LANSCE Division
Hazard Control Plan Cover Sheet

OPERATIONS OF THE LEAD SLOWING DOWN SPECTROMETER--DEVELOPMENT PHASE		
LANSCE-3 HCP-23	Revision:	Date: September 30, 2003
Location of Work: TA-53/ MPF-7		Group: LANSCE-3
Authors:	**Signature**	**Date**
Robert Haight	Robert Haight	9/30/03

Initial Risk Level: Medium		
REVIEW/APPROVAL		
Reviewed by:		
Bruce Takala/Steve Wender	Bruce Takala	10-3-03
Glen Johns	[illegible]	10-7-03
Michael Duran	[illegible] Duran	10-7-03

Residual Risk Level: Low		
Approved by:		
Steve Wender	Steve Wender	10/7/03
Next Authorization Review Date: September 29, 2004		

HAZARD CONTROL PLAN
LANSCE-3 HCP 23

Operations of the Lead Slowing Down Spectrometer -- Development Phase

1. Definition of Work

A Lead Slowing-Down Spectrometer (LSDS) (Fig. 1) is being constructed for installation in the Blue Room of LANSCE. This instrument is based on 20 metric tons of high purity lead in the approximate shape of a cube 1.2 meters on a side. The lead is on loan from the CEA laboratory in Bruyères-le-Châtel, France. When it is used in experiments, this cube is centered on a tungsten target, toward which the 800 MeV proton beam from the accelerator is directed. Neutrons produced in the tungsten are multiplied by the lead and then slow down slowly in the lead cube. Small samples are placed at various locations within the lead and are irradiated by a large flux of neutrons. With this approach, we intend to measure the fission cross section of very small samples of actinides. An ultimate goal is to measure the fission cross section of the 26-minute isomer of ^{235}U (denoted ^{235m}U) over the range of 1 eV to approximately 200 keV.

This HCP addresses the installation and disassembly of the lead cube and the routine operation of the LSDS. This HCP DOES NOT address issues associated with the production of the ^{235m}U sample or the handling of ^{239}Pu from which the isomer is separated. These and other particular samples will be addressed in other HCP's.

The LSDS is located in the Blue Room, also known as Target 2, of the Weapons Neutron Research Facility of LANSCE. The building is MPF-7. Operations will be conducted on and near the low-mass floor of the Blue Room, in the entrance hall, and in the basement. In addition, radiation from the experiments could be a factor in areas near the Blue Room.

In summary, the general operating procedures are as follows, with details and plans described later in this HCP.

1) Assemble the 20-ton lead cube, which consists of 36 subunits, on a support table.
2) Install 30-mil (0.030") cadmium around the full cube. First the cadmium will be cut by a foot-activated shearing device, which cuts cleanly and does not produce small particles. The cadmium at the bottom of the cube will need to be installed before any of the lead is moved into position. Cadmium on the sides of the cube will be held in place by tape. Cadmium is necessary to absorb low energy neutrons that have been moderated in the materials of the Blue Room and then return to the lead.

3) Insert the tungsten target in a channel in the middle of the cube.
4) Prepare and insert the fissionable samples in other channels in the cube. Also insert diagnostic detectors to characterize the neutron flux and fluence.
5) Perform irradiations with possible changes in detectors.
6) Measure radiation levels at low beam current.
7) After a radiation cool-down period, remove the detectors and disassemble the tungsten target and the lead cube. The tungsten target will be sufficiently radioactive that it will need to be handled with a long rod and placed in a lead pig.
8) Move the lead subunits to the basement of the Blue Room so that other experiments can use the space and/or that the beam tube can be reassembled for transporting beam to Target 4.

Accelerator interfaces:

1) The beam from the accelerator will be transported in vacuum until it passes through a window approximately 30 cm in front of the LSDS.
2) Radiation monitors in the Blue Room, so-called IR and GD monitors, will detect significant radiation levels when the beam is on at the maximum designed level. The IR monitors are in the "fast protect" interlock chain. The GD's are in the RSS.

The LSDS will be used for runs of a few days to about a week with running times likely to be spaced by several months.

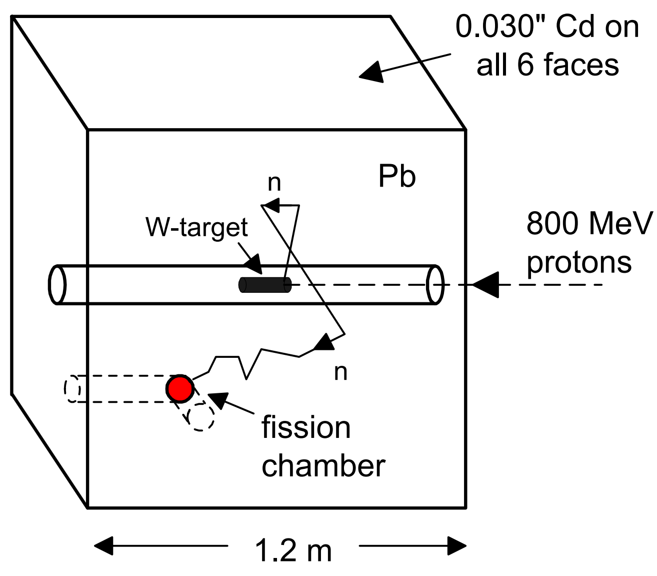

Figure 1. Schematic drawing of the Lead Slowing-Down Spectrometer.

