LOW-LEVEL RADIOACTIVE WASTE TRANSPORT 18 YEARS EXPERIENCE

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ABSTRACT

This paper details Chem-Nuclear's 18 years of actual experience in the development of low-level radioactive waste transport equipment, including tractors, trailers and shielded casks. Insight as to the reasoning for the development of currently utilized equipment in relation to regulations, as well as an attempt to forecast how future required changes in 10 CFR 71 and how the nuclear transportation industry plans to implement a portion of the International Atomic Energy Agency (IAEA) Regulations is presented. Types of equipment available today and required for the future along with the various types of waste currently being transported and expected in the future is also discussed.

INTRODUCTION

In 1972, Chem-Nuclear began providing limited transportation services to the nuclear industry by transporting low-level radioactive waste from various midwest and east coast locations to low-level radioactive waste disposal sites. Today, Chem-Nuclear employs 22 veteran driver-technicians. We have a fleet of 25 Kenworth and Peterbilt tractors and an inventory of over 70 shipping casks, including 10 different NRC licensed Type A models and 7 different NRC licensed Type B models. On an average our transportation fleet logs over three million miles per year and has currently traveled over 28 million miles without a major accident or any release of radioactive material. We have served virtually every nuclear power station in the United States and have transported nearly every category of radioactive material including spent fuel.

BACKGROUND

In the 1960's and early 1970's the industry as a whole was serviced by a handful of common carriers and a small fleet of intermediate sized shipping casks. These casks were capable of handling up to 14 drums of processed waste with radiation levels of less than 10 to 12 R/hour.

During this period, Dry Active Waste (DAW) could be shipped in disposal packages ranging from plastic bags, to cardboard and wooden boxes which would not be permitted in today's regulatory climate. The normal mode of transport for this waste stream was primarily left to the common carrier utilizing their vans and flatbeds.

On the other hand, nuclear power stations were processing wet radioactive wastes by solidifying in 55 gallon drums using in-house drum solidification systems. Shipping casks were developed to accommodate the shipment of these drums rather than the large volume waste containers commonly used today.

In the mid-70's, the primary economic goal in transporting waste material was to ship as much waste as possible in each cask. This led to the development of shipping containers capable of transporting a greater number of drums per shipment. To meet the need for drums of processed waste that had radiation levels too high for vans or shielded vans and yet not restrictive enough to require the container(s) to be shipped in a Type A package, Chem-Nuclear and others began developing box loaders. Box loaders were larger capacity, rectangular shaped shipping containers and were classified as strong tight packages. Chem-Nuclear offered strong tight packages like the 27-415 (27 drums/shipment) and the 18-450 (18 drums/shipment). Another company introduced a cask which could ship up to 24 drums.

In addition transportation companies like ours began to develop heavier and larger volume shipping casks to meet the utility need to ship their higher activity processed 55 gallon drums. In 1975 and 1976 Chem-Nuclear developed and licensed the CNS 21-300 cask and the CNS 14-195 cask.

Processed waste was beginning to increase in activity and needed a more shielded cask like the 14-195 to ship waste that was approaching the 20 R/hr range. Conversely, the less shielded, higher volume 21-300 cask met the growing need to ship a greater number of drums per cask containing lower activity waste. This cask could ship up to 21 55-gallon drums of processed waste in the 1 to 2 R/hr range.

By the late 70's the industry was being serviced by two major transporters; Chem-Nuclear and Hittman Nuclear Development Corporation. Cask types primarily available at that time were:

	Drum Capacity		Radiation Limits
Type A	CNS 14-170	14	14 R/hr
	HN 100	14	14 R/hr
	CNS 14-195	14	21 R/hr
	CNS 21-300	21	1 R/hr
	CNS 7-100	7	190 R/hr
	HN 600	7	190 R/hr
	CNS 6-80	6	800 R/hr
Type B	CNS 8-120	8	800 R/hr
	HN 200	3	1000 R/hr

To understand how the industry moved into the next era of waste transportation, it is important to recap the regulatory shifts and political actions which precipitated the change.

As the 1980's approached, the transportation industry was beginning to be affected by the changing rules and regulations being issued by the Nuclear Regulatory Commission (NRC) and the States which housed the nations low-level radioactive disposal facilities. One major change that took place was the Volume Allocation Program implemented as a result of the state of South Carolina's volume cap on the Chem-Nuclear Barnwell site which limited the amount of radwaste disposed. Another was the NRC's establishing waste form stability requirements by introducing 10 CFR 61. Structural stability, as defined by the NRC Branch Technical Position, is intended to ensure that the waste does not degrade and promote slumping, collapse, or other failure of the cap or cover over the disposal trench which could lead to water infiltration. Structural stability of a waste form can be provided by the waste form itself (as with large activated stainless steel components); or by processing the waste into a stable form (e.g., solidification); or by placing the waste in a container or structure that provides stability (e.g., high integrity container). Stable waste should maintain gross physical properties and identity over a 300 year period.

