Testimony of

Ivan F. Stuart, Vice President
Nuclear Assurance Corporation

Before The

Nuclear Waste Technical Review Board

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1. History/Experience

Good morning, I am Ivan Stuart, Vice President Design Engineering at Nuclear Assurance Corporation (NAC). I have been engaged in the nuclear industry for 28 years. I started my career in the design of nuclear power plants, then progressed to responsibility for their licensing review process. Later I was responsible for repair and maintenance of the plants, including fuel loading, reconstitution and fuel storage. At one point, I was responsible for the Morris Illinois fuel storage facility and transportation of spent fuel to the facility. I am pleased to be here today to present my thoughts and those of NAC. I hope this testimony provides positive and constructive suggestions for the Federal Waste Management System (FWMS). My comments are made from the perspective of a spent fuel management and transportation company.

NAC has been deeply involved in almost all aspects of spent fuel transport and storage for over 15 years. We own a fleet of 16 transport casks and have made well over 2,000 spent fuel shipments, covering millions of miles throughout the United States and internationally. We have handled commercial light water reactor UO_2 fuel, metallic fuel, failed fuel and other special shipments. We want to emphasize that spent fuel transportation has been, and is being, conducted with complete public safety. The record in that regard speaks for itself.

2. NAC Technology Development

NAC is a leader in the design, licensing and supply of metal casks for both dry storage and shipment of spent fuel. This method of spent fuel handling is a mature, proven technology. It offers the substantial advantages of reasonable user costs and preparations, plus casks are purchased only as needed. There is virtually no ratepayer risk; the casks are already licensed. There is no fuel transfer outside the reactor plant pool and its containment system. The casks are fabricated in a pre-qualified factory under intensive inspection, testing and quality controls. A utility receives a proven, safe and passive spent fuel storage or transport cask. NAC has established a family of four different licensed transport casks as well as high-capacity, metal dry storage and transport cask systems covering intact, consolidated and failed fuel.

NAC has also developed a dual-purpose (storage and transport) version of our cask family, designated the NAC-STC. The cask body of our storage casks was upgraded for transport based on time-tested transport safety features, including multi-wall construction using stainless steel and lead.

NAC was selected by the Spanish government authorities in 1988 to provide our technology for the dual-purpose cask as the bases for Spain's national waste program. An important factor in their evaluation was that the NAC-STC, in addition to meeting NRC storage license requirements, is also designed to meet the U.S. NRC's transport license requirements.

The Safety Analysis Report for Packaging (SARP) for the NAC-STC was submitted to the U.S. NRC for transport certification in September this year. This followed the Topical Safety Analysis Report (TSAR) for storage submitted to the NRC in April this year. It is expected we will receive both Certificates in 1991. The NAC-STC is designed so that it can store and transport consolidated fuel as well as intact fuel.

NAC has been actively developing fuel rod consolidation technology for over ten years. Our program has included a cold system demonstration at Barnwell, delivery of a system to TVA and hot system tests at West Valley. Many problems have been encountered by all those who have done consolidation and many lessons have been learned. We believe the problems are now solved. We have performed a component demonstration of our latest equipment, called the FUEL-PAC system, which is a fully automated high capacity robotic system that uses simple one-step processes and easily repairable or replaceable components. Fuel rod consolidation is not yet a mature technology; however, we are confident that it will be in the near future. Although fuel rod consolidation was developed because it is fully compatible with pool storage, there are also benefits for metal cask storage and it has become very apparent that consolidation's real benefits are in cask transportation and ultimate disposal.

NAC is also in the process of developing a spent fuel burnup meter that will be calibrated with data from isotopic analyses of reprocessed fuel previously measured by the burnup meter. This program includes an agreement with the Power Reactor and Nuclear Fuel Development Company (PNC) of Japan where small batch processing of fuel will allow individual assembly measurement and later correlation with reprocessed isotopic analyses. The burnup meter will provide a positive safety device to assure that only spent fuel is loaded into transport casks where burnup credit is part of the casks criticality design bases.