2. Identification of Hazards

The hazards associated with this activity are:

1) Mechanical: The 20-ton lead cube is assembled prior to each experimental run from 36 subunits, each with weight of 540 kg. The support needs to be assembled and verified each time.

2) Radiation with beam on: Radiation levels at the Blue Room door are calculated (see Appendix A) to be 100 mR/hr at the maximum beam current of 1 uA. Other areas near the Blue Room will likely have radiation dose rates above 5 mR/hr.

3) Radiation with the beam off: The tungsten target and the lead will be activated. Radiation levels have been calculated (see Appendix B) to be significant from the tungsten target and of lower values, but potentially also of interest, for the lead.

4) Radioactive materials: Fission chambers used in the experiment will contain actinides. For initial runs, the fission chambers will contain ^{235}U and ^{238}U. As stated above, this HCP does not address the preparation and use of the ^{235m}U samples, which will be separated from ^{239}Pu.

5) Thermal (heat): At the highest beam currents foreseen in this experiment (1 uA), 800 watts of beam power is delivered to the tungsten target. The lead will also experience heating from radiation.

6) Electrical: Some of the detectors use photomultiplier tubes, which require high voltage.

7) Chemical: The LSDS consists of 20 tons of high purity lead and 100 pounds of cadmium. Both of these materials are toxic, RCRA-controlled substances. Lead oxide can form on the surfaces of the lead subunits. Lead oxide may exist as a particulate that can become airborne. It will be removed prior to the irradiations so that the lead-oxide wipes are not "mixed waste". Cadmium will be cut by a shearing device and then attached by tape to the lead. Neither the lead nor the cadmium will be airborne. After the experiment, the lead will be returned to the French laboratory and the cadmium will be used in further experiments at LANSCE.

8) Physical: There are physical hazards of a normal industrial nature: Crane use, hand tools, power tools, etc.

9) Stored energy (pressure): The beam comes through an evacuated tube until about 30 cm in front of the LSDS. At this point, it passes through a window into air.

3. Waste Streams

The lead is on loan from the CEA laboratory at Bruyères-le-Châtel in France. It will be returned after all of the experiments have been completed. The cadmium belongs to LANL and will be used in further experiments. Operation and maintenance may generate small amounts of lead waste, which may include lead or lead oxide-contaminated rags and gloves, in the cleaning process before the lead is irradiated. The satellite accumulation area at the north side of MPF-7 will be used for storage of this waste. All waste storage and disposal will be conducted according to LANL and LANSCE policies under LANSCE waste coordinator guidance.

4. Initial Risk Level Determination

Because of the large mass of lead and the radiation hazards, the initial risk level is **MEDIUM.** The rationale for this initial risk level assessment is as follows:

1) Mechanical: The 20 tons of lead is supported 15 feet above the basement of the Blue Room. If it were to fall, injury and/or significant damage to equipment would result. The initial risk is **medium.**
2) Radiation with beam on: Radiation levels of 100mR/hr at the Blue Room door make this a Radiation Area. The initial risk is **medium.**
3) Radiation with the beam off: The dose rate at contact of the tungsten target can be as high as several hundred mR/hr after 1 hr of cool-down. The initial risk is **medium**.
4) Radioactive materials: The ^{235}U and ^{238}U material in the fission chambers is well contained in them. The risk is **minimal**.
5) Thermal (heat): The heating of the lead is expected to be very small. The tungsten target will be cooled with forced air flow. The initial risk is minimal.
6) Electrical: The electrical power and voltage used in the photomultipliers have the potential to cause a major injury; however, the likelihood of such an occurrence is improbable. This combination of severity and likelihood results in a **minimal** initial risk.
7) Chemical: Lead contamination has the potential to cause occupational illness or environmental harm. Because the lead is clean and has a relatively low surface area, the initial risk is **low**. Cadmium will be cut by a shearing device and then attached by tape to the lead. Exposure to cadmium has a **low** initial risk. Neither the lead nor the cadmium will be airborne.

8) Physical: The general physical hazards have the potential to cause major injuries; however, the likelihood of such an occurrence is improbable. This combination of severity and likelihood results in a **low** initial risk.
9) Stored energy (pressure): The window separating the accelerator vacuum from atmosphere in the Blue Room is sturdy, 1/16" of aluminum. The initial risk from this window breaking is **minimal.**

5. Hazard Controls

5.1 Mechanical

5.1.1 Eliminate the hazard. The LSDS requires a large mass of lead. No other suitable location was available to perform this work. The hazard cannot be eliminated.

5.1.2 Design to reduce the hazard. The table to support the LSDS has been designed with a comfortable safety factor (Appendix C). The supports below the table all the way to the basement of the Blue Room have been analyzed and shown to be adequate with also a comfortable safety factor (Appendix D).

5.1.3 Engineering controls. The support has been designed to support the 20-ton weight of lead with a sufficient safety factor so that an additional floor loading of 500 pounds/sq. ft can be safely supported.

5.1.4 Warning devices. Signs will be posted at the entrance to the Blue Room when the LSDS is installed, stating:

WARNING

Lead Slowing-Down Spectrometer is installed.

Limit of additional floor loading is decreased to 500 lbs/sq. ft.

Lead Use Area
Cadmium Use Area
No eating or smoking

5.1.5 Administrative controls. In assembling the LSDS, it is important that the support table and the lead be located according to the engineering drawing. First, the supports in the basement must be verified to be in position. Then the table and its underlying support of I-beams and support plates must be located according to the engineering detailed in the memo from Effiok B. Etuk to Robert Haight, LSDS-06-19-03. The LSDS can then be built on the table by personnel who have valid crane training.