Stations that were solidifying their wet waste would, typically, have to decrease their waste loading per container in order to obtain a stable waste form. Disposal prices began to escalate due to state imposed taxes, regulatory requirements and volume limitations that were experienced during the early 1980's. Increased costs were also associated with establishing Process Control Programs (PCP) mandated by the NRC's Branch Technical Position. PCP's were established to effectively implement 10 CFR 61 stable waste form criteria. PCP's consist of the established parameters and procedures required to process and bury an acceptable waste end-product. Due to the financial impact of these addedburdens, "Volume Reduction" was to become the catch phrase of the 80's.

Power stations were required to change their radwaste processing operations over night. The in-house 55 gallon drum solidification systems were found to be too costly to operate and maintain. Vendor processing of waste in large volume containers was found to be more economical. In fact, the power stations that were under construction at that time were building their radwaste facilities without a waste processing system. They intended to utilize vendor processing equipment and programs including NRC Accepted Process Control Programs.

With the Institute of Nuclear Power Operators and the NRC recommending that utilities become more concerned with reducing volumes and the cost of transportation and disposal increasing, utilities became interested in their ability to process as much waste as possible inside a container.

By 1985, a major shift had taken place in process technology. Power stations had moved from solidification to dewatering since this process lead to more cost effective disposal. In essence, with new dewatering technology like Rapid Dewatering Systems (RDS) and the increased line of available High Integrity Containers (HIC), in which the container itself could render the dewatered waste stable, a 170 cubic foot liner which contained only 125 cubic feet of solidified waste could accommodate as much as 200 cubic feet of dewatered waste.

At this particular time in our company's history, we felt that the implementation of 10 CFR 61 and the push for volume reduction caused minimal impact to Chem-Nuclear customers. We had prepared and submitted our Topical Reports for waste form chemistry and expanded our line of High Integrity Containers in anticipation of this inevitable shift in regulatory compliance.

The changes by regulatory authority did present a problem for the transportation industry. More waste per container meant higher curie content. Also, dewatered waste does not have the self-shielding affect of solidified waste. Use of box loaders, vans and casks capable of handling processed waste containers in the less than a 10 R/hr capacity were not in as much demand as they had been in the 1970's and early 1980's.

Other problems began to challenge the industry. The political climate had changed dramatically toward the nuclear industry following the TMI-2 accident. Utilities demanded more professionalism in their transport companies. Companies such as Chem-Nuclear who had already implemented strict training and qualification requirements for their transport fleet drivers as well as implementing extensive preventative maintenance procedures for its transport equipment found that without an unblemished transport record and a long list of experience in meeting DOT training and experience requirements for its drivers, the utilities would be reluctant to employ it's services.

As an example of meeting this need Chem-Nuclear driver qualification requirements are contrasted to the DOT minimums:

DOT Minimum Guideline for Driver Qualification and Training:

- 21 years old
- Read and speak English
- Able to operate the type of equipment he drives
- Determine cargo he transports is properly
- Physically qualified to drive
- Have a current, valid license
- Provide his employer with a list of violations
- Not disqualified to drive
- Successfully complete driver road test and possess certification

- Taken and passed a written examination and issued a certificate

CNSI Minimum Guideline for Driver Qualification and Training (In addition to DOT minimum guidelines):

- Possess 5 years over the road experience, with at least 2 years of experience in nuclear, hazardous material or heavy secured haul.
- Must have passed a Class III heavy-duty license and in-depth background investigation
- Must have completed a 23 part rad-worker training course
- Must qualify as a Highway Route Controlled Driver as required by 49 CFR 177.825

To assure an extra margin of safety, each Chem-Nuclear Driver-Technician is also trained for Emergency Response and interface with local officials; is covered under an approved radiation exposure program; is knowledgeable of the waste transportation paperwork package, proper placarding and labeling of radioactive shipments; trained in the use of radiation survey meters and survey techniques; and is required to attend safety meetings every six weeks for updates on all applicable regulations.