Since 1968, NAC has developed several data banks that are unique sources of nuclear information recognized worldwide. The oldest and most comprehensive data base is called Fuel Trac and contains technical and contractual details on all the fuel in all the plants in the free world. More recently, NAC has conducted studies at all U.S. nuclear plants to determine the Facility Interface Capabilities (a study referred to as FICA) and a near site transportation infrastructure study (known as NSTI). Both of these latter studies provide valuable information affecting transport of spent fuel from reactors in the U.S.

3. NAC View of the Current FWMS Program

In addition to the technologies NAC has developed as described above, we also interface heavily with every player in the FWMS - i.e. the DOE, its contractors, the National Laboratories and the utilities. Our view of the overall FWMS program comes from that extensive interaction base.

NAC takes the view that the current methods of transportation and storage have served the industry well and that they established the record of safety first. Optimization from these 'tried and true' approaches need to be taken in measured steps so as to maintain the acceptance of, or confidence in, established technologies.

The magnitude of the Federal program and the benefits of its successful implementation are sometimes ignored in these public forum discussions. While there is a general consensus that environmental issues need to be resolved with maximum urgency, the public acceptance of specific solutions represents an important step to success. With the FWMS, we are attempting to safely store wastes for thousands of years. This has never been done, and like putting a man on the moon, requires the contribution of our top scientists and thinkers and the consensus support of the public.

If the goals of this program are achieved, we will have established that we can, as a country, solve environmental problems and the implications of this success will benefit other disposal problems outside of the nuclear industry.

For this reason, there is unprecedented support for the DOE efforts, both within the government and within the nuclear industry. The program is unique in that the industry is providing the funding for the program. So far nearly $5 billion has been collected and nearly $3 billion has been spent to solve the problem. Nevertheless, the schedule for receiving wastes has been considerably delayed and there is a growing skepticism that the task will be completed. With that overview, I would like to turn to more specific observations about the FWMS.

First, we see no one or no institution looking at the nation's best interests by taking a total system view all the way from the generation of the spent fuel at the reactor; through its storage, transport, preparation for disposal, and finally its disposal. This is most likely a consequence of the governing legislation and related regulations that have compartmentalized the overall process, such that each institution only looks at its own defined scope or area of responsibility. There are no guidelines on what form the fuel should be in when handled in the FWMS. Should it be intact or consolidated? No standardization exists, for example, about burnup credit for fuel storage versus fuel transport. Also, there is no envelope definition of the reactor interface, no standard storage or transport cask, no reference Monitored Retrievable Storage facility and so on and so on. Furthermore, there appears to be little incentive to bring the various players together (i.e. the utilities, the transport vendors, the DOE or the MRS host state) to develop a fully integrated system. As an engineer, I know that if such an approach to aircraft design were taken, we would never have achieved the highly efficient air transport system we now have. Closer to home, I know that today's successfully operating reactors could not have existed without an overall system approach to their design. Thus, on its present course, it is difficult to believe the FWMS can be successfully implemented or if implemented that it will be viewed as the nation's best technical solution.

Many side technical issues also exist and seem to be begging for resolution, but so far without success. For example, as mentioned earlier, will the fuel be consolidated or not? If yes, where will the consolidation take place? Should ALARA be employed or is the FWMS itself ALARA? Must the fuel be criticality safe under all conceivable circumstances including throughout the life of the waste package when buried? Can burnup credit be counted on at each stage of fuel handling and so on. In addition, the FWMS started out with the intent to utilize available industry technology to the maximum extent possible. Yet as we look at the current FWMS, and those technologies that NAC and others have or are in the process of developing; we conclude simply that the FWMS is not taking full advantage of this available technology.

4. Dual Purpose Cask Features and Benefits to the FWMS

For some time NAC has held the view that a dual purpose cask is the optimum solution for the nation's spent fuel program. Others seem to hold this position also and like NAC are developing their version of this technology. Perhaps NAC's experience base with both transport and storage casks was the reason that the Spanish government adopted the dual purpose cask. Their participation came through an organization called Empresa Nacional De Residuous Radiactivos, S.A. (ENRESA) which can be characterized as similar to the U.S. OCRWM. Virginia Power Company and the Electric Power Research Institute, also participated and combined their resources with that of NAC to fund the design of a dual purpose cask that is now going through the NRC licensing process. The cask is referred to as the STC model cask. Based on the present program laid out by NAC and NRC, it is expected that the NRC licenses for both storage and transport will be issued during 1991. As mentioned earlier, others are pursuing a similar concept and it is expected that follow-on approvals will be forthcoming.