To lift the subunit lead blocks, each weighing 540 kg, the special, certified lifting fixture must be used.

The following checklist must be satisfied, referring to the memo of E. B. Etuk:

1. The bearing plates must be in place.
2. Verify that support columns # 5 thru 30, 34, and 35 are in place and their connection to the low mass floor has not been changed. They need to be "adequately connected to the floor beam above and the base mat.
3. Limit the floor loading in the area to 500 psf after the LSDS has been installed in position and post sign as above.

This checklist must be verified by at least one LANSCE-3 technician, who is knowledgeable about the Blue Room, and one LANSCE-3 TSM involved in the LSDS experiment. An example of the checklist is given in Appendix E. For each running period, the checklist must be filled out and copies maintained with the HCP near the Blue Room as well as in the LANSCE-3 Group office.

5.2 Radiation hazard with the beam on:

5.2.1 Eliminate the hazard. It is impossible to eliminate the hazard as the LSDS is designed for a very high neutron flux at the sample position.

5.2.2 Design to reduce the hazard: The Blue Room is a shielded area for conducting these experiments. Shielding and distance from the radiation source lower the dose rate.

5.2.3 Engineering controls: More shielding can be added between the LSDS and the Blue Room door if the initial experiments, conducted at low beam intensity, show that there is a significant problem. LANSCE-3, HSR-1 and LANSCE-6 will decide if more shielding is necessary.

5.2.4 Warning devices: Active radiation monitors (Albatross and beta-gamma monitors) will be located in areas where the radiation levels could be greater than 5 mR/hr. They will be locally alarming. Signs will be posted to alert personnel to possible radiation exposures. Access to areas with radiation levels greater than 5 mR/hr will be restricted to essential personnel.

5.3 Radiation with the beam off

5.3.1 Eliminate the hazard: It is impossible to eliminate the hazard as the LSDS is designed for a very high neutron flux at the sample position.

5.3.2 Design to reduce the hazard: The tungsten target will be the most radioactive component after the beam is turned off. It is well shielded by the lead cube while in position. When it needs to be removed, a long rod will be used to extract it into a lead shield positioned just behind the LSDS. The target will be stored in the box formed by lead bricks now inside the Blue Room. A dry-run of extracting the tungsten target and placing it in the shielded box will be carried out before each running period.

5.3.3 Engineering controls: None

5.3.4 Warning devices: At the entrance to the Blue Room, a sign will be posted by HSR-1 indicating radiation levels at various positions in the Blue Room.

5.3.5 Administrative controls: All work will be conducted according to Laboratory LIR's. Rad-worker training is required for all participants in the experiments. Monitoring by HSR-1 will be required each time an entry to the Blue Room is requested after beam has been incident on the target. Personnel dosimeters as required by HSR-1 will be worn.

All initial entries into the Blue Room will be made with radiation control technician instructions (RCT) coverage. Access to the Blue Room may require waits of up to 20 minutes depending on levels and the length of time required in the work area.

Access to the Blue Room is controlled by RCTs. Personnel must follow radiation control technician instructions and follow the ALARA principle. An RWP will be required for any work if the work is to be done in either a Radiation Area or a High Radiation Area, or if there is a potential for receiving more than 20 mrem for the job, or if the area is posted as a Contamination Area.

5.4 Radioactive materials

5.4.1 Eliminate the hazard: It is impossible to eliminate the hazard as these materials are essential to the flux monitors.

5.4.2 Design to reduce the hazard: The ^{235}U and ^{238}U will be contained in sealed fission chambers. These chambers are not to be opened in the Blue Room.

5.4.3 Engineering controls: None

5.4.4 Warning devices: At the entrance to the Blue Room, a sign will be posted by HSR-1 indicating the use and amounts of radioactive materials.

5.4.5 Administrative controls: All work will be conducted according to Laboratory LIR's. Rad-worker training is required for all participants in the experiments. Personnel dosimeters as required by HSR-1 will be worn. Portal monitors will be used when exiting the Blue Room.

All initial entries into the Blue Room will be made with radiation control technician instructions (RCT) coverage. Access to the Blue Room may require waits of up to 20 minutes depending on levels and the length of time required in the work area.

Access to the Blue Room is controlled by RCTs. Personnel must follow radiation control technician instructions and follow the ALARA principle. An RWP will be required for any work if the work is to be done in either a Radiation Area or a High Radiation Area, or if there is a potential for receiving more than 20 mrem for the job, or if the area is posted as a Contamination Area.

5.5 Thermal

5.5.1 Eliminate the hazard: It is impossible to eliminate the hazard, as beam from the accelerator must be used to produce neutrons.

5.5.2 Design to reduce the hazard: At beam currents above 50 nA, the tungsten target will be cooled by airflow. If the airflow stops for some unforeseen reason, the thermocouple readout, described in 5.5.4, will indicate an abnormal situation and the beam will be shut off.

5.5.3 Engineering controls: None

5.5.4 Warning devices: A real-time monitoring of the temperatures will be used to indicate excessively high temperatures. These data will be transmitted to CCR who will be instructed to turn off the beam if the temperatures exceed 100 ^{o}C for the tungsten and 80 ^{o}C for the lead.

5.5.5 Administrative controls: Personnel will be instructed on the importance of monitoring the temperature. A "T.O." must be submitted.

