes in 1976. The International Atomic Energy Agency (IAEA), with the vital and crucial assistance of member states, has strived toward reliable, credible instrumentation that can be directed toward the various specific applications encountered in the nuclear fuel cycle. This paper provides a status report on agency instrumentation as of 1993 and lists some of the new, perhaps even more formidable, challenges and trends that are expected to be encountered over the next few years.

I. Introduction

Technically and logistically, the application of credible instrumentation for international safeguards purposes is a major challenge. Technically, the IAEA inspector is expected to make credible measurements under industrial conditions on a wide variety of nuclear material in varied chemical and physical forms. Logistically, this must be done at nuclear installations literally around the world. The time available to set up and perform a given set of measurements is strictly limited, with virtually no time allowed on site for control measurements, resolution of equipment problems or other activities that would normally be required.

Meeting the technical and logistical challenges of international safeguards instrumentation has been a major concern since the first safeguards inspection in the early 1960s. This concern and the related activities have been pursued vigorously since the inception of Member State Support Programmes in 1976. The agency, with the vital and crucial assistance of member states, has strived toward reliable, credible instrumentation that can be directed toward the various specific applications encountered in the nuclear fuel cycle. This paper provides a status report on agency instrumentation as of 1993 and lists some of the new, perhaps even more formidable, challenges and trends that are expected to be encountered over the next few years.

One particular attribute associated with the effective utilization of instrumentation (or any tool) must be emphasized. A minimum, continuing infrastructure is essential to support the development and implementation of instrumentation. Operationally, this is equivalent to saying that the design, construction and utilization of a new highway will be seriously compromised unless adequate provision is made to plan, document, maintain and upgrade the highway over its useful lifetime. This is an obvious statement, but it is of fundamental importance when determining the total resources needed for effective development and implementation. Thus an integrated approach to overall resource management is needed to accommodate the development and implementation of safeguards instrumentation in the face of continuing financial constraints, changing requirements and increasingly difficult applications.

II. Background and Present Status

Agency safeguards instruments are traditionally divided into two categories that relate to their function: 1) nondestructive assay (NDA), and 2) containment and surveillance (C/S). In practice, this classification has become somewhat less definitive, since NDA instruments may be employed as components of a C/S system that monitor, identify or count radiative items. In any event, the major operational usage of safeguards instruments can be described by the following:

- quantitative NDA instruments
- C/S instruments
- monitoring systems

Quantitative NDA instruments are primarily used in the course of physical inventory and material transfer verifications. An attribute of the nuclear material is detected and then related to the amount of nuclear material present. C/S instruments provide a continuity of knowledge (COK) of material containment, number of items or the status of areas through the use of optical surveillance, sealing or other means of assuring that the previously acquired quantitative data is

Table 1
Staff Positions
Instrumentation Support

Section	Professional Staff	Technical Staff
DID	12	5
DEM	7	13
DTR	5	1

still valid. Monitoring systems detect an attribute of an item and monitor its movement in a specified area.

An overly simplified description of the present status of agency safeguards instrumentation is that an instrument or instrumental system exists to more or less cover all instrument applications generally encountered by agency inspectors.

A more extended description is required to detail the specifics. Also, more customized applications may lack the appropriate instrumental tools. Of course, advances in technology are also rapidly making components obsolete. In addition, for every specific instrument application there should be a detailed procedure that comprehensively defines all details of the instrument application. Unfortunately, this is not the case. Consequently, one cannot become complacent over the present situation.

The present list of IAEA safeguards instruments authorized for inspection use contains 69 items. Classification of the 69 authorized instruments is as follows:

- NDA 41
- C/S 23
- Monitoring systems 5

Authorization is the process employed by the Department of Safeguards to ensure that the instrument (or instrumental system) meets a minimum set of criteria. To satisfy the criteria several conditions must be fulfilled: experimental evidence is available that the instrument meets the functional specifications, a formalized safety evaluation has been conducted, appropriate documentation is complete and provisions are made for maintenance and training of inspectors and the maintainers.

The total inventory of safeguards equipment consists of approximately 5,000 items with a net value of roughly $20 million. Roughly half of this equipment is located in the field. These quantities are of interest when defining a commensurate support infrastructure, one that can provide performance monitoring, inventory control, maintenance, training and other functions that are required for the implementation of reliable, credible instruments. Therefore capabilities and limitations on human and financial resources available to the agency to perform these tasks must be taken into account when developing new safeguards equipment.

Table 1 lists the agency staff positions available for the Instrument Development Section (DID), Equipment Management Section (DEM) and the Training Section (DTR). It should be noted that due to the present financial crises not all of these positions are filled. In addition, DID can only allocate approximately 50% of staff time to development activities and DEM 50% to maintenance activities. Additional human resources for instrument support activities are provided via cost-free experts supported by Member State Support Programmes (MSSP).

The majority of maintenance is performed by agency staff (DEM) in Vienna. The Tokyo Regional Office has one technical staff member in residence and at the moment the Toronto Office has none. Inspectors ship an entire malfunctioning unit to Vienna for repairs, or if the unit is modularly designed, only the module that has indicated a failure is returned. If sufficient activities warrant the trip and there are travel funds available, some preventive maintenance is performed on site by DEM technical staff. Maintenance is also performed under contract with commercial companies (usually the developer); however, this does not completely relieve the agency of its maintenance burden. It only shifts some of the burden from the support division to the operational division.

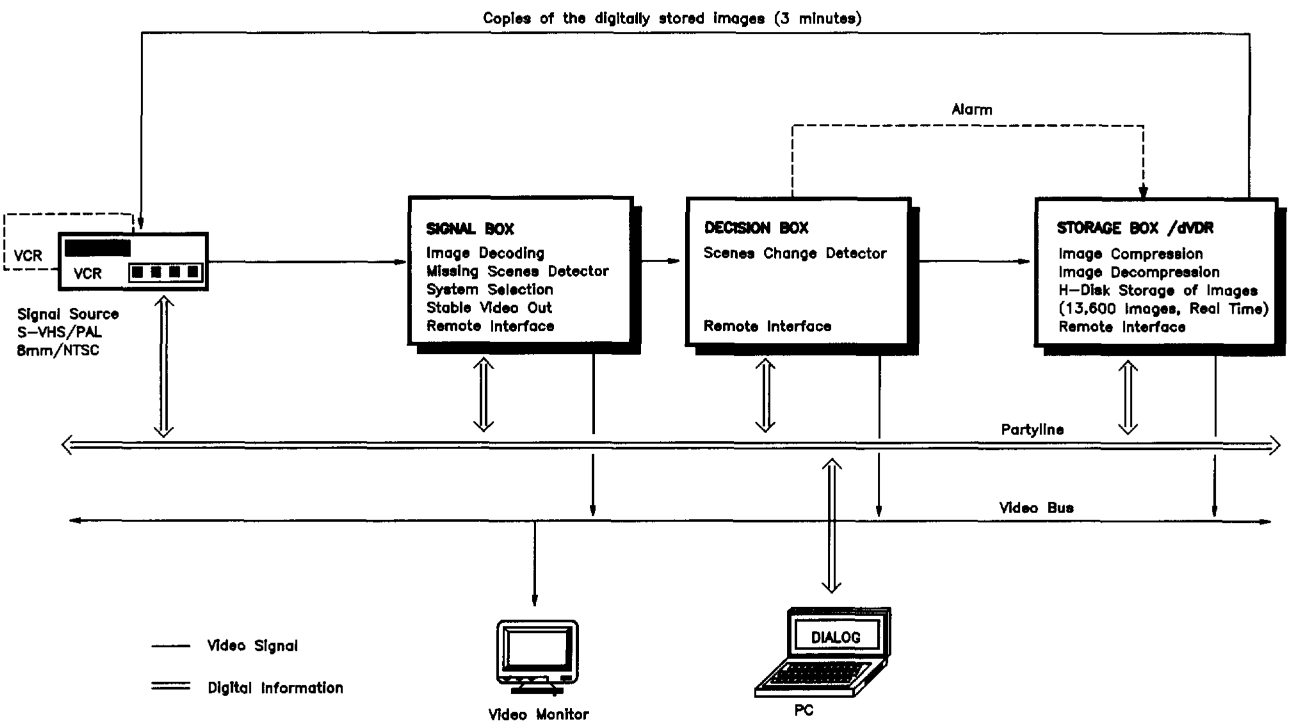
The instrument training program is comprehensive. Training is conducted in a variety of modes ranging from a self-help video to a fully staffed course at a nuclear facility conducted over everal weeks. Not all courses are concerned solely with a single instrument. For example, a course may cover the whole process of conducting a physical inventory verification inspection at a specific type of facility. Consequently, the course would include instructions on the application of a number of instruments that are deployed at that facility.

In 1993, 12 training courses that are related to instruments and instrumental use are scheduled. This represents 254 inspector weeks. (This does not include the agency instructor time or very specialized training that may be required for a custom application.)

Virtually all instrument development is performed via

Figure 1

GRS SCHEMATIC – Multi-System Optical Review Station (MORE)



MSSP tasks. Agency task officers provide liaison with the developers during the formulation and design phases, and at the appropriate time they as well as inspectors participate in the test and evaluation phase. Most instrument development tasks conclude with the production model instrument that can be procured by the agency for inspection use. Occasionally, if the instrument is expected to be used extensively, Member State assistance will be extended to the initial implementation phase.

There are 14 Member State and Euratom Support Programmes presently active. Practically all have some activities associated with safeguards instrumentation, although not all are involved in original instrument design and construction. Some participate primarily in providing facilities for testing.

The final agency resource that should be briefly mentioned is the equipment budget. For 1993 this is $3.8 million. This is an amount that would be expected to take care of the normal replacement cost of a $20 million equipment inventory. However there will have to be some substantial new purchases of equipment for new facilities coming under safeguards. To the extent possible, the replacement cycle of older equipment will have to be extended.

III. Recent Equipment Developments

A few examples of equipment presently under development or recently introduced into use are illustrative of the features and functions of new safeguards equipment.

