

**WHAT IT TAKES TO MAKE A FEDERAL SHIPMENT, USA - 10538**

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**ABSTRACT:**

The High Flux Beam Reactor (HFBR) Decommissioning Project at Brookhaven National Laboratory (BNL) had to dispose of highly irradiated reactor components. Because of the extremely high dose rates, the objective was to identify and use a package that had an expiring certification, to enable its use not only for transportation, but for final disposal of the components.

BNL procured three (3) Type B packages from EnergySolutions, LLC that had sufficient shielding for compliant transport. These shipments were originally scheduled to take place prior to the Certificate of Compliance expiration date but project delays prevented this. The Brookhaven Site Office requested authorization for limited use of these packages from the Department of Energy (DOE) Packaging Certification Program. A Revised Certificate of Conformance was issued under DOE authority and required the use of Federal government drivers. Brookhaven did not have the government resources (i.e. drivers) and turned to the commercial sector, Hittman Transport Services, for assistance.

Hittman Transport Services had the knowledge and resources to develop a plan to assist BNL. Through an arduous process and review of requirements Hittman formulated an option that would allow an owner/operator to become a Federal employee for the shipment then return to a normal contract with Hittman. This permitted the government shipments to be made without interruption or loss to the Hittman driver fleet. This innovative process satisfied all the needs of the customer, all State and Federal Regulations and enable successful project completion.

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In September 2008, the Brookhaven Site Office (BHSO) requested Department of Energy (DOE) authorization for limited use of Type B packages, approved to the 1967 edition of the International Atomic Energy Agency (IAEA) regulation, after the October 1, 2008 expiration date. Specifically, the request was for one final shipment of three (3) Type B packages, the CNS 1-13 C, the CNS 1-13 G and the CNS 3-55, which were purchased, from Energy Solutions by Brookhaven Science Associates (BSA) under contract DE-AC02-98CH10886 to the Department of Energy.

These packages were purchased to support disposal of highly activated components from the Brookhaven National Laboratory (BNL) High Flux Beam Reactor (HFBR) Decommissioning Project. It was prudent to allow one last shipment in these packages that had demonstrated a proven safety record during transportation for many years as certified and licensed by the Nuclear Regulatory Commission (NRC) Type B shipping packages.

The HFBR control rod blades and beam plug consisted of approximately  $7.4 \times 10^{14}$  Becquerel (20,000 curies) of activated metals. The components also exhibited extremely high dose rates, expected to be greater than 100 Sieverts (10,000 Rem per hour) measured at one foot from the component underwater. In accordance with ALARA principles, one objective of the HFBR Decommissioning Project was to identify and use a package that had an expiring certification, in order to enable its use not only for transportation, but for final disposal of the components. Disposal of the control rod blades (CRB's) and beam plug directly in the package reduced the potential radiation dose to workers at the disposal facility by minimizing handling and limiting radiation exposure to workers by eliminating the need to unload the contents. In addition, the waste disposal volume was minimized and these shipments facilitated project completion and enabled the satisfaction of commitments made in the HFBR Record of Decision. Additional justification and information that was provided to assist the DOE Packaging Certification Program in authorizing the use of these packages is summarized below.

The HFBR project originally planned to use the DOE owned BMI-1, CNS 1-13C-II and T-2 casks, which were in use at the Idaho National Laboratory (INL). However, these casks were not available for use on this project due to a continuing need by INL. Efforts were initiated to identify and purchase alternate NRC licensed Type B packages specifically ones who's NRC Certificates of Compliance (COC) were expiring, to enable the project to realize the benefits stated above. Three (3) NRC licensed Type B packages, the CNS 1-13 C, the CNS 1-13 G and the CNS 3-55, were located and purchased, from Energy Solutions in January 2008 and scheduled for delivery to the Brookhaven site in June 2008.