5.6 Electrical Hazard.

5.6.1 Eliminate the hazard: Electrical power is required; associated hazards cannot be eliminated.

5.6.2 Design to reduce the hazard: Commercial power supplies and bases for the photomultipliers are used.

5.6.3 Engineering controls: These are designed in the commercial units.

5.6.4 Warning devices: Not necessary

5.6.5 Administrative controls: All electrical work will be conducted according to LANL guidelines specified in LIR402-600-01.1, Tables 2.1, 2.2 and 2.3. Virtually all electrical work will be Mode 1 (non-energized). If work must be performed in Mode 2 or 3, an SEWP or HCP will be generated for that work. Monitoring by HSR-1 will be required each time an entry to the Blue Room is requested after beam has been incident on the target. Work on electrical equipment will be performed only by qualified, fully trained personnel. The 2-man rule is required, for work in Modes 2 or 3.

Lockout/Tagout procedures will be employed during all electrical work.

All workers have Electrical Training for the R&D worker or equivalent.

LANSCE-3 Electrical Safety Officer (ESO) will approve all electrical work and equipment.

5.7 Chemical Hazard.

5.7.1 Eliminate the hazard: The chemical hazard is lead and cadmium. Both of these materials are essential to the LSDS. The hazard cannot be eliminated.

5.7.2 Design to reduce the hazard: Temperature indicators (used for beam currents over 50 nA) will be used to keep the temperature well below the point where lead and cadmium have significant vapor pressures.

5.7.3 Engineering controls: None.

5.7.4 Warning devices: Signage shown in 5.1.4 is posted at all work area entry points during operations:

WARNING
Lead Slowing-Down Spectrometer is installed.
Limit of additional floor loading is decreased to 500 lbs/sq. ft.
Lead Use Area **Cadmium Use Area** **No eating or smoking**

5.7.5 Administrative controls: When the lead or cadmium needs to be touched, PPE is required: leather gloves and safety shoes. The leather gloves are to be stored in a ZIP-loc bag labeled "Gloves for Lead and Cadmium only"

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5.8 Physical Hazard.

5.8.1 Eliminate the hazard: Elimination of physical hazards is not possible. Use of cranes, hand tools, power tools, etc. is part of normal operation and maintenance.

5.8.2 Design to reduce the hazard: Use of cranes, hand tools, power tools, etc. cannot be reduced further.

5.8.3 Engineering controls: None.

5.8.4 Warning devices: Workers in the area are briefed on physical hazards. Special controls are implemented when necessary, such as vacating the area of nonessential personnel when crane work is in progress.

5.8.5 Administrative controls: Equipment such as cranes are used only by properly trained personnel.

5.9 Stored energy (pressure) hazard.

5.9.1 Eliminate the hazard: The beam must be transported in vacuum until it is near the LSDS. The hazard cannot be eliminated.

5.9.2 Design to reduce the hazard: A sufficiently robust window (aluminum, 0.060" thick) will be used.

5.9.3 Engineering controls: None.

5.9.4 Warning devices: None.

5.5.5 Administrative controls: None.

6. Skills, Training and OJT Requirements for Workers

All participants must have completed training required to work at Los Alamos National Laboratory and at Los Alamos Neutron Science Center
In addition all participants must have completed the following:

Laboratory Training:
1. Hazard Communication Introduction.
2. Lead awareness.
3. Radiation worker II for LANL employees; TA-53 Site Specific Rad-Worker training for non-LANL employees.
4. Certified crane operator training for personnel operating the crane.

5. TA-53 Site Specific Training
6. Blue Room RAA Training

The list of personnel is provided on a signature sheet in the documents folder.

All workers involved with this operation must have completed the following On-the-Job Training:

   a. Read HCP and test procedure.
   b. Obtain authorization by the Principal Investigator, who has described the system according to the steps below.
      1. LSDS is a system built to generate a large neutron flux at sample positions.
      2. Main hazards: Radiation with the beam on; Radiation with the beam off; Mechanical; Lead; Cadmium.
      3. PPE for different operations.
      4. Meaning of the warning signs.
      5. Description of the operation.
      6. Inspection for mechanical safety
      7. Radiation monitoring
      8. Questions.
   c. Sign the acknowledgment log (last page of this HCP).

Applicable Institutional Requirements are given in: LIR 402-700-01.2, Occupational Radiation Protection Requirements

7. Residual Risk Determination

Residual risk is **LOW.** The rationale for this residual risk level assessment after implementing controls is as follows:

1) Mechanical: The engineering analysis gives a comfortable safety factor for supporting the 20-ton lead cube. The residual risk is **minimal.**
2) Radiation when the beam is on: The radiation calculations will be tested at low beam current. Where necessary, areas classified at Radiation Areas will be roped off. Radiation levels will be determined by HSR-1, who will advise on proper controls. The residual risk is **low**.
3) Radiation when the beam is off: The activation calculations will be tested at low beam current. The only expected large radiation will come from the tungsten target. Operational procedures described above will reduce the radiation dose to low levels. The residual risk is **low**.
4) Radioactive materials: Because of the containment of these materials, the residual risk is **minimal.**

5) Thermal (heat). The temperature increase due to beam heating in the tungsten and radiation heating in the lead is expected to be low. Thermocouple readouts will indicate the actual temperatures. Operational procedures discussed above will shut off the beam if the temperatures become too high. The residual risk is **minimal**.
6) Electrical. The electrical power and voltage that are being used have the potential to cause injury, however, the likelihood of such an occurrence is remote. All of the modules are commercially supplied and operated in conventional manner. This results in a **minimal** residual risk.
7) Chemical. Lead or cadmium contamination has the potential to cause occupational illness or environmental harm and the likelihood of such an occurrence is now remote. The residual risk is **minimal**.
8) Physical. The general physical hazards have the potential to cause major injuries, however, the likelihood of such an occurrence is now remote. This combination of severity and likelihood results in a **minimal** initial risk.
9) Stored energy**:** The stored energy in the vacuum is deemed not to be a problem because of the rather thick exit window through which the beam passes into air.