General features can be simply described. A typical system (for any category) consists of a sensor, data processor, data storage unit and a review unit. The sensor could be a TV camera, radiation detector or similar device coupled to its control, data storage and review modules. The actual packaging varies from device to device; however, the functions are universal and the implicit notion that all systems are microprocessor or computer controlled is valid.

The major challenge is to effectively exploit these capabilities *and* similarities to optimize and standardize the equipment and resources needed to efficiently implement them. In the final analysis, a reliable, rugged, user friendly instrument is needed.

Generic review station (GRS).[1, 2] (Figure 1) With the increased capacity of CCTV optical surveillance systems, the review of data by inspectors is a time-consuming and potentially ineffective task. From past experience, less than 5% of the recorded data has any safeguards significance in

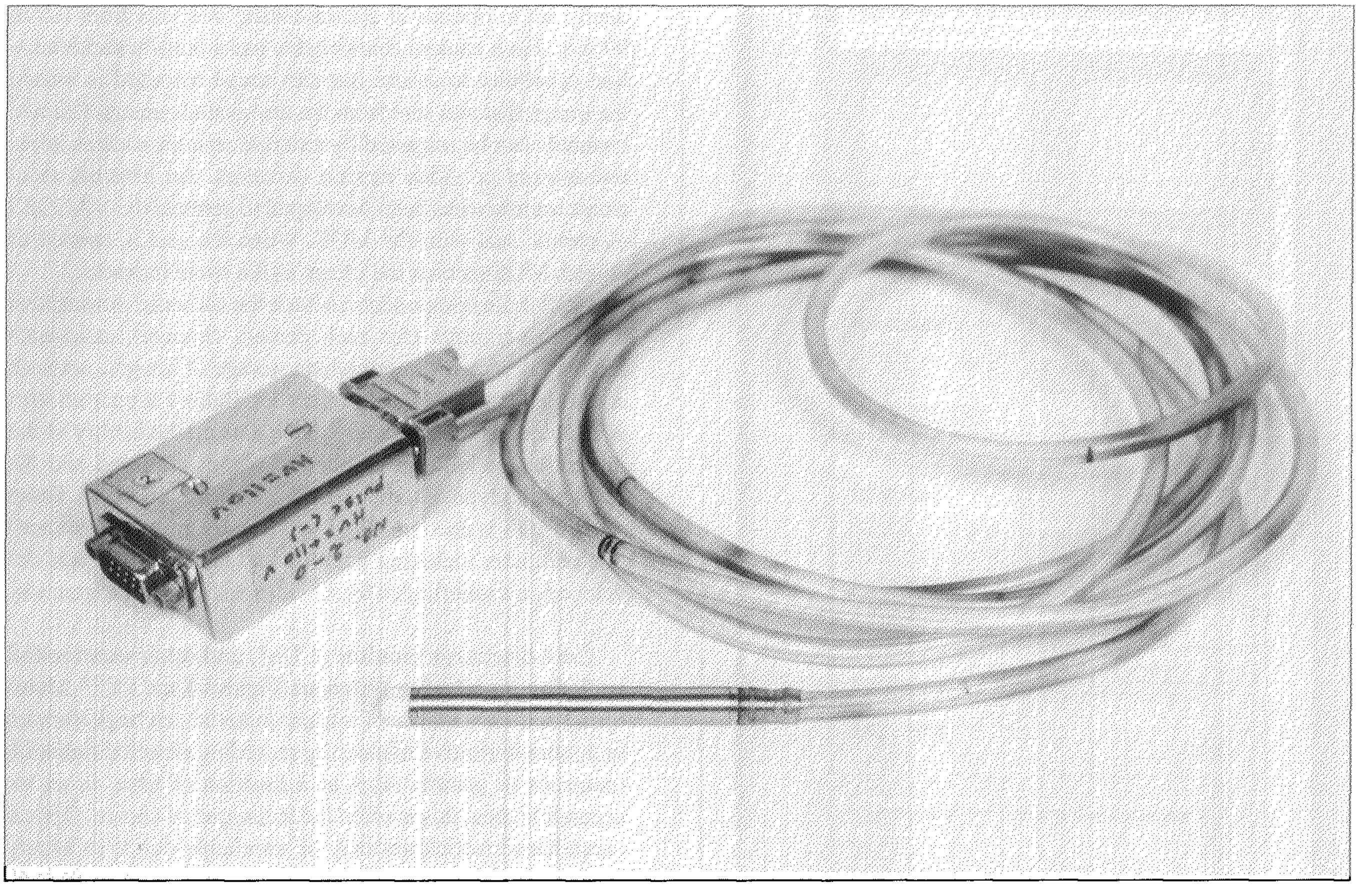


Figure 2. Miniaturized CdTe detector probe with cable and preamplifier.

terms of a changed situation (i.e., indicates a possible movement of nuclear material). Consequently this situation represents an ideal opportunity to increase efficiency and effectiveness through an automated review station.

Besides reviewing the safeguards significance of surveillance data, inspectors must be assured that the system functioned during the entire surveillance period (i.e., there were no missing or black scenes). Tamper signals must also be acknowledged. Typical surveillance tapes contain 30,000 scenes, so the technical or functional review is a nontrivial task.

Three CCTV optical surveillance systems are presently authorized for inspection use and a fourth system is in the final stages of development and acceptance testing. The GRS concept was proposed as a single entity to process video surveillance tapes from all of these systems. The surveillance systems record on different tapes (8mm, VHS and Super VHS, and in different recording standards EIA and CCIR — North American and European standards). Convenience of a single GRS is important; however, the savings from reduced inspector training, maintenance, inventory and other support costs is even more significant.

Operationally the GRS will reduce the inspector's total review time by 75% or more. For multicamera surveillance systems (MUX and MOS), the reduction should be by more than 90%. Effectiveness should also be increased since all the scenes of safeguards relevance are identified and separately stored for careful review by the inspector. The feasibility of the GRS has been demonstrated and production models are expected to be available in mid 1993.

Miniaturized CdTe detector systems.[3] Cadmium-telluride (CdTe) gamma ray measurement systems (Figure 2) are potentially well-suited to complement existing NaI and high purity germanium (HPGe) detector systems for international safeguards applications. Two factors are responsible for our interest:

1) CdTe detectors can operate at room temperatures, and
2) detectors are small and easily transportable.

Even when operating at room temperatures, the energy resolution of CdTe detectors (1% to 4%) is superior to that of NaI detectors. At lower temperatures (obtainable by Peltier cooling), the energy resolution is further improved. The inherently small size of CdTe detectors is particularly important when measurement accessibility is restricted or collimation or shielding dimensions are limited.

An example of a CdTe probe that has been developed through the Russian Federation Support Programme is a

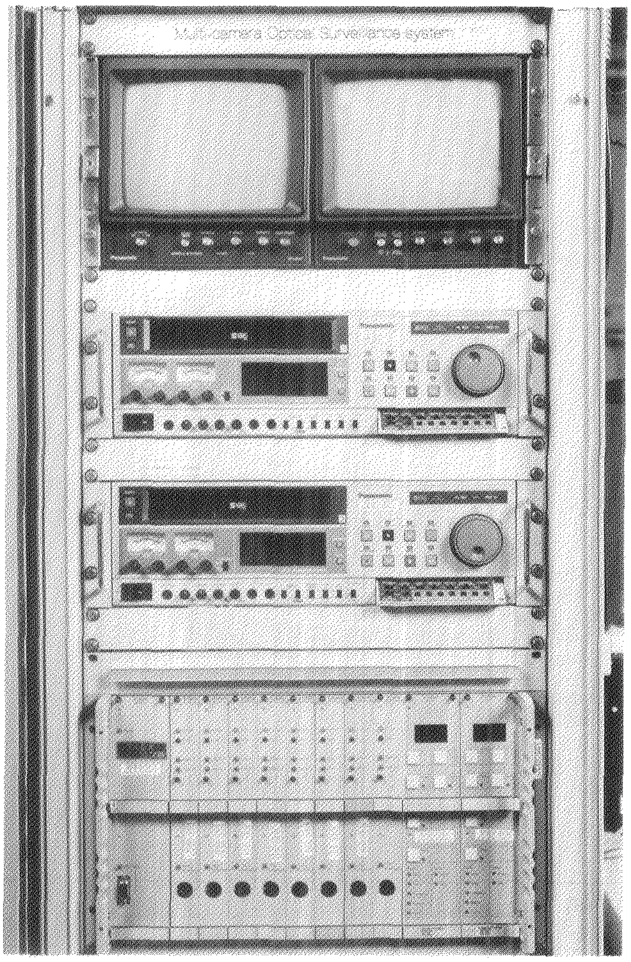


Figure 3. Multicamera optical surveillance system.

miniaturized device that incorporates both the CdTe detector and a hybrid chip that forms the first stage of a charge sensitive preamplifier. The detector probe has a diameter of 8.2 mm and length of 100 mm. The probe can be located up to 2 m from a small portable multichannel analyzer. The probe's numerous useful applications include insertion into cooling channels of reactor fuel assembles.

Further CdTe detector resolution improvements have been demonstrated through the use of pulse-shape discrimination (PSD) electronics developed under a joint French-German Support Programme task. PSD systems have been used before with an unacceptable loss of detection efficiency. The new system corrects, rather than eliminates, pulses with slow rise times. Consequently, dramatic improvements in detection efficiency, spectrum resolution and enhancement of the photopeak fraction are now possible.

Multicamera optical surveillance system (MOS).[4, 5] (Figure 3) The most recently developed and the most sophisticated optical surveillance system authorized for inspection use is the MOS system. Up to 16 cameras can be connected to the system. Each camera channel can be independently set to operate at picture-taking intervals from 0.5 to 99 min. Each camera channel also has a built-in authentication capability to assure that the image recorded is indeed the image that was sent from the designated camera. Camera channels can be triggered by external sources such as infrared sensors or video motion detectors. An external electronic interface has been developed to connect the VACOSS electronic seal with the MOS. When the seal is opened or closed, MOS records the image as the event happens.