The concept of the dual purpose cask is really quite simple. Having said that, NAC has found that implementation of the dual purpose cask concept, and demonstrating compliance with the multiple requirements of NRC, while optimizing payload, but living within transportation weight limits; has proved to be a complex technical matter. Notwithstanding all of that, quite simply with a dual purpose cask, the reactor operator loads the spent fuel in his pool operating under all of the existing safety and plant operations rules that NRC has approved. These are conditions with which the operators are familiar and that they have demonstrated are safe and appropriate. The loaded cask is then stored at the reactor site in a simple pad area within the normal plant security controls systems. There will be a minimal added monitoring and alarm system to notify the plant operator if anything unusual occurs. Alternately, the dual purpose cask is immediately ready for shipment to any selected location such as an MRS, the repository, or a lag storage location used by DOE. The point is, that the fuel need not be disturbed or removed from its cask until some final disposition is to be undertaken even if that is many years in the future.

Conceptually the dual purpose cask has an unlimited life. The NRC has granted licenses for metal storage casks that cover a 20 year period with five years renewable options; so it is anticipated that the dual purpose cask will also be similarly licensed.

Our design of the dual purpose cask uses a double lid concept where the inner lid and its associate metal o-rings act as part of the stainless steel containment during the storage phase. The outer lid is also installed during the storage phase and provides added margin to assurance of containment. However, in accordance with design rules the outer lid is not considered as part of the official containment structure in the storage phase. In the transport phase, the outer lid comes into play and is relied upon as the containment barrier according to the design rules applicable for transport casks. The significance of this prescriptive distinction on the functions of the two lids is that the outer lid is removable at the storage site where its teflon seals may be replaced while the inner maintains containment. The outer lid can then be reinstalled and leak checked to assure that transport starts off with a newly qualified leak tightness after what may have been an extended storage period. Note that during the entire dual purpose cask life, i.e. the storage period; the simple preparation time for transport; the actual transport; and any later storage at an MRS or the repository; there is no additional fuel handling and limited additional man-rem occurs. This contrasts significantly with the present FWMS that contemplates storage only vaults at the reactor, separate casks during transport, new vaults at the MRS, separate casks during transport to the repository and possible vaults at the repository for lag storage. The multiple fuel handling sequences that such a program entails appear to NAC to be decidedly non-optimum and in fact highly undesirable.

The key reaction of people who understand the benefits of the dual purpose cask is to ask how much such a device will cost. While I assume cost is not an issue for this Board to address, I will tell you simply that NAC has shown that when the dual purpose cask, in its existing form, is integrated into the total FWMS, there is a modest cost savings to the program. If fuel consolidation at

the optimum time is considered, or even if burnup credit is utilized, then the use of dual purpose casks in the FWMS can save $1B or more. In addition, the inherent safety of the dual purpose cask system; its flexibility to accommodate any conceivable change in timing or direction of the FWMS; its ability to expand or contract to meet needs; the reduced amount of transportation required; the ALARA benefits; and the basic peace of mind offered by a one-step fuel handling system; all of this must be worth significantly more to the nation than even the program dollar savings NAC believes can be demonstrated.