8. Procedures

- A pre-job briefing will be held before each experimental beam time.
- The mechanical checklist will be followed in reassembling the LSDS each time.
- A dry run for removing the tungsten will be carried out before irradiation to establish procedures for reducing radiation exposure to personnel.
- Radiation monitoring will be carried out by HSR-1 continuously:
    - As the beam is being brought up to determine radiation levels at the Blue Room Door, the Men's Room in MPF-7, and any other location that could be inhabited
    - For each entry into the Blue Room after beam has been put onto the LSDS
    - For the tungsten target and the lead blocks before and during disassembly
- All Blue Room procedures will be followed. In particular any material located in the Blue Room during beam operations will be surveyed for radioactivity before removal from the Blue Room.
- The checklist as found in Appendix E must be completed for each running period.

9. Emergency Procedures

In case of emergency or off-normal operations the following contacts must be contacted immediately:

- For emergencies with immediate life-threatening danger: 911

- For any emergency or off-normal operation:

CCR		7-5729
LANSCE-3 management (Wender/Takala)		7-1344
		5-2029
	page	4-2185
	page	4-8827
Robert Haight		7-2829
	page	4-6842

- In any off-normal event that relates to radiation or possible radioactive contamination, contact the RCT's in HSR-1 must be contacted: 7-7069

- For off-normal events with waste disposal implications: FMO-SWO 7-2210
  page 4-2852

Personnel are to stop work and remain in the area, if this area is safe, until told to resume work or leave the area by LANSCE-3 management or HSR-1 as appropriate to the situation. In all cases, personnel are to report to LANSCE-3 management their status and the status of the situation.

10. Personnel

Cognizant Scientists on the project are:

Name	Office	Pager
Robert Haight	667-2829	104-6842
Dimitri Rochman	667-9393	104-8286
Andreas Kronenburg	664-0333	

Other participating persons, provided they have training and OJT described in 6:

Name	Office	Pager
Gregg Chaparro	665-2861	104-3023
Art Bridge	665-4124	104-2469
Lloyd Hunt	665-6300	104-8738
David Lujan	667-4285	104-5027
Nate Archuleta	667-3632	104-8358
David Vieira	667-7231	----
Robert Rundberg	667-4785	----

All Personnel must sign the acknowledgment log below.

Acknowledgment Log

I have read this Hazard Control Plan.

NAME	SIGNATURE	DATE

Appendices:

A. Radiation levels with the beam on (Kelsey)
B. Radiation levels from activation following cool-down times (Pitcher)
C. Mechanical design of table (Taylor)
D. Engineering analysis of support below the low-mass floor (Etuk)

Electronically:

Appendix A is a separate file: Appendix_A.pdf

Appendix B is a separate file: Appendix_B.pdf

Appendix C is included here

Appendix D does not include the full drawings used for the engineering analysis of the floor loading in the Blue Room. It does however indicate the columns and their numerical designation necessary for the checklist.

Appendix E -- Checklist

APPENDIX C

Los Alamos
NATIONAL LABORATORY
memorandum

To/MS: Robert C. Haight, H855
From/MS: Mark A. Taylor H805
Phone/Fax: 667-4555/665-2676
E-mail: *markt@lanl.gov*

Date: June 24, 2003

Stress Analysis of Table and Load Distribution Frame for the Lead Slowing Down Spectrometer to be Installed in the WNR Target 2 Blue Room