The HFBR project had to upgrade the safety basis of the facility to a Hazard Category 3 Nuclear Facility and implement a new Documented Safety Analysis (DSA) prior to removal of the control rod blades. Due to delays in implementing the new DSA at the HFBR, the Operational

Readiness Review (ORR) was not completed until September 2008. This review resulted in some corrective actions that had to be implemented prior to being authorized to commence removal of the control rod blades and beam plugs. At the time of purchase of the NRC licensed packages in January 2008, the project schedule allowed sufficient time to complete shipments before the expiration date of the COC for the NRC licensed packages. However project delays, associated with preparation for and completion of the ORR extended the project completion date beyond the COC expiration date. An alternative solution was required to facilitate successful project completion. Although the COC had expired, it was still safe to transport and dispose of the control rod blades and beam plugs in these previously NRC licensed Type B packages. Therefore authorization for limited use of these packages for a period not to exceed one year was requested from the Packaging Certification Program in DOE headquarters.

**Reasons for Requesting Extended Use:**

Due to limitations of the HFBR facility (i.e. size of the fuel pool, capacity and clearance of the crane, amount of shielding required for these high dose rate items, etc.) the project identified only one commercially available package that was capable of making these shipments after October 1, 2008. Using this alternate package would require twice the number of shipments and the control rod blades and beam plug would have needed additional size reduction. Furthermore the components would have to be unloaded at the disposal facility, resulting in increased handling and potential worker radiation exposures and all of the ALARA benefits of disposal in the package would be lost. In addition, availability of this package was limited, and the decision to use this alternate package would have extended the project completion date and increased the project cost by over \$500,000 beyond the Project Baseline.

**A Plan and Schedule to Acquire Replacement Packages or Complete Necessary Shipments:**

As discussed above, much effort had gone into finding packages that could be used for final disposition of the contents. Only one viable alternative Type B package for use after October 1, 2008 was identified, however the decision to use this alternate package to dispose of the HFBR control rod blades and beam plug would have introduced additional schedule delays, increased costs, increased the number of shipments on the road and resulted in increased potential for worker radiation exposures.

Disposal of the control rod blade and beam plug in the previously NRC licensed Type B packages purchased by BSA was clearly in the best interests of the government and provided more than adequate protection of the workers, the public and the environment. BHSO thereby requested authorization for limited use of the three packages for one final shipment to disposal to be completed by October 1, 2009.

**Safety Justification for Continued Use and Compensatory Measures:**

The identified packages were previously licensed NRC as Type B packages and had been utilized at other DOE facilities and in the commercial industry for many years without ever having a release of their contents to the environment. They were proven, dependable, and robust packages for the safe transport of highly irradiated radioactive materials.

The NRC licensed Type B packages were purchased from Energy Solutions (ES) formerly Chem-Nuclear Systems (CNS) and underwent inspections and testing prior to being used at

BNL. The casks would be closed and loaded onto trailers at BNL under the supervision and guidance of ES supplied trained and experienced Type B package handlers. The trailers for transportation of the packages were also purchased by BSA and were the same ones previously used and specifically made for these Type B packages. The trailers would be inspected and maintenance performed prior to use by BNL for the three shipments.

All drivers would be provided detailed driver instructions; including the exclusive use instructions, emergency contacts, emergency response information and general driver instructions. The driver instruction package would be reviewed with each driver prior to each shipment and stayed with the shipping paperwork during transport to the disposal facility.

The request for DOE certification of the packages specified that the Type B shipments would be made as Federal shipments in accordance with the provisions of Title 49, Code of Federal Regulations, and Part 171.1(d)(5). The shipments would be managed, packaged and transported in accordance with, or with equivalent safety, to all relevant regulations, including those of the Department of Transportation (DOT) and the DOE. In addition, the shipments would be "Exclusive Use" shipments, and were transported by federal employees, solely for Government purposes from one Federal Government DOE site to another, specifically, the Brookhaven National Laboratory, operated by BSA, to the Nevada Test Site, operated by National Security Technologies, LLC (NSTec).

#### **Compliance with the Certification:**

The following information was also provided to compare the original Certificate of Compliance contents requirements to the proposed contents in order to demonstrate compliance with the acceptable contents as previously approved for the package.