The dual purpose cask system that NAC has designed utilizes a multi-wall concept made up of a 304 stainless steel inner shell that is 1.5 inches thick, then a 3.7 inch thickness of lead for gamma shielding, an outer shell of 304 stainless steel that is 2.7 inches thick, and finally 5.5 inches of a solid neutron absorber material known as BISCO. Imbedded in this neutron shielding material are copper and stainless steel fins to promote heat transfer to the environment. This assures continuous cooling of the fuel so that cladding temperatures remain below 380°C as required by the NRC. The double lid concept alluded to earlier uses an inner lid 9.0 inches thick made of 304 stainless steel and secured by 42 bolts 1-1/2 inches in diameter. The outer lid is 5.5 inches thick and made of 17-4PH stainless steel material. It is held in place by 36 bolts 1.0 inch in diameter. The fuel in the dual purpose cask is held in place in an aluminum basket made up of 27 discs 2-1/2 inches thick stacked six inches apart (center-to-center). The 26 tubes that each house a fuel element run transverse to the discs and use a borated aluminum material to insure criticality control at all times.

There are no moving parts in the dual purpose cask system. It relies strictly on the natural heat transfer properties of the materials used and the shielding quality of its materials, all of which can be documented, measured and verified if need be. There are no maintenance needs of the dual purpose cask. Its integrity is continuously monitored by a pressure transducer system that can alarm upon detection of any change in the pressure of the internal cavity that houses the fuel. The volume between the two lids is also monitorable to

determine if lid leaktightness is being maintained. This integrity measurement is achievable both during transport and storage.

The NAC-STC cask weighs 125 tons when fully loaded with 26 PWR fuel elements and has its impact limiters installed ready to transport. The complete assembly is analyzed in accordance with very strict NRC rules to demonstrate its ability to survive severe events including a 30 foot drop onto an unyielding surface at a variety of angles and a one meter drop onto an unyielding pin of approximately eight inches in length on both its side and its lid end. These tests show the sturdiness of the cask as well as the ability of the impact limiters to absorb the deceleration energies with overall demonstration that cask damage is minor and containment integrity is maintained.

During the NAC-STC test program, done at Winfrith in the U.K., a 1/4-scale model demonstrated its design conservation in the various drop tests. One specific test subjected the cask with its basket and simulated fuel assemblies to g-loads that were five times the design values. The simulated fuel showed no damage, the basket exhibited minor distortion and the cask body was dented, but not breached. In the pin drop test series, the lid showed itself to be so hard that only a minor scratch was evident after the drop. These data demonstrate the safety and conservatism of the dual purpose cask concept.

The shielding materials used in the dual purpose cask are simple and their properties are known. These properties can be counted on to be maintained throughout the cask life to assure worker and public exposure are controlled. Verification of surface radiation fields can be done at any time if needed. The maximum dose rate at or near the cask surface must be within NRC limits. There is a personnel barrier that surrounds the dual purpose cask at 2 meters from the cask surface where the rate must be less than the limit of 10 mr/hr. An estimate has been made that 60,000 man-rem could be saved in the FWMS if it utilized dual purpose casks totally, compared to the current program of storage only and transport only vaults and casks. These benefits of the dual purpose cask continue to reinforce NAC's belief that the FWMS could benefit significantly from

adopting the concept. I believe it is even worthwhile to evaluate whether the dual purpose cask can be qualified for a third purpose namely the waste package used for the ultimate burial of the spent fuel. Perhaps simple additional tests would qualify its materials. Or perhaps reasonable additional features such as welding the lids shut would also be appropriate. It may be practical to view the waste package, made from whatever special material is needed, as simply a liner into which the dual purpose cask is inserted.

5. NAC Recommendations for the NWTRB

I felt it was important to go through this rather detailed look at the dual purpose cask because members of the public who may be present here need to have a complete understanding of the thought process and design consideration involved in implementing a cask project. The complexity is necessary in order to assure compliance with regulations designed to protect the public safety. Nevertheless, I must inform the Board that the dual purpose cask concept is not currently a part of the FWMS as far as NAC can determine from discussions with DOE and their consultants or contractors. The modeling techniques used by DOE for evaluating alternative concepts appears to be incapable of properly evaluating the dual purpose cask concept. This stems primarily again from the division of responsibilities where DOE does not consider the storage at the reactor site as a phase in the total FWMS program. Other modeling limitations exist such as single purpose attributes of casks versus multi-use attributes. This should be considered by this Board and the DOE itself as an unacceptable situation. NAC invites this Board to review the details of the NAC dual purpose cask and the engineering analyses that demonstrate its capability and ability to meet the NRC requirements. This review could include our cost analyses and savings both in time and in man-rem or other system savings such as in number of shipments. We have started such a dialogue with DOE, but we are concerned about the limitations of their evaluation techniques, as I noted earlier, and the timeliness of the review relative to decisions that DOE will need to make to meet their 1998 obligation to accept fuel from the reactors. One evaluation technique that could be worthwhile is for this Board to sponsor a Probablistic Risk Assessment (PRA)