The Department of Transportation has issued a recent rule making that will require that by 1991 every transporter of nuclear and hazardous material meet the training and qualification requirements similar to that of Chem-Nuclear's. Further evidence that the transportation industry has been required to tighten its safety and training requirements is the April 4, 1988 Bulletin issued by the American Nuclear Insurers recommending that their policy holders ensure that their carriers had adopted the American National Standard (ANSI N14.27-1986) "Carrier and Shipper Responsibility and Emergency Response Procedure for Highway Transportation Accidents." A quote from that bulletin illustrated their concerns: "It is suggested that you review American National Standards N14.27 to make certain that the shipper and the carrier, working together, build a complete program." Upon issuance of that Bulletin, Chem-Nuclear responded to the industry concerns by detailing its compliance by outlining Chem-Nuclear's maintenance, training, quality control, and Emergency Response Procedures.

As the 1980's came to a close nuclear power stations were seen shipping their radwaste as illustrated below:

Typical Station Transportation Scenarios:

Waste Type	Processed	Method Shipped
Primary Resin or Reactor Water Cleanup	Dewatered	Licensed Type A or Type B shipping Cask
Steam Generator Blowdown/ Condensate	Dewatered	Large Volume (215 cubic feet) Type A casks*
Filters	In-situ	Licensed Type A or Type B shipping cask
Evaporator Bottoms	Solidified	Flatbeds or Large Volume (215 cubic feet) Type A casks
DAW	Drummed or Boxed	Flatbeds or Shielded Vans

*When newer power plants came on line in the mid to late 1980's, they found that their condensate resin comprised of very low activity. Many of these stations elected to ship these low activity, dewatered resin in large volume shipping casks as an added safety factor. Even though their contact radiation levels were far less than DOT required 200 mR/hr - therefore qualifying this container to be shipped on nothing more than a flatbed- the added protection factor of placing this container inside a licensed Type A container illustrates the concern that utilities placed upon insuring that in the case of an accident no release of radioactive material would take place.

PWR's generating contaminated steam generator blowdown resin followed suit and shipped this low activity resin in much the same manner. Chem-Nuclear experienced a resurgence in utilization of the CNS 21-300 cask for large volume low activity shipments. Although this practice still remains the same today, much of this waste stream requires the use of a licensed Type A Cask due to activity increases through plant aging.

REGULATIONS AND THEIR EFFECT ON THE FUTURE

As we prepare to enter a new era of transporting radioactive material, shipping casks will be required to have more shielding and thus be heavier and more volume restrictive. This alone will require power stations to move into smaller sized containers and increase their usage of Type B casks This will be the direct result in meeting the new proposed regulations scheduled for implementation sometime in 1991.

The Nuclear Regulatory Commission is revising its 10CFR71 transportation regulations to be aligned with the 1985 International Atomic Energy Association (IAEA) regulations. The intent of the NRC changes is compatibility with the international standard of shipping containers, packaging requirements, and performance criteria. The

NRC has, however, modified part of its regulations to restrict the packaging of LSA radioactive material by limiting the total package activity rather than adopting the entire IAEA standard.

As it is impossible to completely detail all the regulatory changes, a generalized summary is as follows:

1. Under today's regulations, radioactive material being processed and shipped are, depending on which radioactive material transport category utilized, placed inside one of the following container types:
   - Strong Tight Containers
   - DOT Type A Containers
   - NRC Type A Containers
   - NRC Type B Containers

   Under the new rule making:
   - Strong Tight Containers will still exist but will have a well defined testing and qualification criteria. The results will be documented and a file maintained for a period of one year after use.
   - There will no longer be a NRC Type A Container category. This container classification was used whenever a shipper would ship greater than Type A LSA material. Under the new rule LSA material that exceeds the Type A limitations will be shipped in a Type B package. The DOT will regulate Type A packages.
   - The NRC will continue to regulate Type B packages.
   - For LSA material there will be 3 new package categories:

   Industrial Package 1, 2, and 3.

2. Initially, the NRC proposed to adopt the IAEA standard that states unshielded containers having radiations levels of 1 R/hr at 3 meters or greater would constitute a Type B shipment category. Finding this rule extremely difficult to impose, they have revised the rule to limit radioactivity content which qualifies for shipment in a Type A package to 2 times the A1 (2A1) limitation found in 10 CFR 71 and 49 CFR. Activity content exceeding 2A1 will require a Type B transport package. (A1 or A2 quantities of radioactive material means the maximum activity of radioactive material permitted in a Type A package.)

LSA material that is less than the 2A1 quantity will be shipped in an Industrial Package 3. This package is essentially a Licensed NRC Type A package as we know it today. Since NRC Type A packages already meet this new package category, it appears that obtaining this classification will be nothing more than an administrative function of documenting compliance. In other words, an Industrial Package 3 will not be any more restrictive than a Type A Package; only the regulatory authority will shift from the NRC to the DOT. Quite honestly, Chem-Nuclear believes the current regulations are adequate and these changes are not required. Obviously this has been proven by the outstanding safety record the radwaste transport industry and their equipment has demonstrated over the years.