MOS main components include the cameras, transmitters and receiver units (for each camera channel), solid-state memory device for intermediate storage of images, network controller and the videotape recorder. Battery supported storage (notebook) is available to save data on the history of the inspection period, the number of scenes recorded and the number and type of tamper events that have occurred. Setup of the MOS is accomplished by virtually any IBM-compatible computer including palmtop and laptop. MOS was developed on a task funded by the German Support Programme.

Core discharge monitor (CDM) and other unattended radiation monitoring systemsn (Figures 4 and 5).[6,7,8] Monitoring and surveillance of nuclear material can be performed in a more definitive manner by recording detected radiation (neutrons or gamma rays) as a function of time. In an inaccessible area, this is often the technique of choice. Optical surveillance techniques may be unreliable due to relatively high radiation fields that are occasionally present in such areas. This is particularly true of reactors that are fueled on-load such as CANDUs or other facilities that move irradiated fuel on a routine basis.

The CDM, which was developed by the Canadian and United States Support Programmes, detects fuel at discharge from the core face of CANDU reactors. Both neutron (normal on-load discharge signal) and gamma ray detectors are continuously monitored over time. The inspector, upon review of the data, is able to clearly identify irradiated fuel discharge even when the reactor is in a shut-down condition.

The CDM system was designed to be "fail-safe." Sufficient redundancy was built in to accommodate individual component failures without compromising the CDM's operation. The detection monitors are designed to last the lifetime of the reactor, since their location inside an inaccessible area limits possibilities for maintenance and repair. Automatic performance monitoring and failure announcement are other features that have been incorporated.

To date, the CDM system has performed very well. Normal on-load refueling is detected with a strong signal to background regardless of the reactor power level and the location of the discharge channel. Discharge of fuel bundles after long periods of reactor shut down (more than one year) have been clearly seen, provided the bundles have a non-trivial burnup.

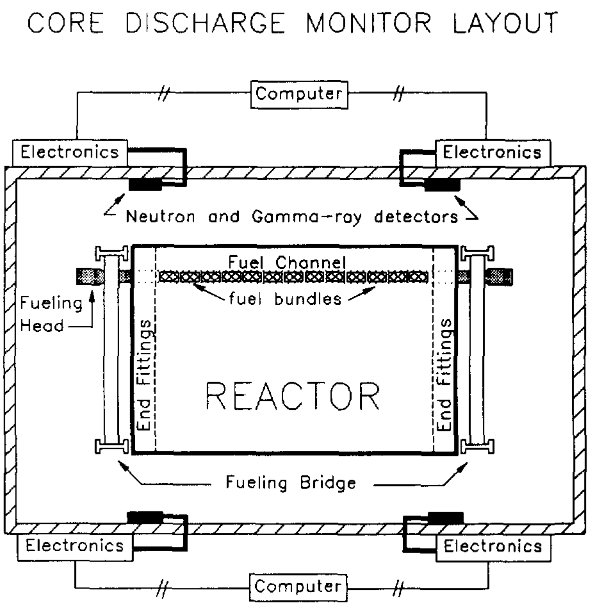


Figure 4

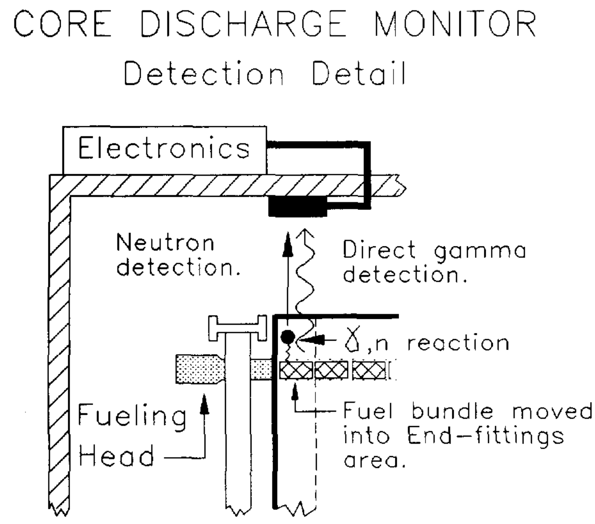


Figure 5

IV. Trends for Future Equipment Development

Predicting safeguards equipment trends is a bit like long-term predictions of the weather or the stock market — uncertain at the best. However, if the past, and in particular the recent past, is any guide, then some trends seem evident.

Overall equipment costs must be minimized. The financial and human resources of the IAEA are limited and are likely to remain so. Instrument costs have always been a prime consideration, but other costs that are directly related to instrument usage must also be minimized.

Development of new equipment must include the lifetime costs associated with the instrument. Use of standard and modular construction that minimize training and maintenance requirements are two examples of potential cost savings. Designing in flexibility for integration of modular components into a system whole is another cost-effective technique. Planning for technological improvements or changes that can be cost-effectively incorporated into an evolving instrument can be important.

Design of an instrument for the future must include not only the intended application but also the agency environment and infrastructure that will support and utilize the instrument.

Shifting role for agency instrumentation. It is likely that the future role of agency instrumentation will shift somewhat to emphasize minimum inspector time at a facility and more use of multipurpose lightweight portable equipment.

In-situ equipment with a capability for quick readout via a notebook or palmtop computer will improve efficiency. If conditions are appropriate, this readout could be done remotely.

Special inspections if performed at an increased frequency will require very portable multipurpose equipment. This may include survey instruments capable of determining elemental identification of samples in the field or sorting samples for classification or shipment. Complementary equipment for geophysical location determination and communication may also be necessary.

Highly accurate measurement capability for checking other results. In the future, the IAEA may make increasing use of SSAC (State System for Accounting and Control) verification measurements. Techniques and equipment will be needed to independently and accurately check these measurements. In a similar sense, the checking of outlier measurements may become increasingly important.

Long-term storage of irradiated fuel. Over the next decade the long-term storage of irradiated fuel will increase. Two aspects associated with this tendency will merit attention. A cost-effective measurement technique to determine quantitatively the input material for storage, preferably after conditioning of the material, would be most useful. Cost-effective, highly reliable monitoring techniques after placing the material into storage will also be needed.

V. Summary

An extensive set of instruments exists today to meet the varied applications encountered by agency inspectors in the field. A major effort is needed to maintain our present instrument capability, including provision of the required support services.

Newly developed agency equipment exemplifies several trends that are becoming increasingly prominent. The generic review station will substantially reduce inspector review time of optical surveillance data and improve the reliability of review results. A single unit will be capable of reviewing data from different optical surveillance systems. Training, maintenance and inspection costs will be reduced. Miniaturized detection systems (CdTe) will increase portability and measurement accessibility. Integration and system flexibility will be enhanced through the use of the multicamera optical surveillance system. Unattended monitoring systems such as the core discharge monitor provide definitive information at key measurement points.

To achieve cost savings, the total instrument infrastructure needs to be considered in the development of new equipment. Increased use of standards and flexible design may improve the situation.

The Safeguards Department has embarked on a program designed to consolidate and optimize use of its instrument development and support resources (IAEA Integrated Safeguards Instrumentation Programme — I²SIP). The application of such a program will be evolutionary rather than abrupt. Initially, the use of appropriate standards and concepts will be studied to facilitate communication, data authentication, software and hardware development, maintenance and training.

The integrated approach should help the IAEA in the years ahead to maintain and improve its deployment of credible instrumentation to help meet its international obligations for nuclear material safeguards.

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Ultrasonic Sealing Techniques: A Possible Solution for Safeguarding the Containment or Storage of Spent Fuel in an Underwater or Dry Environment

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Abstract
Since 1986, JRC-Ispra has devoted efforts to develop and implement special sealing techniques, aimed at the safeguarding of transport/storage spent fuel containers, in particular in view of their probable long-term storage in storage ponds. The technique has been intensively tested on containers called multielement bottles *(MEB) between 1990 and 1992 at the British BNFL Sellafield plant in the presence of EURATOM and International Atomic Energy Agency (IAEA) inspectors, on occasion of 11 exercises on site and three in Ispra. The solution makes use of a special* sealing-bolt *(SB) which is used to replace one of the standard bolts closing the lid of the container. The special SBs are provided with a unique random signature and an internal breaking device. The first feature allows the verification of the SB's identity and the latter checks its integrity status, both verifications being done at once in a few minutes by means of an ultrasonic reading tool and associated computerized ultrasonic/electronic reading equipment. By using laboratory-PC-based and/or portable equipment, any SB can be read or verified in either dry or underwater conditions. There are several applications under study at JRC-Ispra, each requiring the development of a specific mechanical seal/ item interface, such as MAGNOX reactor calibrated dead weights for underwater spent fuel weighbridge, PWR MOX fresh fuel assemblies or PU02 transport casks.*

1. Introduction

Since 1986, JRC-Ispra has developed special sealing techniques aimed at the safeguarding of transport/storage spent fuel containers designated for long-term underwater storage. These techniques were derived from fuel assembly ultrasonic seals studied at JRC-Ispra some years ago and tested in actual conditions at the German BWR reactor facility in Kahl. The good performance of these F.A. seals in the reactor core suggested their application to underwater storage containers, easy installation and verification being main requirements.

The technique has been intensively tested on spent fuel multielement bottles (MEB), between 1990 and 1992, at the British BNFL Sellafield plant in the presence of EURATOM and IAEA inspectors, during a series of laboratory and site exercises. About 60 sealing bolts (SBs) could be installed in a transfer bay and about 30 were successfully reverified after their transportation into the new THORP storage pond. This field test was completed to the satisfaction of EURATOM and IAEA inspectors. A complete set of equipment has been left on site for future routine use.

Very recently another series of 50 SBs was delivered by JRC-Ispra and then installed on site.

This paper is aimed at giving a general presentation of this sealing technique and suggests other possible applications.

2. Description

2.1. General

The solution adopted for the safeguarding of containers like the BNFL MEB makes use of a special SB which is installed in place of one of the standard bolts closing the lid of the container. This special SB embodies two features: a unique random signature and an internal breaking device. The first feature allows the verification of the SB's identity and the latter provides the possibility of checking its integrity status. Other details may be found in references 1 through 5.