#### **1) CNS 1-13C - Certificate of Compliance / Package ID number: USA/9081/B ( ) - Revision 15**

Certificate of Compliance Requirement: Greater than Type A quantity of byproduct material as solid metal. Decay heat not to exceed 600 joules per second (600 watts).

The HFBR control rod blades met this requirement because they qualify as byproduct material as defined by the Atomic Energy Act (42 U.S.C. Sect.2259) "byproduct material — (1) any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material, and ..." [AEA, Section 11(e)]. Additionally, the maximum total decay heat generated from any combination of the HFBR control rod blades is 114 joules per second (114 watts), which is less than the maximum allowed.

#### **2) CNS 1-13G - Certificate of Compliance/ Package ID number: USA/9216/B ( ) F-Revision 10**

Certificate of Compliance Requirement: Solid non-fissile irradiated metal hardware, reactor control rods (blades), reactor start-up sources, and segmented boron carbide tubes (tube contents not to exceed a Type A quantity).

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The HFBR control rod blades met this requirement because “control rods (blades)” is specifically described in the certificate of compliance.

**3) CNS 3-55-2 - Certificate of Compliance / Package ID number: USA/5805/B ( ) - Revision 25**

Certificate of Compliance Requirement: There are two requirements specified for this package.

(1) Type and form of material: Depleted Antimony-Beryllium (Sb-Be) neutron sources and irradiated metal components packaged in secondary containers.

**And**

(2) Maximum quantity of material per package: Package internal decay heat load not to exceed 250 joules per second (250 watts). The source strength of depleted neutron sources not to exceed  $8.51 \times 10^{10}$  Becquerel (2.3 curies) of Antimony-124

The HFBR beam plug met the requirement of being an "irradiated metal component" and the beam plug was packaged in a “secondary container” (liner) within the package. Additionally, the HFBR beam plug has a total decay heat of  $3.86 \times 10^{-1}$  joules per second ( $3.86 \times 10^{-1}$  watts) which is less than the maximum allowed.

**Issuance of a Revised Certificate of Conformance:**

Based on the justification of need provided, the DOE Packaging Certification Program and in accordance with the authority granted in Title 49 Code of Federal Regulations Part 173.7 (d) (issued a DOE Certificate of Compliance. BHSO was now the Certificate holder and responsible for maintaining the COC and meeting all requirements during shipment.

Initially, the DOE COC, was issued was based on the original existing NRC approved safety basis, and also expired on October 1, 2008. However, just prior to expiration; the DOE issued COC was revised and reissued to allow for a single final shipment beyond the expiration date, for up to one year, until October 1, 2009.

In addition to other compensatory safety measures, such as satellite tracking and requiring a copy of the COC in the vehicle, the DOE issued COC required the shipments to be conducted as Federal government shipments in accordance with the provisions in Title 49, Code of Federal Regulations, Part 171.1(d)(5). This required the Type B shipments to be transported by Federal employees that were certified/trained drivers.

In addition to issuing a new CoC for the packages, the DOE Packaging and Certification Program issued Exemptions DOE-E0801, DOE-E0802 and DOE-0803 to allow the use of the DOE COC's for up to one year to make a single one way shipment.

**Identification of Shipments:**

There were three (3) individual one way shipments from BNL on eastern Long Island in New York State to the Nevada Test Site (NTS) near Las Vegas, Nevada. The exact routing was determined just prior to each shipment and incorporated the NTS preferred routing. Each shipment was made via truck with flatbed trailer and included a single package.