INDUSTRY EFFECTS

In 1989, Chem-Nuclear performed an evaluation and published its conclusions on the effect that this rule making will have on the industry's cask availability to ship the radioactive material and overall cost to the industry. The data we analyzed was complied from records obtained at the Barnwell Waste Management Facility operated by Chem-Nuclear.

At the time of that analysis indications were that in order to comply with the proposal 2A1 LSA limit there could be an increase of over 300% in the number of DOT Type B radioactive waste shipments. Under the current regulations there are approximately 20-30 processed waste shipments made each year to the Barnwell Facility that are required Type B cask shipments. Many more shipments are made in Type B casks that only require an NRC Type A Cask.

With the proposed 2A1 limit this would increase the number of Type B process waste shipments to over 90 per year. Since there are currently six (6) Type B casks available within the industry from various companies and these casks currently are utilized approximately 70% of the time, one can only conclude that there will be a shortage of available Type B casks. On the average, the analysis indicated that waste reading in the 20 to 25 R/hr range could be enough to require a Type B casks versus 60R/hr on average as is experienced under today's regulations.

Through that analysis, we estimate that the industry may need to manufacture over 8 new casks in order to effectively service the industry. It has been Chem-Nuclear's experience that it takes anywhere from 3 to 5 years to design, license and manufacture a new Type B Cask. Additionally, the cost can be extremely prohibitive. In the early 1970's a company such as ours could submit a license application for a new Cask to the NRC for a mere $150.00. The majority of the cost was invested in Design and Manufacture.

Today the rules are much different; license application and NRC review and approval requires a corporate investment of $300-500,000, the design and manufacture cost at least as much as the regulatory review and approval process.

Disposal volumes, transportation and associated costs will also increase. If, for example, waste currently transported in a typical 200 ft^3 Type A cask is transported in a

120 ft^3 Type B cask, due to the proposed 2A1 Limit, it would take nearly 2 Type B shipments to transport the same amount of waste.

Adoption of the NRC proposed regulations will economically impact the U. S. nuclear industry by $4 to $5 million per year according to EPRI (Daloisio 1988). EPRI's study utilized shipping information from a 1985/1986 database. The study evaluated solidified and dewatered primary and non-primary resin from BWRs and PWRs that were transported in three different casks. The $4 to $5 million impact identified in this study is the direct cost increase in package use, transportation miles, and disposal. The study did not evaluate the cost of new equipment (i.e., cask, trailer, design, licensing, and manufacture).

DIRECTION OF THE PROCESSOR AND TRANSPORTER

As the processor enters this new regulatory climate we may find them coming full circle. Although a good percentage of stations waste stream will continue being processed in much the same manner under the new regulations as they were under the old, the station will encounter waste that will be approaching Type B transport requirements.

Likewise, as indicated above, many of their shipments that were LSA Type A or greater will now be classified as Type B. They may find it necessary to lower the curie content by downsizing their process container in order to utilize the more readily available Type A shipping cask; or find new process technologies, whereby, the processor can concentrate more waste in the smaller process container which will ultimately raise the total curie content and maximize the required Type B shipment.

Chem-Nuclear, seeing the changes that were about to take place, began designing and licensing a new generation of intermediate sized Type B casks nearly four year ago. As mentioned earlier, this process takes anywhere from 3 to 5 years to complete. We intend to be ready to meet industry needs in line with the implementation of the new rule making.

Type B casks available within the industry have a volume range from 73 ft^3 to 160 ft^3; payload ranges are from 8,195 pounds to 16,600 pounds; and radiation level limitations ranging from 50 R/hr to 900 R/hr.

In conclusion, over the last 18 years, the nuclear transportation industry has changed with the regulatory climate. More important, the industry's safety record has been consistently excellent year after year. When was the last time you picked up a newspaper or turned on the evening news and read or heard about a transport accident that involved the release of radioactive material? The bottom line, however, is that without dedication to a safe operating fleet and attention to regulatory details, a radioactive material transport company will soon find itself without customers to serve.

Now, the transport industry finds itself in the throes of another round of regulatory change. These changes are more than just a few token upgrades. As mentioned earlier in this paper, these changes could cost not only the transport industry but also the operating nuclear power stations millions of additional dollars to meet the proposed regulatory changes.

Chem-Nuclear will support and meet any regulatory changes and will ensure that it's customers receive nothing but the best in transportation service. At what point, however, must the industry ask "Are these changes really necessary?"