of the FWMS considering the use of dual purpose casks. NAC is confident that the reduced handling and reduced shipments, combined with the inherent safety of the dual purpose cask, would show it to be a superior risk concept.

The issue of fuel consolidation seems to be languishing in indecision within the FWMS. It is NAC's belief that consolidation should be done. Further, we believe that the full benefits of the dual purpose cask lies in consolidating the fuel before it is inserted in the cask. Consolidation, in our opinion, is properly done at the reactor plant where required operations are either familiar to the plant staff or are logical extensions of their capabilities and that of their service vendors. The consolidation would be performed within the plant containment structure which is certainly the safest place for it to be done, by an infrastructure in place, versus building a new one such as at an MRS or at the repository. Here too, NAC believes a PRA would show this to be the prudent approach. Once again, however, the separated responsibilities of the utilities versus the DOE does not encourage the evaluation of what is best for the nation on this issue. Some sort of incentive needs to be provided to the utilities to encourage them to consolidate their fuel so that the FWMS can receive the benefits, since the utility will clearly not see the full benefit of this activity.

We have heard that some responsible participants in the FWMS have raised the issue of whether the waste package needs to be demonstrably criticality safe over thousands of years even if intrusion occurs due to deterioration or human activities. Certainly consolidation would help to answer concerns in this area.

NAC happens to be on the leading edge of the dual purpose cask technology. We see its benefits and we believe that the public and the FWMS need to seriously consider this concept. The NAC-STC is an economic asset because of our lead position. However, we expect others will successfully and in fact already are developing their own version of the dual purpose cask concept. At the same time, NAC is developing a transport-only cask concept under contract to DOE. That design includes a new generation of features such as an innovative WEDGE-LOC lid

that requires no bolts and more efficient shielding material through use of depleted uranium. Notwithstanding this diverse participation in cask technology development, NAC believes the dual purpose cask concept, even in its current stage of development, has a higher benefit/cost ratio for the FWMS. Later versions of the dual purpose cask can adopt fuel consolidation, the WEDGE-LOC lid and other innovations to further benefit the FWMS.

Early in the formative stages of the FWMS cask development program, NAC offered, on a no-cost basis, to make available to DOE a truck cask design and a dual purpose cask design which at that time was also just in the preliminary design stages. To date, DOE has not responded to that offer. Recently NAC has reiterated the offer to make available to DOE the dual purpose cask design that now exists. NAC hopes that DOE will accept this offer. Perhaps this Board could be a catalyst on this matter, performing its own independent evaluation of the integrated benefits of the dual purpose cask to the FWMS. The technology exists today; the NRC review of the technology is underway. The NRC views on the acceptability of the design should be solicited by this Board.

A generic rule recently promulgated by the NRC under Part 72 has given general approval to certain metal storage casks and will also be applied to the dual purpose cask. This general license helps utility users since they now know they can select a pre-licensed design without site specific licensing actions by the utility. Pursuit of extending this general license to the MRS or to lag storage at the repository would also benefit the FWMS program. Further, endorsement of the use of such a license would signal the utilities that there is an incentive to using a pre-licensed dual purpose cask. This would promote the benefits of the cask system as well as define a lot of interface issues currently unanswered in the FWMS. In addition, this endorsement would minimize the proliferation of storage options being selected currently by utilities with which the FWMS transportation segment will have to interface in the not too distant future. The standardization that would ensue in system design, system requirements, spare parts, tools, handling equipment, transporters and servicing would be a cascading phenomenon that would assure that the FWMS was on a solid