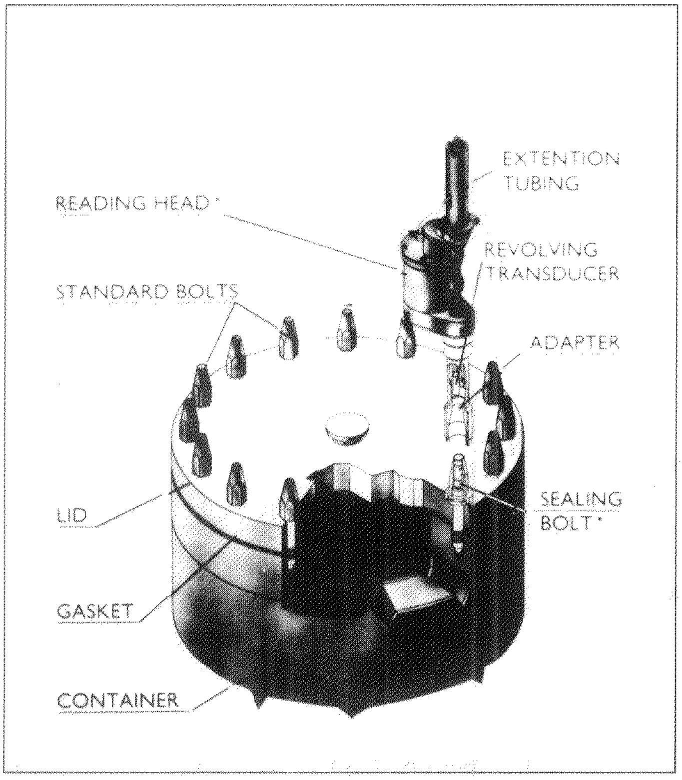

Figure 1. View of a sealed "MEB" showing an installed sealing bolt being approached for verification purposes by the reading tool.

2.2. Identity and Signature

The random signature is embodied in a small metallic core called the identity insert located into the upper part of the SB (Figure 1) and provides several cavities or defects which are read (or explored) by ultrasonic measurement. The record of the measurement gives the signature of the seal.

2.3. Integrity

The integrity is controlled by the breakage of a special integrity link, located into the central part of the SB (Figure 1), which is automatically broken when the SB is removed after a minimum unscrewing torque has been applied. This change will be revealed at the same time the signature is acquired so that the inspector, in one measurement (requiring only a few minutes) first identifies the SB (and the corresponding container) and second knows whether it has been removed or not.

2.4. Readings

Figure 2 shows a typical result obtained on the computer screen while verifying a SB in an actual exercise. The signature measured (B) is compared by correlation to the stored reference signature (0). The flat valley is typical of an unbroken seal. Should the seal have been withdrawn or tampered with, a peak would be detected by using a special algorithm in the "valley" on curve B.

2.5. Tools

In the present application, two tools are used to handle and read the SBs. The *handling-tool* is used to install/remove standard stud-bolts or SBs which are practically identical in shape, as shown on Figure 1, and are handled in the same way by the fitters. The reading-tool is used to perform the ultrasonic measurements because of its *reading head* which can also be seen on Figure 1. Figure 3 gives the general configuration. To reach the MEB lids underwater, extension tubes of about 8 m are necessary, the immersion length being approximately 4 m.

The reading head, at the lower extremity of the reading-tool, is provided with a conical extension called the *adapter*. While performing a verification, the reading tool is lowered until the adapter fits over the tapered head of the SB as shown in Figure 1. This permits the revolving transducer of the reading head to be positioned at a known distance from the SB's upper edge. The correct matching is normally obtained by the sole weight of the reading tool. Then the incorporated 5-W 24-V AC motor drives the transducer into a 3.5-mm off eccentric rotation around the SB axis, at a distance of about 25 mm above it.

The acquisition during which the transducer emits impulses and receives echoes from the built-in random defects requires only three revolutions of 5 seconds. The medium duration of a completed reading is about 3 minutes, after which the reading-tool can be removed and transferred to another SB.

2.6. Reading Equipment

Figure 4 shows a complete set of equipment recently supplied to the EURATOM Headquarters in Luxembourg. The site reading equipment is very similar but with the following differences: a) a portable 3200 Toshiba computer is used in place of the PC; b) the reading head is attached to an 8-m extension tube and works underwater; and c) a small (optional) Dikonix printer is used.

The ultrasonic instrument and the motor switch in the middle are used in both situations. In the example in Figure 2 the reference signature (0) was acquired on a similar laboratory reading-station (note that a small vessel of water is provided to allow the ultrasonic coupling between the SB and transducer), whereas the signature (B) was acquired with the equipment on site. This demonstrates the stability of the results after changing the reading heads, adapters, transducers, motors and environment (air/water).

2.7. Software

JRC-Ispra has developed the software necessary to control the following tasks from the computer keyboard of: the ultrasonic measurements on the SBs; the data processing of the signatures; the identification and integrity algorithms; storing all signatures measured at any time along with the related experimental parameters as well as all administrative data needed during inspections; and creating a statistical tool

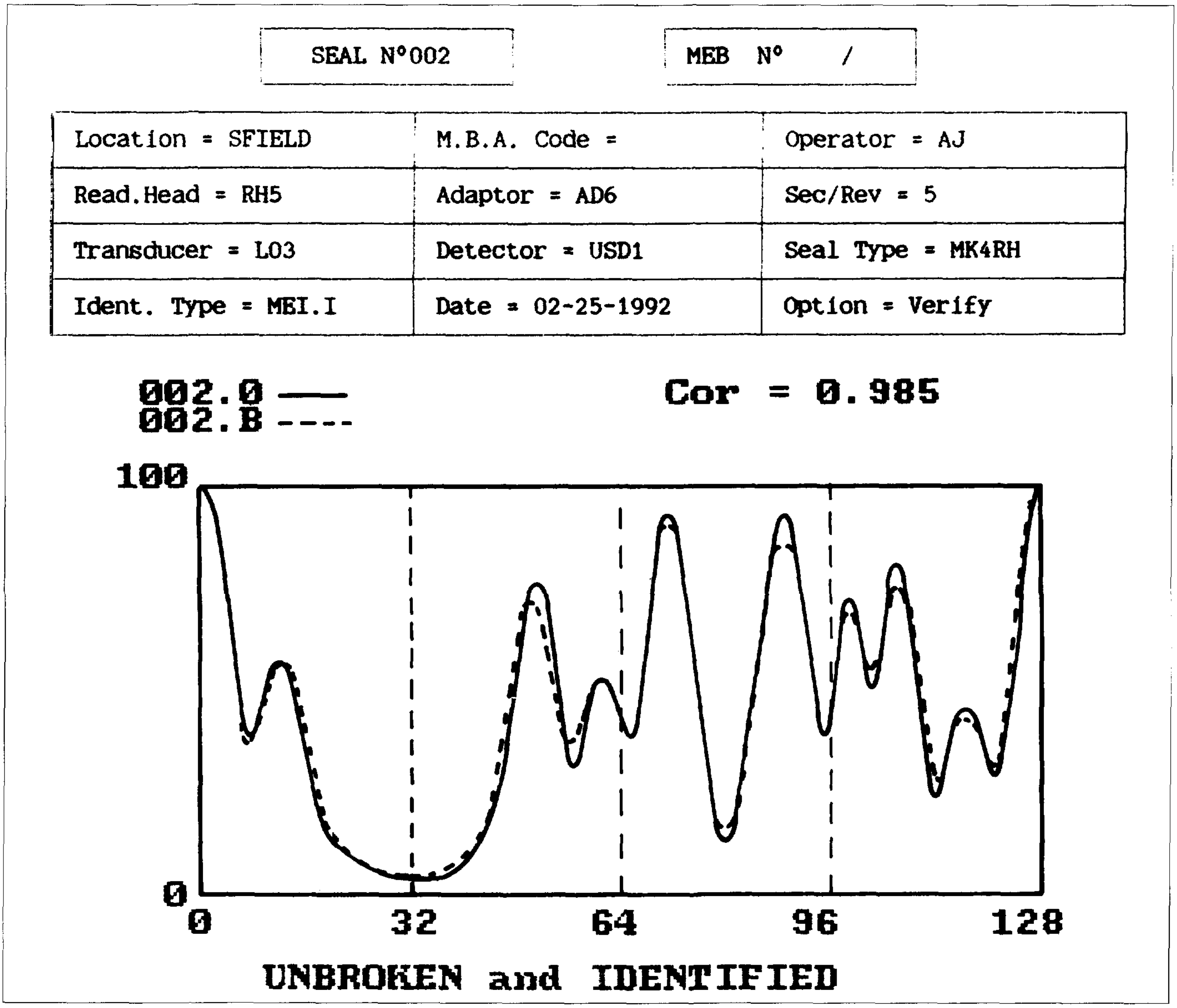

Figure 2. Typical screen of the verification of a sealing bolt.

in order to follow any population of measurements and generate appropriate histograms based on the correlation coefficient obtained while comparing different SBs or various signatures of the same SB.

A user's manual has been issued to guide the inspector through four possible procedures: a) install SBs, b) verify SBs, c) remove SB and d) quit procedure.

Also, a series of "warning loops" were introduced as experience was gained in actual exercises.

2.8. Hardware Evolution

Based on the above-mentioned reading equipment, JRC-Ispra has started developing more compact equipment which might be required for inspections where inspectors must carry their verification instrument to different sites. It is presently based on a IBM-compatible laptop computer in which there is enough room to incorporate both one programmable ultrasonic board and one A/D convertor PC board. This equipment would allow the consolidation of the present computer, the ultrasonic instrument and the motor switch shown in Figure 4.

Nevertheless, these changes will not affect the measurements previously performed with the present set of equipment.

On request of the IAEA, in collaboration with Sandia National Laboratories, Albuquerque, New Mexico, U.S.A., and now with the Canadian AECL, JRC-Ispra is presently setting up a cooperation program for the development of common reading equipment able to read the JRC SBs and the AECL "ARC" seals used on CANDU underwater spent fuel stacks.