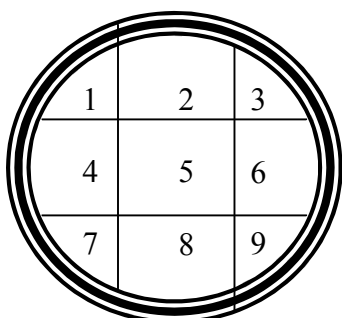
The contents of the CNS 1-13C and CNS 1-13 G packages included activated metals in the form of highly irradiated control rod blades (calculated total of  $5.96 \times 10^{14}$  Becquerel (16,107 curies),

and the CNS 3-55 package contained activated metals in the form of one beam plug (approximately  $1.85 \times 10^{12}$  Becquerel (50 curies). The dominant radionuclide in both the control rod blades and beam plug was cobalt-60 and the maximum measured dose rate at one foot from the component underwater was 66.74 Sieverts (6,674 Rem per hour), just slightly less than the 100 Sieverts (10,000 Rem per hour) predicted dose rate. The packages had sufficient lead shielding such that the dose rate on the outside of the packages met DOT requirements for safe travel over public roadways.

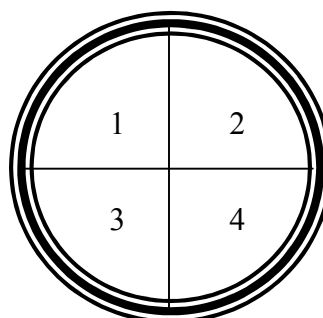
**Measured Dose Rate (in Rem per hour and Sieverts per hour) and Package Loading Configuration For the HFBR Control Rod Blades**

CRB #ID	TOP R/Hr @ 1'	CENTER S/Hr @1'	BOTTOM S/Hr @ 1'	RPM Designated Loading Position (e.g., 1-13C-3)
M - 1	110	13.73	43.09	1-13G - 1
M - 2	286	8.34	41.94	1-13G - 2
M - 3	344	15.67	42.83	1-13G - 4
M - 4	217	13.89	31.50	1-13G - 6
M - 5	231	16.70	39.22	1-13G - 8
M - 6	245	23.41	44.17	1-13G - 3
M - 7	165	23.80	44.62	1-13G - 7
M - 8	200	28.69	47.97	1-13G - 9
A - 1		8.36		1-13G - 2
A - 2		8.18		1-13G - 6
A - 3		9.99		1-13C - 4
A - 4		8.62		1-13G - 8
A - 5		67.74		1-13G - 5
A - 6		21.78		1-13C - 1
A - 7		8.60		1-13G - 4
A - 8		9.12		1-13G - 5

**CNS 1-13G**



**CNS 1-13C**



**HFBR Control Rod Blade Calculated Activity (in Becquerel and Curie) Content by Nuclide**

Nuclide	Total Activity in the CNS1-13G		Total Activity In the CNS 1-13C		Total Activity in both casks	
	Becquerel	Curies	Becquerel	Curies	Becquerel	Curies
C-14	2.22e+11	6	2.59e+10	0.7	2.22e+11	6
Fe-55	1.23e+14	3,320	6.92e+12	187	1.30e+14	3,508
Co-60	1.82e+14	4,928	1.15e+13	310	1.94e+14	5,238
Ni-59	5.55e+11	15	4.81e+10	1.3	6.29e+11	17
Ni-63	1.19e+14	3,216	1.13e+13	306	1.30e+14	3,522
Eu-154	9.49E+13	2,565	1.28e+13	346	1.08e+14	2,911
Eu-155	3.06e+13	826	4.14e+12	112	3.47e+14	938
<b>Total</b>	<b>5.50e+14</b>	<b>14,876</b>	<b>4.55e+13</b>	<b>1,231</b>	<b>5.96e+14</b>	<b>16,107</b>

**Shipment Approvals and Outreach**

The BHSO Site Office Manager approved all three Type B shipments from BNL and notification was made to DOE Headquarters.

A Fact Sheet was prepared with the help of the DOE Transportation Emergency Preparedness Program in the Office of Packaging and Transportation, EM-63 (see attached). This was used to help facilitate additional outreach with the affected regional Council of States Governments points of contacts and with the local Offices of Emergency Management, Police, Fire, Sheriff, New York City Departments of Transportation, Health and others in the local New York area including Suffolk County, Nassau County, Westchester County and New York City. Planning, coordination and outreach began several months in advance.