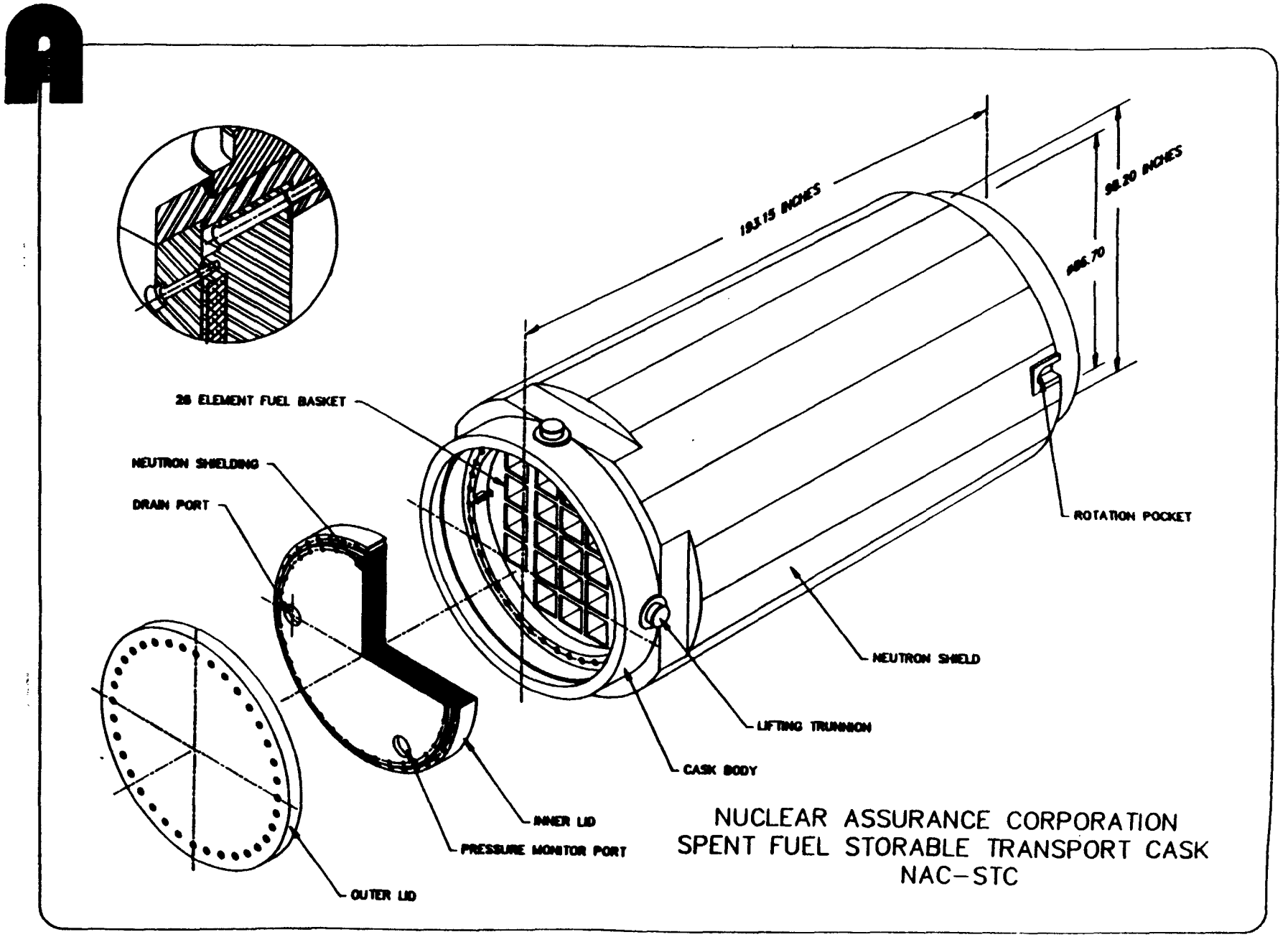
technical footing. This is akin to many other successful technical-based industries that could not exist today if they had not made similar standardization decisions early in their life cycle.