2.9. Costs

Our present experience in producing series of about 150

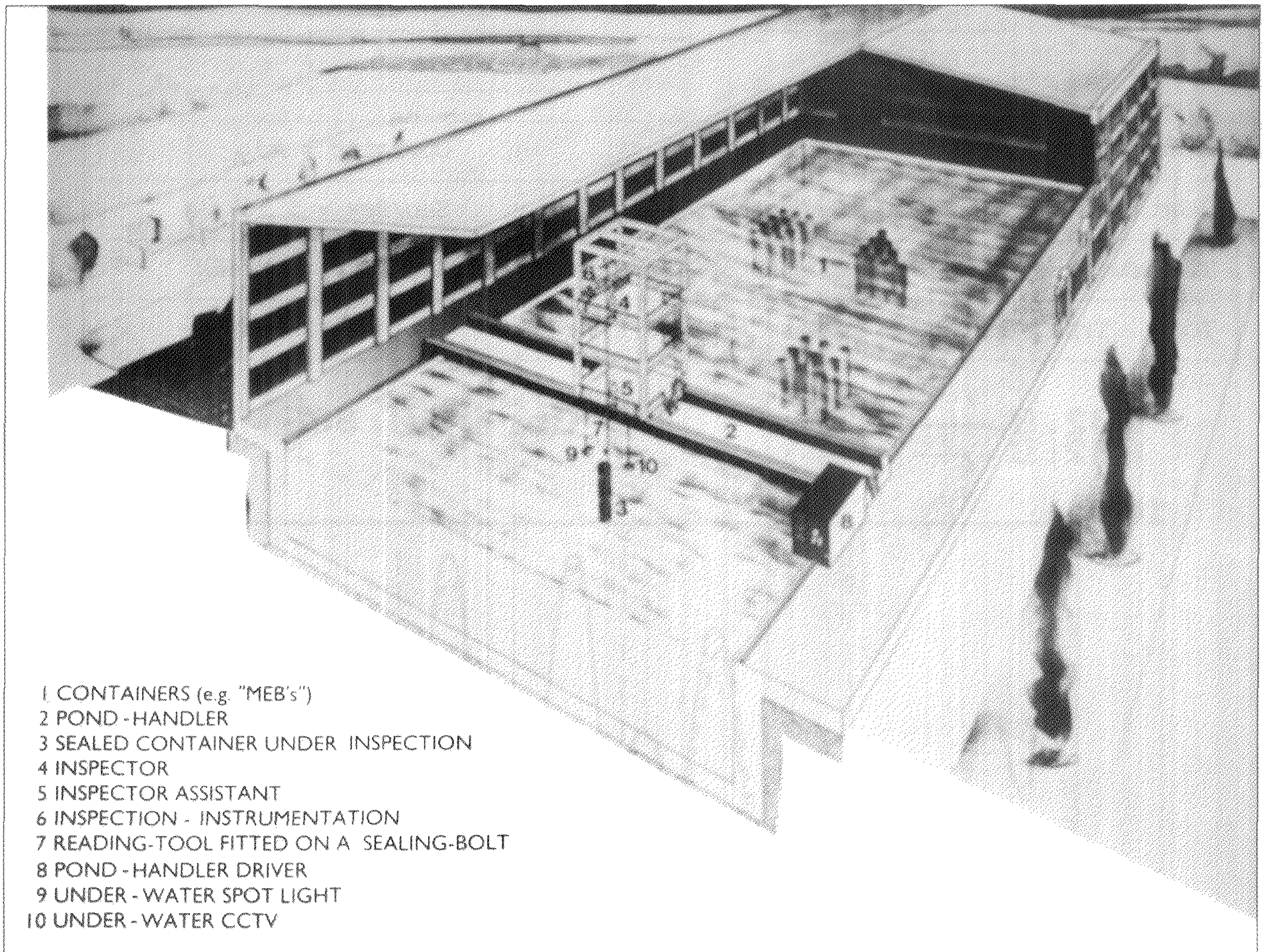

Figure 3. Inspection in a spent fuel storage pond.

items, shows a medium cost of about $450 (US) per SB. A complete laboratory reading station as shown in Figure 5 costs approximately $40,000 (US). The next generation of portable reading equipment will be less expensive. A set of one reading tool and one handling tool for on-site underwater operation costs around $7,000 (US).

3. Other applications

3.1. General Observation

The SB technology briefly described in the previous paragraphs uses a kind of ultrasonic seal which is characterized by its sturdiness and ability to be measured either underwater or above ground and also in different locations. It has proven, in past experiments, to withstand the conditions inside a BWR reactor core during the full cycle of some fuel assemblies. The drawing of such SBs show that the "core" of the seal — containing the signature and the integrity link — represents only a very small part (about one cubic centimeter) of the whole. It is understandable that, provided an adequate mechanical connection is found, such an "insert" could be installed in various structures.

3.2. Other SBs

Practically the same type of SB might be used for any application where the closure of a lid is obtained with similar stud bolts or when it is necessary to screw the bolt onto some valuable or strategic structure. Screw length and pitch are generally the only factors that vary from one application to another. In fact, JRC-Ispra is involved in the study of two such applications:

a) The first is for the safeguarding of calibrated underwater counterweights used in a British MAGNOX reactor. In this application, 12-m handling tools are necessary to reach the underwater seals.

b) The second is for the possible "tagging" of transport casks used by the French COGEMA. In that application, the reading head is brought into contact with the seal ("tag") directly by hand.

In both cases, the hexagonal head of the SB was of the same type as the one for the BNFL MEB SBs and could be read with the same reading equipment. Figure 5 shows a reading head fitted to a "tagging bolt" shown mounted on a dummy plate. Note, the reading head works exactly like the

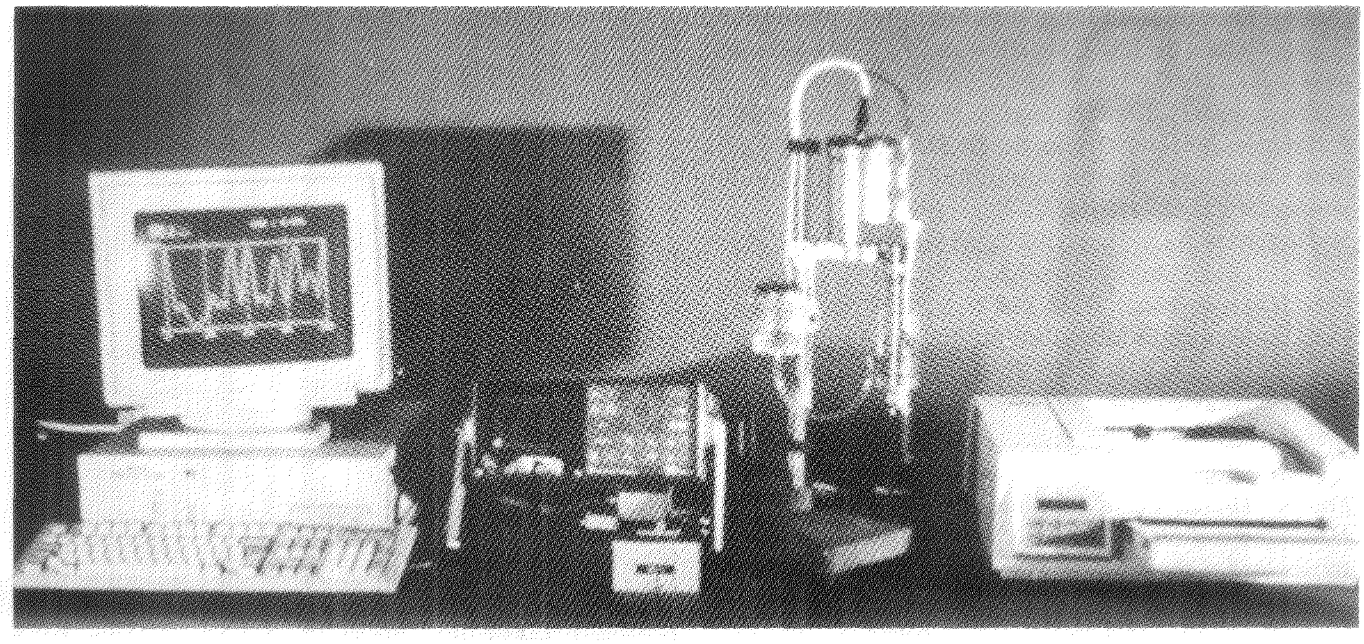

Figure 4. Set of a sealing-bolt headquarters reading station.

one shown in Figure 4, but in this configuration the driving motor for the rotating transducer has been installed laterally. The reading head is also provided with a sort of syringe to pour water into the seal/transducer interface while air measurements are carried out.

3.3. Other Sealing Devices

When there is no standard bolt to replace, or when it is not possible to find a threaded hole or to drill one, there are other mechanical possibilities for fastening an ultrasonic seal. Ispra is presently studying the possibility of clamping the seal in an irreversible way. The seal would be "gripped" onto a protruding pin at installation (tagging, or sealing a lid). But at removal, it would be sufficient to unscrew it with a certain torque to produce the change of its integrity status.

In the framework of the Japanese Support Program to the IAEA, a contract has been signed between JRC-Ispra and the PNC Company aimed at the development of a specific sealing technique for application to the external envelope of PNC's COGEMA PuO_2 transport casks traveling from France to Japan.

3.4. Extensions

Figure 6 schematically shows various applications which have been taken into consideration by JRC-Ispra. Concrete dry storage containers for repositories were not mentioned. However, it seems obvious that the technique presently implemented by the EURATOM and the IAEA for the Underwater BNFL MEBs, for which a production by JRC-Ispra of up to 3,000 SBs is planned, could well be envisaged to seal the concrete standing containers if these are closed with bolted lids or by similar methods.

The sealing of fresh PWR MOX fuel assemblies has been indicated as an important issue by the IAEA. A study is underway concerning the protection of the upper part of the fuel assembly.

Also, regarding the consolidation of spent fuel assemblies, the employed canisters might well have their safety bolts replaced by some ultrasonic SB.