**Developing a Federal Driver program**

BHSO had to find federal employee drivers to conduct the shipments. The search began within the Department of Energy and the Department of Defense, but even after exhausting all efforts, BHSO was not able to secure the support of a federal driver that met the required qualifications and was able to support the BNL shipments. At this point the contractor at BNL, Brookhaven Science Associates (BSA), looked to the commercial sector for help and began discussions with their shipping sub contractors. Hittman Transport has supported BNL's cask transportation for many years, so a call was made to Hittman's Management to inquire about supporting BNL in this unusual request. In the beginning there were many groups involved in the planning and as the reality of a Federal driver program grew nearer, the interface narrowed to just Hittman Transport and BSA personnel.

Hittman began the arduous process of developing the process internally. Because Hittman Transport has a split fleet of drivers, company employees and owner/operator drivers, Hittman had a few options to explore. Hittman discussed the issues with our Human Resources department and how to approach the issues of benefit packages, 401K deposits and vacation accruals. The drivers would have to take a break in service for the shipment and then we would re-hire the drivers and re-instate the benefits. Upon further discussions, we determined the

company driver option to be too laborious and would create un-due work and possible disadvantages to the company drivers.

Hittman's next option was to use owner/operators. Hittman has individual contracts with our owner operators and as contract employees they are not paid any additional benefit packages eliminating many of those human resource type issues. We determined that we could break the owner operator contract, allowing them to become Federal employees for the shipments and then re-issue their contract once the work was completed and they were discharged as Federal employees. Hittman began looking at the tractor requirements for the shipments and determined that four-axle equipment would be required for the overweight casks and three-axle equipment would suffice for the other shipments. At the time of the shipments Hittman did not employ team drivers that operated a four-axle tractor, so Hittman had to determine how to approach this issue. Hittman had a single driver that was will to participate in the program and agreed to team with the four axle driver. By doing so, he would have to shut his truck down for the time period. For the legal weight shipments, Hittman had a husband and wife team that was interested in joining the adventure.

Once the decision was made to use owner operator drivers, Hittman then began determining what driver information BSA and DOE required from Hittman. Hittman provided a Motor Vehicle Report within the past 30 days, driver's license, and passport information, copies of driver's logs and training qualifications.

The DOE had issues to overcome as well. First authority had to be obtained in order to hire the drivers to a federal term appointment. Position descriptions, pay grades, hours of service, duty stations and many other employment details were worked out with extensive help from staff at the Office of Environmental Management Consolidated Business Center. Eventually all issues were resolved and offers of employment were made to four drivers.

The drivers were sworn in as Government employees and US Government placards were designed and installed on the tractors. The federal drivers were dispatched to BNL to provide their services. Hittman was able to provide overall project management for the shipments and also provided logistics support, Qualcomm monitoring, and permits under its existing contract with BSA. Hittman coordinated with State Permit agencies to secure all of the necessary overweight permits on behalf of the Government.

Once the Federal shipments were delivered, the drivers' employment with the Government was terminated and their contract with Hittman Transport was re-instated.

The local agencies made the decision to escort the shipments while in New York State and until the trucks exited the heavily populated metropolitan area. Coordination with the agencies to make the hand-offs between jurisdictions required significant coordination of efforts and many conference calls. All three of the Federal shipments, which began in mid-February 2009 were completed by the end April 2009 were escorted by police and or sheriff patrol cars in their jurisdiction and were safely transported out of the metropolitan area and all the way to their destination at the Nevada Test Site without incident.

This project was successfully completed, safely transporting the highly activated reactor components from BNL to the NTS for disposal of the components and the Type B packages with minimal dose to the package handlers during transport and at the disposal site. Nearly 25% of the radiological inventory of the HFBR was removed with a total dose of less than 2 millisieverts