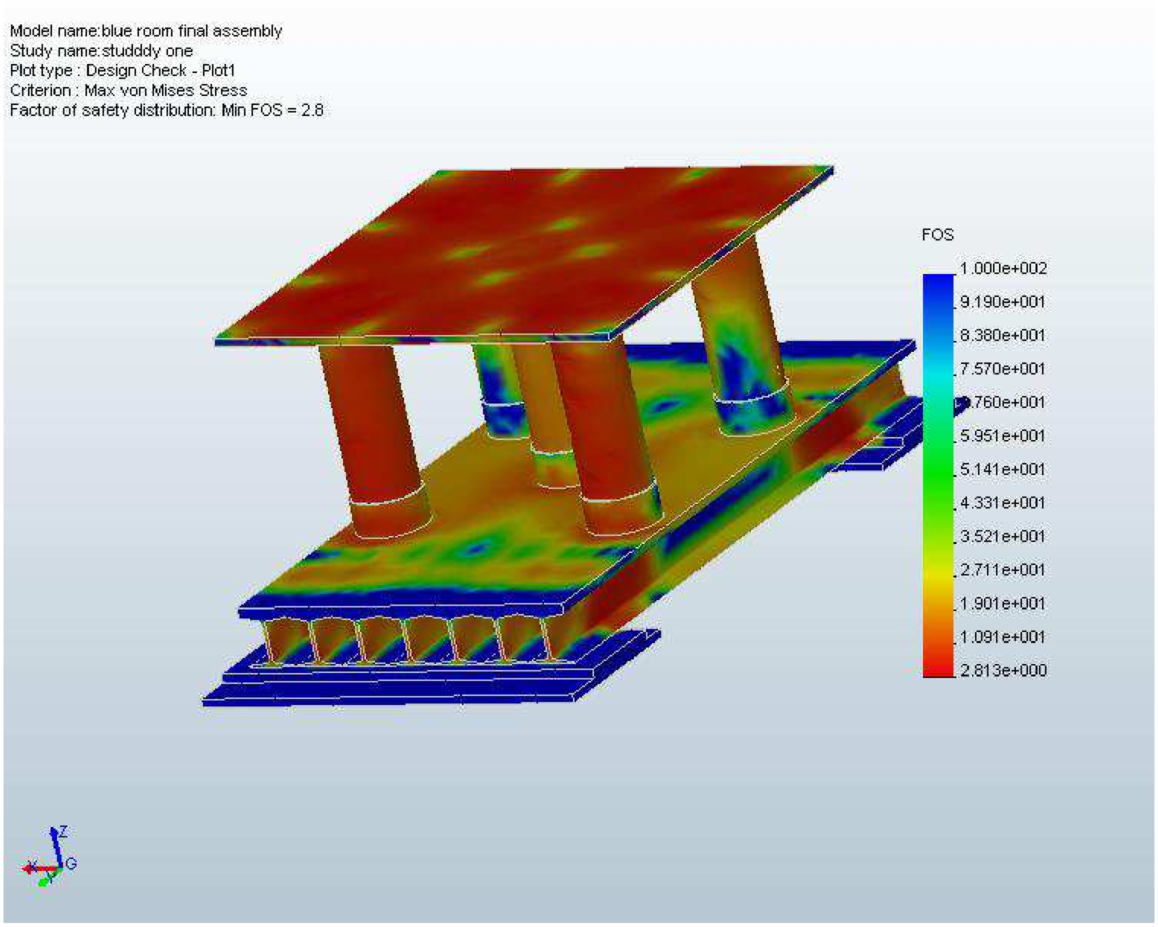
A table and weight distribution frame has been constructed to support the 44,000 lb Lead Slowing Down Spectrometer that is to be installed in the WNR target 2 Blue Room. The table is necessary to put the center of the spectrometer at the height of the beam, and the load distribution frame is needed to place the weight of the spectrometer directly over structural beams that support the upper Blue Room floor. The structural analysis of the Blue Room floor to determine suitability for carrying the spectrometer has been performed by Ben Etuk, and should be included with this document.

The load distribution frame is based on seven WF6 steel I-beams that bear the spectrometer load in a 38" square evenly distributed load in the center of span, and place the load over structural beams in the floor, a distance of approximately 70 inches, (see attached figure) The table top which is in contact with the spectrometer is supported by five 8" diameter 0.25" wall 6061-T6 aluminum pipes with a 3.2 length to width ratio.

The table and load distribution frame have been modeled as an assembly in Solidworks, and have been analyzed for stresses using COSMOS finite element linear solver. The linear solver is suitable to this application because of relatively small deformation of the frame (0.025" bow in 70" span). A factor of safety (FOS) map was created by COSMO and is included with this document. The map is autoscaled from an FOS of 200 to the minimum FOS of 2.81 found in the steal I-beams, where the color red indicates areas of low FOS and blue represents areas of high FOS. FOS is based on the yield strength of the materials and not the ultimate strength. The Minimum calculated FOS of 2.8 predicts `that the table and frame should be capable of supporting 123,600 lbs before any structural component reaches yield stress, where the spectrometer weighs 44,000 lbs. Or in other words, the table and distribution platform could support 2.8 times the weight of the spectrometer.

CONCLUSION

Based on my 21 years experience an engineer, I feel that the 2.8 minimum FOS is sufficient for the static loading condition of the WNR blue room.


Model name:blue room final assembly
Study name:studddy one
Plot type : Design Check - Plot1
Criterion : Max von Mises Stress
Factor of safety distribution: Min FOS = 2.8
FOS
1.000e+002
9.190e+001
8.380e+001
7.570e+001
5.951e+001
5.141e+001
4.331e+001
3.521e+001
2.711e+001
1.901e+001
1.091e+001
2.813e+000
Z
X
Y
G

Appendix D is a paper copy. First is a memo from Steve Wender to Kevin Jones, June 30, 2003, entitiled "Request Approval to Begin Assembly of the Lead Slowing-Down Spectrometer"; followed by a memo from Effiok B. Etuk , LSDS-06-19-03, entitled "TA-53, Building 7 (Blue Room) Floor loading Study" The first memo and relevant pages from the second are included here.

Appendix D

Los Alamos
NATIONAL LABORATORY
memorandum
LANSCE-3

To/MS: Kevin Jones, LANSCE-DO, H845
From/MS: Steve Wender, LANSCE-3, H855 SW
Phone/Fax: 7-1344/Fax 5-3705
Date: June 30, 2003

Subject: Request Approval to Begin Assebly of the Lead-Slowing-Down Spectrometer (LSDS)

This memo is to request approval to begin assembly of the Lead-Slowing-Down spectrometer (LSDS) in Target-2 (Blue Room). The LSDS consists of a cube of lead 1.2m on a side and weighs approximately 20 tons.

We have analyzed the floor loading requirements and find that the floor can support the required load. The attached memo from Etuk (FWO/DECS, LSDS-06-19-03) states that " Our analysis results show that the Blue Room floor can adequately support the 20-ton Lead Slowing-down Spectrometer and 500 psf live load simultaneously."