4. Conclusions

We have given an overview on the ultrasonic sealing bolt (SB) technology developed at JRC-Ispra which has reached different levels of development according to the various applications. In particular we have focused on the technique presently implemented on request of both EURATOM and IAEA agencies for the safeguarding of the multielement bottles (MEB) used for the transport/storage of spent fuel designated for reprocessing at the British Nuclear Fuel Ltd. (BNFL) plant at Sellafield. We have mentioned other applications under study or development, such as the counterweight seals or the PuO_2 casks seals and tried to show the flexibility of the technique for other possible applications or domains. JRC-Ispra would be willing to consider other eventual applications to standing or moving containers or structures.

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Bertrand C. d'Agraives received his diploma from the French "Grande Ecole d'Ingenieurs": Ecole Spéciale de Mécanique et d'Electricité, Paris, in 1963. After his military service and a short period at the 3M company in Paris, where he carried out applied research on the wear resistance of industrial abrasives, he was appointed in 1965 by the Joint Research Centre of the Commission of the European Communities, Establishment of Ispra (Italy). There he was made responsible for a plant for testing organic cooled fuel assemblies in real size and thermal conditions. In addition to this, he started a laboratory of tribology devoted mainly to testing nuclear reactor components undergoing wear and friction. In 1982, he was given new responsibilities within the CEC Safeguards Program, particularly in regard to containment/surveillance. Since then, he has been developing — and is currently leading — a research and development unit working on "Seals and Identification Techniques" and involved in the study and production, under contract or agreement, of specific Ultrasonic Sealing Systems or Tagging Techniques. He has published or presented more than 60 papers, about 30 of which are on safeguards. In recent years, d'Agraives has contributed papers to several ESARDA and INMM meetings. He is a regular member of the INMM.

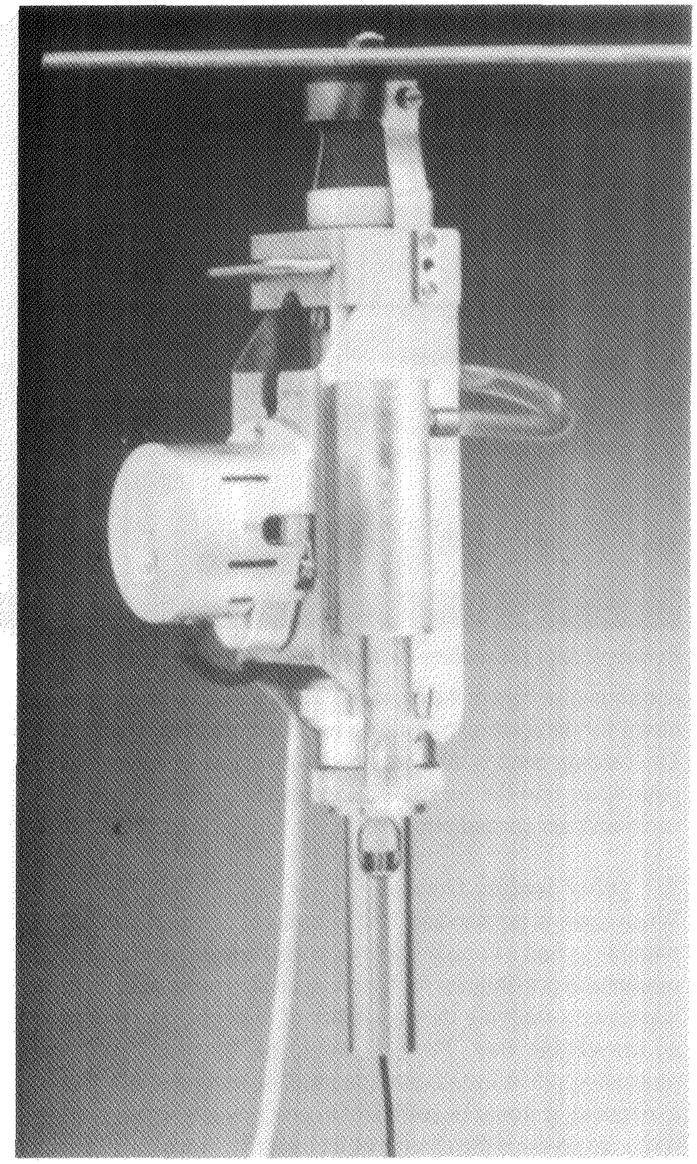

Figure 5. A typical portable reading head for verification in air.

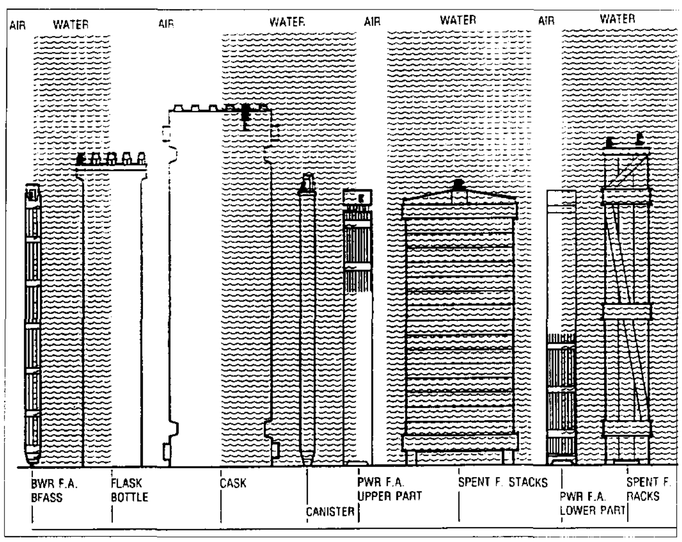

Figure 6. Several possible applications of the JRC-Ispra techniques.

GNS Spent Fuel Cask Experience

■
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■

Abstract

The Gesellschaft für Nuklear-Service mbH (GNS), which is owned by German utilities, is responsible for the management of spent fuel and nuclear waste on behalf of the German utilities operating nuclear power plants. This paper describes the spent reactor fuel and waste shipping and/or storage casks that GNS manufactures for nuclear facilities in Germany, and worldwide. So far more than 30 different casks have been produced in quantities ranging from one to several hundred of each type. GNS participates in the German Support Programme to assist the International Atomic Energy Agency (IAEA) in developing verification procedures for dry storage casks containing spent fuel. This activity is also summarized.

Introduction

German nuclear utilities have established the Gesellschaft für Nuklear-Service (GNS) in its present form to be responsible for the management of their spent fuel and nuclear waste. This includes the design and operation of conditioning systems as well as packaging, storage and transport systems for the radioactive waste produced by the German nuclear power plants, the design and fabrication of transport and storage casks for spent fuel and radioactive waste, the design and fabrication of final disposal casks, the interim storage of spent fuel and radioactive waste, and the management of the reprocessing contracts with British Nuclear Fuels, Ltd. and Compagnie Générale des Matières Nucléaires. Presently, GNS is operating interim storage facilities in Ahaus and Gorleben and is constructing a pilot conditioning plant to demonstrate the conditioning of spent fuel for final disposal. The market for casks in the United States is served by an associated company, GNSI General Nuclear System Inc., Columbia, South Carolina, U.S.A..

This paper describes the design and fabrication of the transport and storage casks, and the procedures developed with the safeguards inspectorates of EURATOM and the IAEA for safeguarding nuclear material in dry storage casks.

Description of the Transport and Storage Casks

As early as 1978, GNS began to develop casks of the CASTOR type for a dual purpose, that is, the transport and the interim storage of spent fuel assemblies. The casks must meet three main requirements: the safe containment of the radioactive contents, the shielding of radiation and the dissipation of the heat generated by the radioactive material. Thus strict specifications were introduced for the manufacture of the casks; they have to be carefully complied with and compliance is checked all the time.

The basic material used for the production of the heavy cask bodies is ductile cast iron (DCI), a malleable iron with nodular graphite. This material is used by GNS for the transport and storage casks for the following reasons:

- A homogeneous body, without welds, allows "simple" measurements of tritium diffusion.
- The material is easy to machine, which facilitates high production rates and reduces the costs.
- The material has three times the heat conductivity of stainless steel.
- It is relatively easy to make different designs for specific purposes.

The minimization of impacts on the environment is the first principle of GNS for the interim storage of spent fuel assemblies in CASTOR casks. In the past, this has led to a series of improvements with regard to safety:

- The casks are closed not only with one but two lids. This "dual-lid system" guarantees the necessary leak-tightness ($<10^{-7}$ mbar ▪ l/s).
- The system is, at the same time, used to continuously monitor the leak-tightness of the casks.
- In addition, gases such as tritium cannot escape through the cask walls. Tests have proven this.
- Special fuel baskets in the casks have the effect of reducing the temperature of the fuel rod cladding. This prevents any damage to the fuel assemblies, even during long-term interim storage.
- The casks are designed in such a way that they can even withstand an airplane crash. This has been proven by

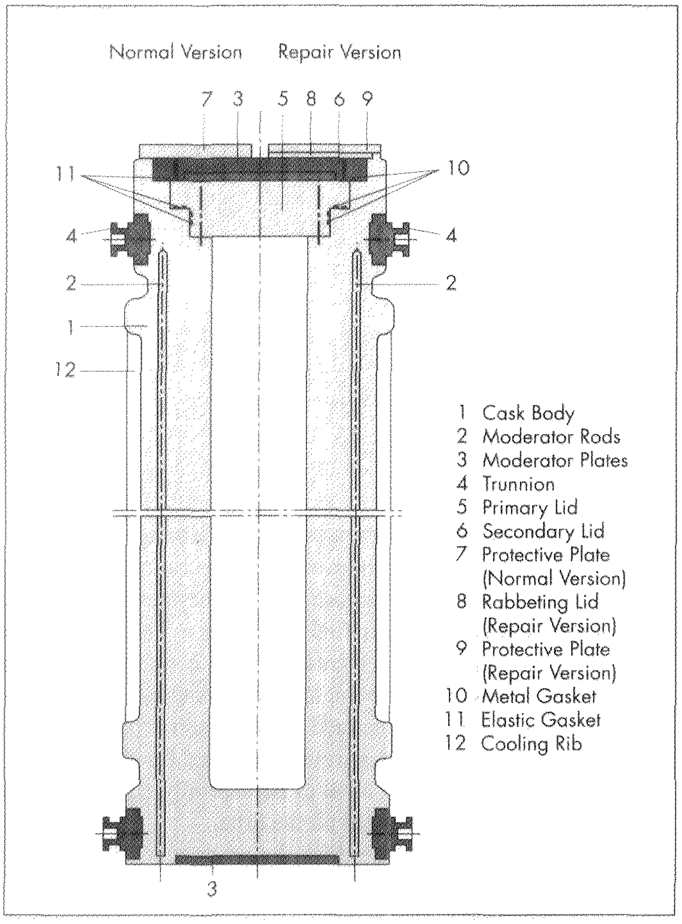

Figure 1. Cross-section diagram of a typical CASTOR cask.