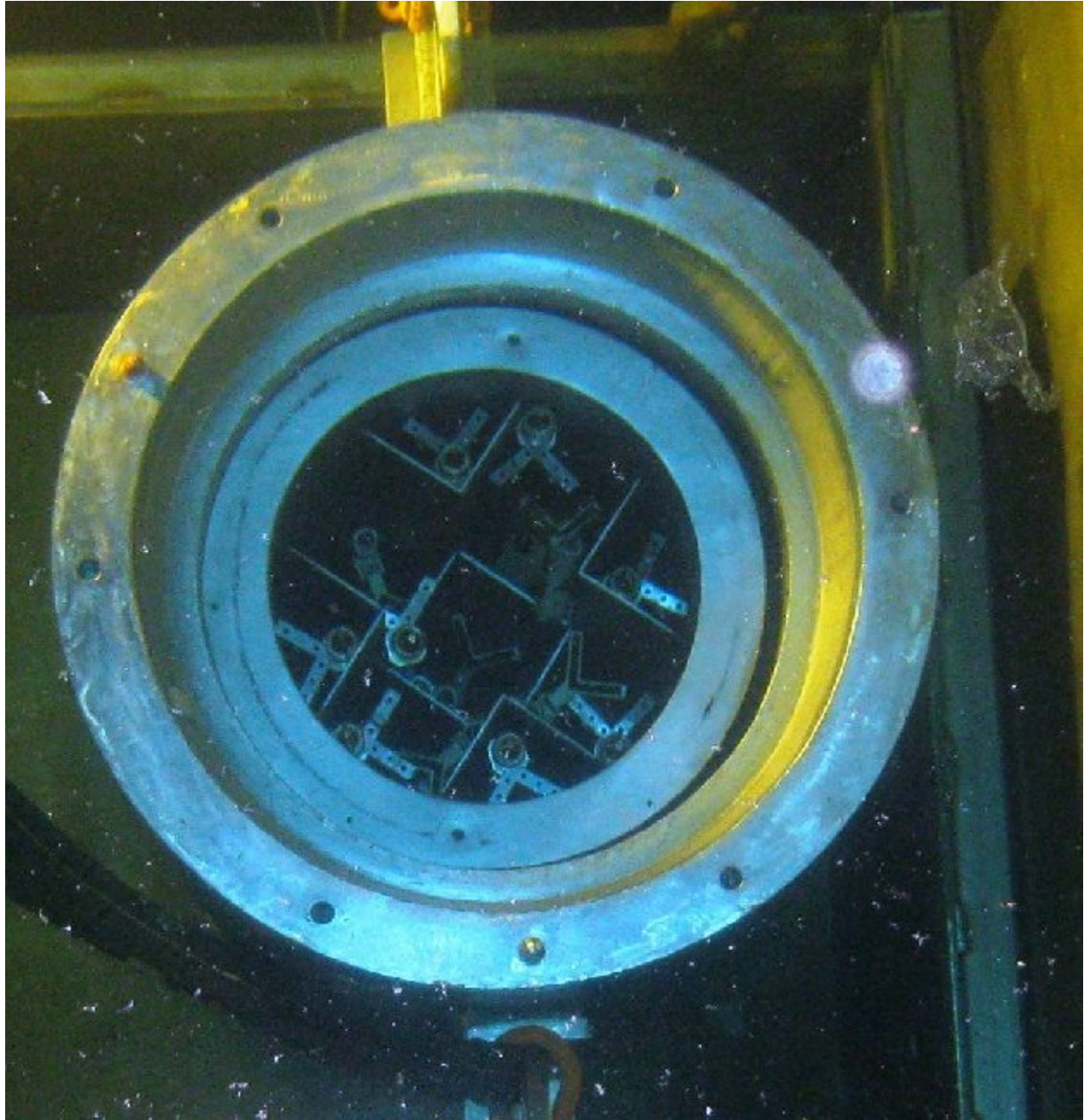


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(200 person milli-Rem) combined to all of the workers on this project. In addition this project has established a process to obtain qualified Federal drivers and it has laid the groundwork for the use of Federal drivers within DOE complex to conduct Federal Government shipments.



Getting ready to place CNS 1-13G cask into spent fuel pool to load control rod blades underwater.



Final loading of control rod blades in CNS 1-13G cask.



Checking tie downs of the CNS 1-13G loaded on trailer.



Truck used to transport 3-55 – Notice US Government sign covering Hittman truck markings.