Prior to the first assembly of the LSDS in the Blue Room we will perform a walk through to verify that the requirements presented in Etuk's memo are met. The walk through will specifically address the following issues:

- ✓ The support structure for the LSDS is as designed and fabricated correctly.
- ✓ The support columns are correctly in place and correctly connected to the floor and foundations.
- ✓ There is no other floor loading that would modify the conclusions of the analysis.

The above conditions are satisfied and we certify that the assembly of the LSDS can begin.

Ben Etuk FWO/DECS Effiok Etuk.

Mark Taylor LANSCE-12 Mark Taylor

We approve the installation of the LSDS:

Robert Haight LANSCE-3 Robert Haight

Bruce Takala LANSCE-3 Bruce Takala

Steve Wender LANSCE-3 Steve Wender 7/2/03

Kevin Jones LANSCE-DO Kevin Jones 7/3/03

Operation of the LSDS and subsequent assembly and disassembly will be covered in an HCP for the LSDS.

ARR:ajt

Los Alamos
NATIONAL LABORATORY

memorandum

Facility & Waste Operations

Design Engineering & Construction Services.

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SUBJECT: TA 53, Building 7 (Blue Room) Floor Loading Study

Introduction:

The purpose of this study was to review existing Blue Room floor at elevation +6950.0', for the feasibility of placing a 20-ton Lead Slowing-down Spectrometer (LSDS) on it.
The study will also recommend structural modifications to be made to the existing floor in order to satisfy the LSDS load requirements.

Structure Description:

The Blue Room floor (elevation +6950.0') is made up of aluminum grating supported by structural steel and aluminum beams. The overall floor structure is supported at the Target Building concrete wall and by steel pipe columns anchored to the base mat. Steel floor beams are W8 x 31, with W12 x 65 as girders; and the aluminum floor beams are WF8 x 10.72. The floor support columns are: 5" diameter standard pipe for members 1 thru 5, 26, 31, 32 and 33; 10" diameter standard pipe for members 6, 9, 10, 27 and 30; 8" diameter standard pipe for members 7, 8, 28, and 29; and 4" diameter standard pipe for members 11 thru 25, 34 and 35. (See Figure-1)

Two (2) bearing plates: 2" thick x 2'-0" wide x 4'-0" long; placed 6'-0" apart, is used to distribute LSDS loads to the floor structural members.

A review of the existing Construction Drawings, showed floor live load of 1,500 psf. is permitted for this area. Efforts were made to utilize the high allowable floor live load in combination with the LSDS load.

Analysis Method:

Floor strength investigation was done by developing a "SAP2000 Nonlinear" finite element model of the floor structure. The floor system and components are then checked for compliance with AISC ASD-89 and UBC-97 requirements.

Design parameters and assumptions used in the floor loading investigation included the followings:

1. LSDS weight with impact and miscellaneous loads is 47,320 LBS. This load was applied to the two bearing plate as Area load, with value = 3000 psf.
2. Allowable floor load when the 20-ton LSDS has been permanently installed on the floor was selected between load range 400 psf. through 1500 psf.

3. All structural steel beams and plates are ASTM A36, with yield strength, Fy = 36.0 ksi.
4. All aluminum shapes and plates are 6061-T6, with tensile yield strength, Fty = 35.0 ksi.
5. All steel pipes area ASTM A53, with yield strength, Fy = 35.0 ksi.
6. All connection bolts are stainless steel AISI 304, with yield strength, Fy = 35.0 ksi.

Analysis Results & Conclusions:

Our analysis results show that the Blue Room floor can adequately support the **20-ton Lead Slowing-down Spectrometer and 500 psf. live load simultaneously.**

Figure-2 shows Demand/Capacity ratios for all structural steel members used in the analysis as adequate, based on AISC ASD 89 code check.
Demand/capacity ratios for selected critical members are:

Column# 17 = 0.623
Column# 18 = 0.629
Column# 19 = 0.621
Column# 20 = 0.625

Figure-3 shows Demand/Capacity ratios for all aluminum members used in the analysis as adequate based on AA-ASD 2000 code check.
Demand/capacity ratios for selected critical members are:

Beam B1 = 0.214
Beam B2 = 0.117
Beam B3 = 0.104
Beam B4 = 0.207

Figures 4 & 5 shows stresses in the floor grating material, and are less than the allowable stress of 28.0 ksi.

Recommendations:

We recommend that the following tasks and requirements be satisfied prior to, and during the 20-ton LSDS installation:

1. Fabricate and install the Bearing plates.
2. Verify that steel columns: 5 thru 30, 34 and 35 are in place, and are adequately connected to the floor beam above, and the base mat.
3. Limit floor loading in the area to **500.00 psf**. after the LSDS has been installed at its permanent position.

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Attachments:

1. Figure-1: Blue Room floor Plan
2. Figure-2: Sap2000N plot of Demand/Capacity ratios for Steel members

3. Figure-3: Sap2000N plot of Demand/Capacity ratios for Aluminum members
4. Figure-4: Sap2000N Stress plot for floor grating
5. Figure-5: Sap2000N Stress plot for floor grating
6. Figure-6: Sap2000N Input model.
7. CALC-001: Demand/Capacity calculations for selected critical members: 17, 18, 19, 20, B1, B2, B3, & B4