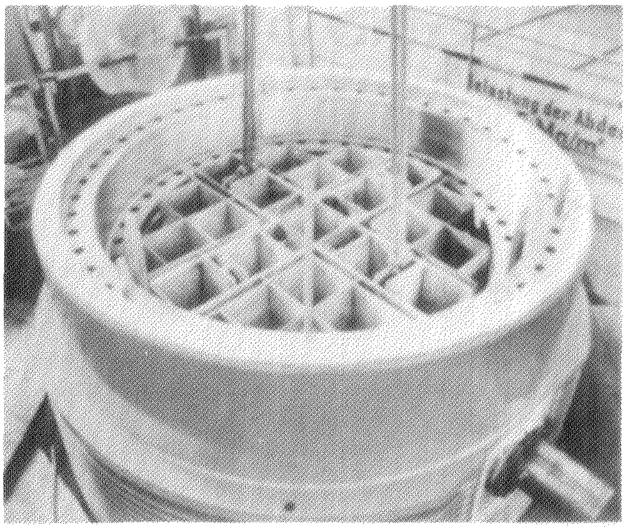

Figure 2. Top view of an open CASTOR V/21 Storage Cask.

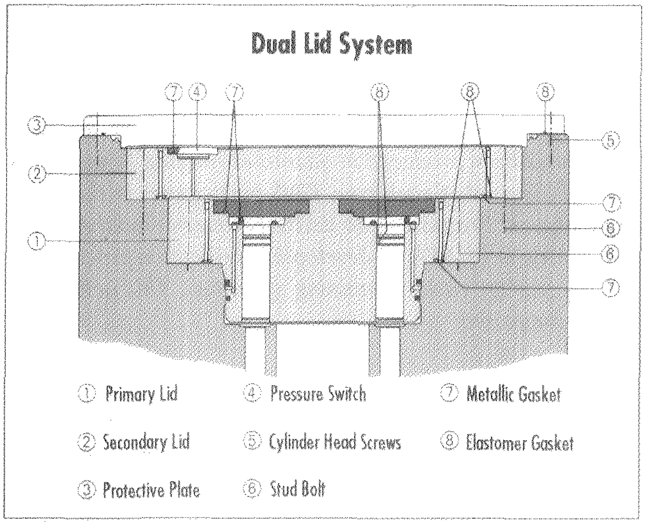

Figure 3. Dual-lid system of a CASTOR cask.

extensive simulation tests.

To test the actual safety of the casks, extremely hard tests (more extreme than the regulatory requirements) were conceived, including for example:

- A 9-m drop test onto an unyielding surface performed at – 40 °C. For the drop, the cask was equipped with shock absorbers such as those used for the transport of the casks.
- Drop tests without shock absorbers under the same conditions.
- Further drop tests on a cask with artificial flaws (a cut 80 mm deep and 480 mm long, sharpened by laser) in the area with the highest stress.
- Fire tests performed at temperatures of up to 1,200 °C over a long period of time.

The transport and storage casks remained leak-tight and functional even under the most extreme conditions.

Figure 1 is a cross-section diagram of a typical CASTOR cask. Figure 2 shows the top view of an open CASTOR V/21 storage cask. Figure 3 shows the dual-lid system of a CASTOR cask.

Table 1 lists parameters for the CASTOR transport and storage casks and Table 2 presents the data for the MOSAIK casks, which are designed for shipping and storing all kinds of radioactive waste. Table 3 [page 40] lists all of the different casks which have been produced or are presently under construction.

Figure 4 is a cross-section diagram of the POLLUX cask, which is being designed for transport and permanent disposal of spent fuel in a geological repository.

EURATOM and IAEA Safeguards on Spent Fuel Casks

Intermediate dry storage of spent fuel elements is characterized by the fact that the fuel is not directly accessible during the entire period of storage in the plant. Since spent fuel is contained in shielded and hermetically closed casks that cannot be opened for reasons of radiation, a direct verification of the nuclear material content of the casks has to be carried by means of NDA out at the reactor facility prior to cask

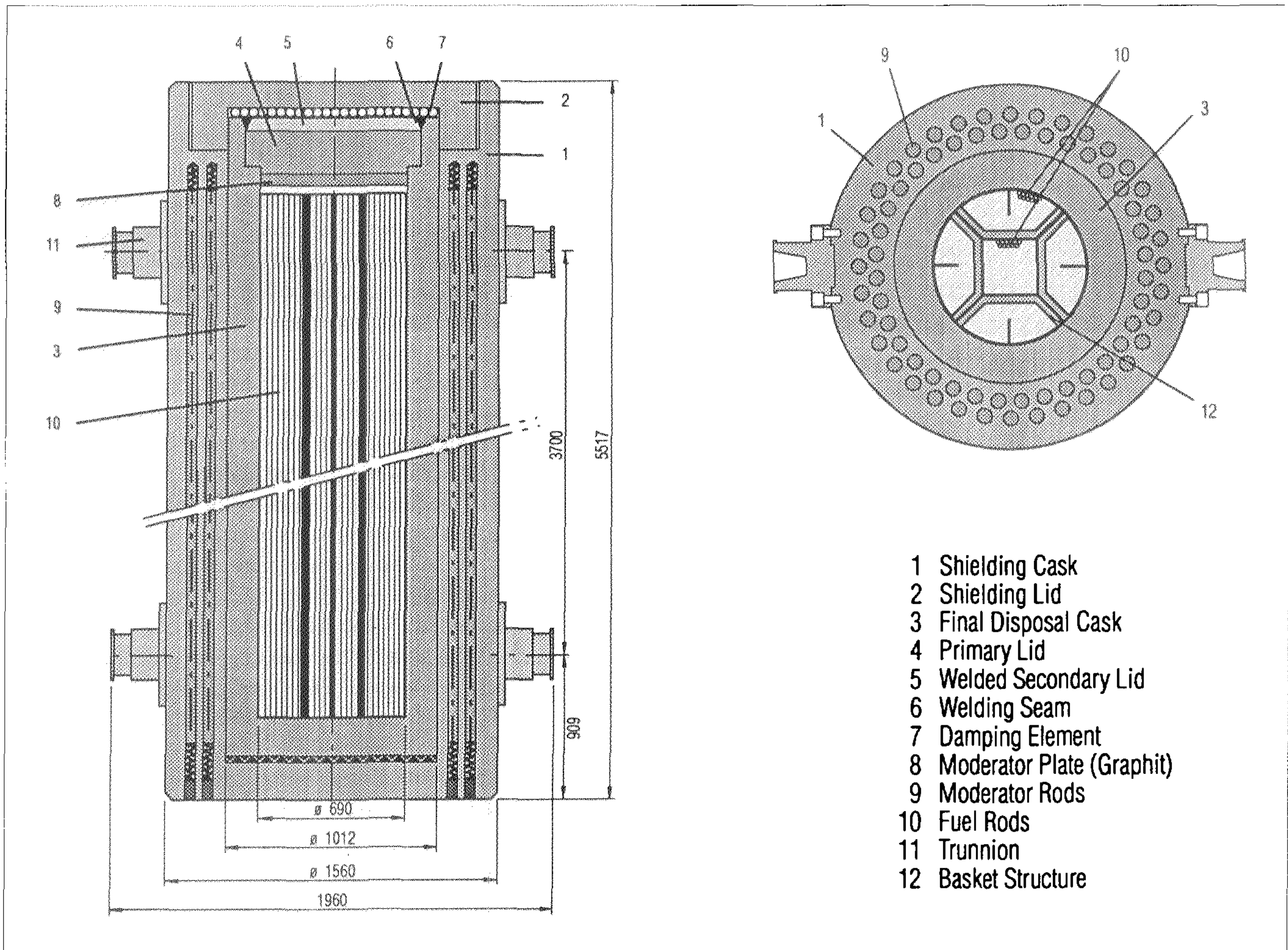

Figure 4. Cross-section diagram of a POLLUX cask.

Table 1
CASTOR Transport and Storage Cask Parameters

Wall Thickness	300 to 450 mm
Weight Range	50 to 120 MT
Number of Types	18
Number of Casks	100 manufactured, 100 under option
Number of Tests	about 40

loading. The maintenance of knowledge, once established, of the nuclear material content of casks is the crucial point of safeguards for dry storage facilities.

The safeguards approach for dry storage facilities, discussed and agreed upon with EURATOM and the IAEA, is mainly based on the application of containment/surveillance techniques, since these measures are suitable to meet the requirements mentioned above.

Because of the impracticability of camera surveillance during the transportation of casks from the shipping facility to the dry storage facility, seals alone are used to prove the identity and integrity of the casks. Special bolts on the secondary lid of the cask have been designed to allow sealing with an electronic seal. The seal can be fitted directly beneath the protective plate. Depending on the temperature between the secondary lid and the shock absorber, however, it may have to be applied on the outside of the cask, using a long fiber-optic cable.