Earlier, I mentioned two studies known as FICA and NSTI that NAC has conducted about the interface conditions and limitations both at reactor sites and in the transport infrastructure near sites. Both of these studies were commissioned by and paid for by DOE. In NAC's view, these studies provide a wealth of data that is not yet being used to the benefit of the FWMS. For example, the present FWMS program contemplates that as much as 45% of spent fuel shipments will be by truck, hence the existence of a truck cask design program underway at General Atomics. The current program also has undertaken development of two rail/barge cask programs, one of which NAC is performing, the other by B&W, with a limitation of 100 tons weight. A review of the FICA data, however, shows that the optimum FWMS cask fleet should consist of a high-end capacity cask in the range of 120 tons that could service approximately 65% of the plants as they exist now. A medium-end capacity cask of about 70 tons would be useable by about 30% of the remaining 35% of plants not able to currently handle the high-end capacity casks. This cask fleet arrangement would result in only 5% of the spent fuel being shipped by truck. In addition, preliminary data recorded in the course of the FICA study suggest that plant upgrades such as crane capacity improvements could significantly alter the conclusions about the optimum cask fleet. Once again, I would like to point out to this Board, that given the prescriptive definitions of which institution will consider which phase of the FWMS, I believe it is unlikely that this important information will be used in the selection of the optimum cask fleet. I urge this Board to evaluate the FICA and NSTI program results and draw its own conclusions about the appropriate parameters for the cask fleet.

I believe that this Board could make a significant contribution to the FWMS if it conducted a complete evaluation of these benefits of the dual purpose cask that I have enumerated today, and then pass its conclusions onto the DOE for incorporation into the FWMS. It may be that this Board is the only public

institution that exists that can look at the total FWMS program, from beginning to end, unencumbered by the legislated divisions of responsibilities I have discussed here.

Thank you for this opportunity to share our thoughts and concerns. I would be pleased to answer any questions you may have at this time.


183.15 INCHES
98.20 INCHES
ø86.70
28 ELEMENT FUEL BASKET
NEUTRON SHIELDING
DRAIN PORT
ROTATION POCKET
NEUTRON SHIELD
LIFTING TRUNNION
CASK BODY
INNER LID
PRESSURE MONITOR PORT
OUTER LID
NUCLEAR ASSURANCE CORPORATION
SPENT FUEL STORABLE TRANSPORT CASK
NAC-STC

NAC-STC

Designer	Nuclear Assurance Corporation
Type	Storage/Transport (Dual Purpose)
Capacity	
Intact Spent Fuel Assemblies	26 PWR (5-year cooled) 52 BWR (5-year cooled) 37 PWR (10-year cooled) burnup credit
Weight (tons)	
Loaded	116 (with 26 PWR assemblies) 124 (with 37 PWR assemblies)
Empty	103
Design Heat Rejection (kW)	26
Shape	Cylindrical
Dimensions	
Overall Length (in)	193
Overall Diameter (in)	99
Cavity Length (in)	165
Cavity Diameter (in)	71
Wall Thickness (in)	13.6
Inner Lid Thickness (in)	9
Outer Lid Thickness (in)	5.3
Bottom Thickness (in)	14.4
Basket Length (in)	160.5
Basket Diameter (in)	70.9
Neutron Shield	
Side Thickness (in)	5.5
Inner Lid Thickness (in)	2
Outer Lid Thickness (in)	None
Bottom Thickness (in)	2
Materials of Construction	
Cask Body	SS/Lead/SS
Basket	Aluminum
Neutron Shield	Bisco NS4FR
Cooling Fins	None
Cavity Atmosphere	He
Cavity Pressure (psig)	30
Outside Surface Dose (mrem/hr)	100 (maximum)

Licensing Status - NAC has requested a docket number from the USNRC for license application and has had preliminary meetings with the USNRC. License submittal for storage was completed in April 1990. Submittal for transport licensing is expected in late 1990. Both storage and transport approvals are expected in 1991.

Comments - NAC is currently under contract to Empresa Nacional de Residuos Radiactivos, S.A. (ENRESA) to provide two NAC-STC casks for use in the Spanish National Waste Program.