Cc: Mark Taylor, MS H805
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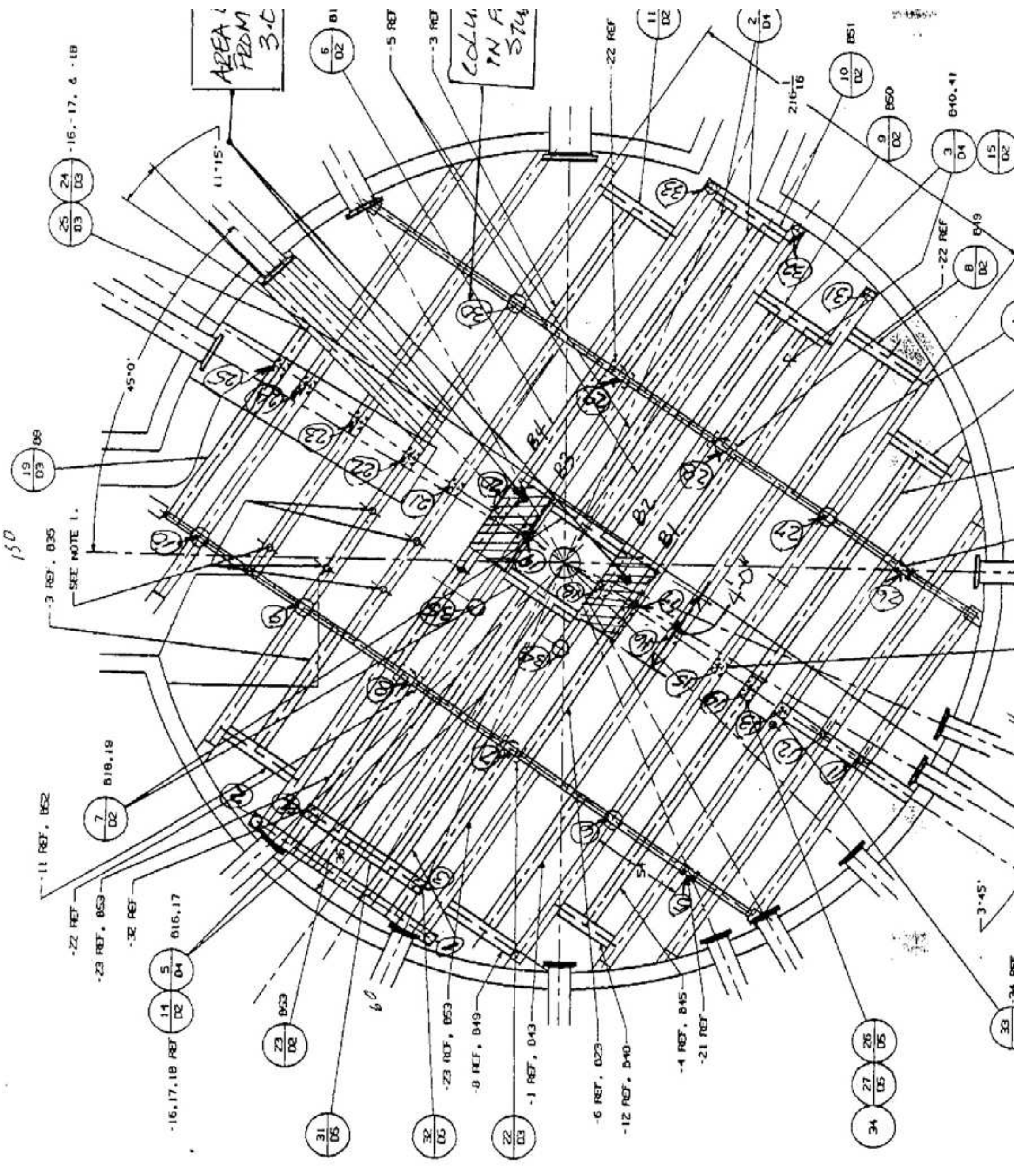

Appendix E

Checklist

Lead Slowing-Down Spectrometer Check List		Date	_______			
Mechanical support **	Name	Z#	Initials	Name	Z#	Initials
Bearing plates are in place						
Support columns # 5 thru 30, 34, and 35 are in place						
Connection of columns to the low mass floor has not been changed						
Columns are adequately connected to the floor beam above						
and to the base mat						
Sign stating floor loading limit now 500 lbs/sq. ft. in place						
All participants are briefed on the mechanical hazards and						
reduced limit of floor loading						
Radiation safety						
HSR-1 has been informed of experiment and can provide						
continuous coverage						
Active radiation monitor is in place at Blue Room door						
Signs in place warning of possible radiation dose - Blue Room door						
and Men's Room in MPF-7						
Areas with greater than 5 mR/hr roped off and indicated						
"For Essential Personnel Only"						
HSR-1 will post a sign at the entrace to the Blue Room warning						
of radiation levels at various locations in the Blue Room and						
of any radioactive materials in use in the experiment						
Sign is in place: "Warning Lead Slowing-Down Spectrometer is Installed						
-- Limit of additional floor loading is decreased to 500 lbs/ sq ft.						
-- Lead Use Area; Cadmium Use Area; No eating or smoking"						
A dry-run has been conducted for removing the tungsten target						
and placing it in a shielded area before beam is turned on						
If beam current is possibly above 50 nA						
Temperature monitors read out at CCR						
Active warning device is installed and working at CCR						
to shut off beam if temperature exceeds 100-deg C on tungsten						
or 80-deg C on lead						
A Timely Order has been submitted to CCR						
Before each running period						
Pre-job briefing has been held						
List personnel attending pre-job briefing						
List:						
All participants have read and signed the HCP						
** All items in this section must be verified and initialed						
by a LANSCE-3 TSM and a LANSCE-3 Technician						