Table 2
MOSAIK Transport and Storage Cask Parameters

Wall Thickness	120 to 215 mm
Weight Range	3 to 10 MT
Number of Types	5
Number of Casks	approx. 2,800
Number of Tests	about 40

The most advanced sealing system to be employed is the VACOSS-S seal.[1] This type of seal is designed to register access to nuclear material which is contained under seal. The locking or sealing function is realized using an optical fiber cable. Opening and closing of this optical fiber cable

Table 3

GNS — Delivery and Current Production of Containers

2	CASTOR I a	NPP Biblis
7	CASTOR I b	NPP Stade
10	CASTOR I c	NPP Würgassen GNS DWK
1	CASTOR I c-Diorit	Paul Scherrer Institut, Switzerland
1	CASTOR II a	NPP Philippsburg
3	CASTOR II b	NPP Stade
4	CASTOR AVR/AVR-T	Forschungszentrum Jülich Transport Container
4	CASTOR BARRE	Superphénix, France
1	CASTOR D1	RWE, PreussenElektra
2	CASTOR MTR-F	Forschungszentrum Jülich
2	GNS 11	Transport container for MTR fuel
2	GNS 12	GSF Forschungszentrum für Umwelt und Gesundheit
1	GNS 14	Hahn-Meitner-Institut
6	CASTOR GSF	GSF Forschungszentrum für Umwelt und Gesundheit
1	CASTOR-21 (HAW)	Prototype for vitrified waste
4	CASTOR KRB-MOX	NPP Gundremmingen
6	CASTOR MTR/MTR-F	Forschungszentrum Jülich
4	CASTOR S1	GNS Transport Container
1	CASTOR SPX/St	Superphénix, France
420	CASTOR THTR/AVR	NPPs THTR and AVR
1	CASTOR TVO	NPP Olkiluoto, Finland
25	CASTOR V/21	Surry Power Station, USA
1	CASTOR VHLW	Department of Energy, USA
1	CASTOR WWER 1000	NPP Nowo Worronesch, USSR
1	CASTOR X/33	Surry Power Station, USA
1	Transfer container (Hotte)	Superphénix, France
1	MOSAIK-CLAB	Swedish Nuclear Fuel and Waste Management, Sweden
3	TARJAN containers	Superphénix, France
1	Transfer container (Hotte)	Superphénix, France
1	Transfer container	Paul Scherrer Institut, Switzerland
10	TS 28 V	RWE
approx. 3,000	MOSAIK waste casks	German utilities

are recorded with times and dates in a battery powered microchip which is housed in the seal. The information can be extracted from the seal using an adaptor box. This interrogation may be carried out on site or remotely without removing the seal from the sealed item. Seal identity and integrity are ensured by several tamper-proofing features.

While casks are being received at the dry storage facilities and during shipment from them, increasing numbers of inspections for seal removals and applications take place. In order to reduce the inspection effort, delegation of the seal operation to the facility operator is currently undergoing a trial period. One system which largely objectifies the process of seal service is the VACOSS-S/Video Interface.[1] Simultaneous recording of seal data and video recordings of seal removal and application are the main characteristics of the system. Operation based on the dialogue regime by means of a terminal facilitates the handling of seal operations for the operator and largely prevents mistakes. Interference with and failures of the seal system can be assigned clearly to the person causing it.

GNS supported EURATOM and especially the IAEA in conducting field tests for the containment/surveillance measures described above. The VACOSS-S seal and the VACOSS/TV interface have now been introduced into routine use.

Other development work with regard to sealing systems is currently being carried out with a view to safeguarding final disposal packages. These final disposal casks of the Pollux type are loaded in the course of the conditioning process of spent fuel assemblies with consolidated fuel rod bundles, which are verified by NDA beforehand. Any future reopening of the casks during the intermediate storage period prior to the final disposal in a geological repository is not planned. Sealing systems, which allow for clear identification as well as for proof of the integrity of casks, are therefore necessary. Ultrasonic and optical methods are currently being investigated for this purpose.

Both methods are based on the assumption that a weld seam, applied between cask body and lid, will display nonreproducible, characteristic features (fingerprints), which could be used for the purpose of verification. Any opening of the cask lid would destroy the weld seam and change, at the same time, the fingerprint.

For the ultrasonic method, the microstructure of the weld seam and the cask material is being used as fingerprints. By way of ultrasonic backscattering from the grain and phase structures, a signal is generated clearly reflecting the fingerprint. By keeping within defined parameters, such as frequency, pulse length and measurement position, the ultrasonic signal is reproducible and can be used for purposes of verification.[3]

For the optical method, the nonreproducible relief of the weld seam provides the fingerprint, based on a three-dimensional image of the weld seam, contour lines and centers of gravity. The reproducibility of those features, which form the basis of identifying casks, has been proven, taking into account ageing processes.[4]

Both studies demonstrated the feasibility of the methods on a laboratory scale, using experimental equipment and weld-seam samples. A prototype for each method must be developed as a next step, taking into account real inspection conditions.

Conclusion

GNS has considerable experience with transport and storage casks as well as the other activities involved in managing spent fuel and radioactive wastes. For a number of reasons, it has chosen to construct the casks using ductile cast iron. GNS supports and contributes to the German Support Programme for IAEA safeguards. Investigations for identity and integrity verification of long-term storage and final disposal packages are being continued systematically in order to implement safeguards of long-term storage effectively, and to improve them further.

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Rudolf Weh received his degree in chemical engineering from the Technical University of Munich, Germany. Subsequently, he spent more than seven years at the Institute of Radiochemistry in Garching/Munich. In 1979, he joined the Deutsche Gesellschaft für Wiederaufarbeitung von Kernbrennstoffen mbH (DWK) in Hannover, Germany. Due to the changes resulting from the abandonment of the Wackersdorf Reprocessing Plant project, he moved to the Gesellschaft für Nuklear-Service mbH (GNS) in 1990. He is currently head of Quality Management and Safeguards, and project leader for the return of residues from the reprocessing of German spent fuel in France and the United Kingdom.

Practical *In Situ* Measurement of Gamma Emitters on Ground

EG&G Nuclear Instruments' new M-1 Portable Gamma Spectroscopy System measures nuclide-specific activity *in situ* of gamma-emitting radionuclides deposited on the ground. Applications range from decontamination of previously used nuclear sites to routine environmental monitoring near nuclear facilities. M-1 is based on the 1-meter methodology developed by the U.S. Department of Energy Environmental Measurements Laboratory. M-1 includes a tripod-mounted HPGe detector, a NOMAD™ portable gamma spectroscopy system and the M-1 application software.

EG&G ORTEC (a subsidiary of EG&G, a Fortune 200 company based in Wellesley, Mass.) is in its 32nd year of operation in Oak Ridge, Tenn. EG&G ORTEC manufactures radiation detectors and associated electronic modules, plus instruments and systems for radiation detection, measurement and analysis. For information, contact EG&G ORTEC, 800/251-9570.

Radiation Monitoring System from Teledyne Isotopes

Teledyne Isotopes has introduced the System 300, a thermoluminescent dosimetry (TLD) system for personnel and environmental radiation monitoring.

System 300 incorporates a TLD reader, software, TLD cards, badge cases and an automatic irradiator. The system uses a highly sensitive phosphor that measures exposure levels of less than 100 mRem.

The TLD card with eight independent dosimeters enables a second analysis and additional energy information. "Standards on Demand" is a system 300 feature that eliminates the need to manually intersperse calibration cards between samples. Other features include digitized glow curves recorded for analysis of each TLD card, automatic calibration, reader speed of one card every 25 seconds, traceability through recording of 78 critical readout parameters for each TLD card and bar coding for accurate identification.

For more information, contact Teledyne Isotopes, TLD Dept., (201)664-7070.

Pacific Nuclear Wins Spent Fuel Contract

Pacific Nuclear has been selected by the GPU Nuclear Corp. of Parsippany, N.J., to engineer, license and construct a spent fuel storage system for the Oyster Creek Nuclear Generating System in New Jersey. The project is scheduled for completion in 1998.

The contract calls for the design and construction of concrete modules and stainless-steel containers for the on-site storage of the Oyster Creek plant's spent fuel. Pacific Nuclear is based in Federal Way, Wash.

May 11 – 13, 1993
ESARDA 15th Annual Symposium on Safeguards and Nuclear Material Management, Rome, Italy. *Sponsor:* European Safeguards Research and Development Association and the Joint Research Centre of the Commission of the European Communities. *Contact:* C. Foggi, CEC-JRC, I-21020 Ispra (Varese), Italy; phone +39-332-789372; fax +39-6-3048-4965.

May 24 – 29, 1993
Management & Disposal of Radioactive Waste, Boston, Mass. *Sponsor:* Harvard School of Public Health. *Contact:* Mary F. McPeak, 677 Huntingdon Ave., Boston, MA 02115; phone (617) 432-1171; fax (617) 432-1969.

June 21-24, 1993
10th International ASTM Symposium on Zirconium in the Nuclear Industry. Sponsor: American Society for Testing and Materials. Contact: Steve Mawn, ASTM, 1916 Race St., Philadelphia, PA, U.S.A. 19103-1187; phone, (215) 299-5400, fax (215) 977-9679.

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INMM's 34th Annual Meeting, The Scottsdale Princess Hotel, Scottsdale, AZ. *Sponsor*: Institute of Nuclear Materials Management. *Contact*: Barbara Scott, INMM headquarters, (708) 480-9573.

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Emerging Technologies in Hazardous Waste Management V, Atlanta, GA. Sponsor: American Chemical Society. Contact: Dr. D. William Tedder, I&EC Symposium Chair, 778 Atlantic Drive, School of Engineering, Georgia Institute of Technology, Atlanta, GA, U.S.A. 30332-0100; phone (404) 894-2856, fax (404) 894-2866.

November 1-5, 1993
Third International Symposium on Stabilization/Solidification of Hazardous Wastes Co-sponsors: ASTM D-34 Committee on Waste Management, Oak Ridge National Laboratory, U.S. Environmental Protection Agency, Alberta (Canada) Environmental Centre, and the Hazardous Substance Management Research Center of the New Jersey Institute of Technology. Contact: Michael Gilliam, Oak Ridge National Laboratory, phone (615) 574-6820.

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