

**Chit Resolution Report: NSTX-U-REC-097-02**

<b>CHIT CODE</b>	<b>REPORT LOG #</b>	<b>STATUS</b>
TCACS01	CR-NTC-01	Out of Scope
TCACS02		
TCACS03		
TCACS04		
TCMISC01		
TCMISC02		
TCMISC03		
TCMISC04		
TCMISC05		
TCMISC07		
TCACS05	CR-NTC-03	Out of Scope
TCMISC06	CR-NTC-04	Closed
TCRMS01	CR-NTC-05	Closed
TCRMS02	CR-NTC-06	Closed
TCRMS03	CR-NTC-07	Closed
TCRMS04	CR-NTC-08	Closed
TCRMS05	CR-NTC-09	Closed
TCRMS09	CR-NTC-10	Closed
TCRMS06	CR-NTC-11	Closed
TCRMS10	CR-NTC-12	Closed
TCRMS11	CR-NTC-13	Closed
TCRMS12	CR-NTC-14	Closed

NTCSPDRII01	CR-NTC-15	Out of Scope
NTCSPDRII02	CR-NTC-16	Closed
NTCSPDRII03	CR-NTC-17	Closed
NTCSPDRII04	CR-NTC-18	Closed
NTCSPDRII05	CR-NTC-19	Out of Scope
NTCSPDRII06	CR-NTC-20	Closed
NTCSPDRII07	CR-NTC-21	Closed
NTCSPDRII08	CR-NTC-22	Closed
NTCSPDRII09	CR-NTC-23	Closed
NTCSPDRII10	CR-NTC-24	Closed
NTCSPDRII11	CR-NTC-25	Closed
NTCSPDRII12	CR-NTC-26	Closed
NTCSPDRII13	CR-NTC-27	Closed
NTCSPDRII14	CR-NTC-28	Closed
NTCSPDRII15	CR-NTC-29	Closed
NTCSPDRII16	CR-NTC-30	Closed
NTCSPDRII17	CR-NTC-31	Closed
NTCSPDRII18	CR-NTC-32	Closed
NTCSPDRII19	CR-NTC-33	Closed
NTCSPDRII20	CR-NTC-34	Closed
NTCSHIELDPDR02	CR-NTC-35	Closed
NTCSHIELDPDR05	CR-NTC-36	Closed
RPCDR061	CR-NTC-37	Closed
NTCFDR01	CR-NTC-38	Closed
NTCFDR02	CR-NTC-39	Out of Scope
NTCFDR03		
NTCFDR04	CR-NTC-40	Closed
NTCFDR05	CR-NTC-41	Closed
NTCFDR06	CR-NTC-42	Closed
NTCFDR07	CR-NTC-43	Closed
NTCFDR08	CR-NTC-44	Closed
NTCFDR09	CR-NTC-45	Closed

Cognizant Engineer: \_\_\_\_\_ (name, sign and date)

Approver ( \* ): \_\_\_\_\_ (name, sign and date)

( \* ) For CDR and PDR the DRC, for FDR and after FDR the Main Approved (A-1: Chief Engineer, A-2 and A-3: DRC). DRC = Design Review Chairperson

# **Chit Resolution Report** **for** ***NSTX-U Test Cell*** ***Shielding***

**NSTX-U-REC-097-02**

February 28, 2019

Prepared By: \_\_\_\_\_  
Cognizant Engineer

Approved By: \_\_\_\_\_  
Responsible Engineer

Approved By: \_\_\_\_\_  
Project Engineer

# Record of Changes

Rev.	Date	Description of Changes
0	11/30/2018	Initial Release
1	12/19/2018	Document number change only
2	2/28/2019	Included FDR Chits and Resolutions (see Section E). Also resolved PDR-I chits (see Section C) and NSTX-U Recovery CDR Chits (see Section D). Corrected chit numbers starting from CR-NTC-04. Updated cover sheet per the requirements of ENG-033, Rev 7.

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**Disposition Key:**

A	=	Actionable
NA	=	Not Actionable
NB	=	Not Actionable Due to Budget Constraints
O	=	Out of Scope
R	=	Redundant

## A. NTC Shielding DVVR Chits and Resolutions

### CR-NTC-01 – *Out of Scope DVVR Chits*

Disposition	Review	ID	Chit
O	Test Cell DVVR	TCACS01	Consider reviewing a fault condition where a false high is present in the loop due to a 120V crossover. The concern is that the loop may not drop if a loop short to 120V occurs (through a cable issue etc). Consider running the hot and return wires for the loop through separate conduit or install redundant parallel loops that are run in separate conduits.
		TCACS02	The consequence of a false E-Stop during a shot can be dire in terms of damage to SDS cabinet components. Consider an assessment of false trips including i) blocking access to doors during operations, ii) redundant switches on doors, iii) other things that might prevent an errant e-stop...
		TCACS03	Status transition logic for E-loop. What happens when E-loop is broken during a pulse? Which transition occurs and what sequence of actions is taken?
		TCACS04	All E-loop knowledge with one person, combination of others covers part.
		TCMISC01	Consider replacing the sodium lamps.
		TCMISC02	The instrumentation and controls for the HVAC systems need to be updated.
		TCMISC03	The HVAC hardware needs to be evaluated to determine if it needs to be replaced due to its age.
		TCMISC04	The Compressed Air hardware needs to be evaluated to determine if it needs to be replaced due to its age.

		TCMISC05	The festoon wiring for the overhead crane needs to be re-terminated in the terminal box in the NE corner of the NTC.
		TCMISC07	Test Cell Ceiling Leaks on the North Side. Should assess if we can get this fixed.

*The chits collected at the NSTX-U Test Cell DVVR were carefully evaluated and finally grouped into “Super Chit” and the remaining as out of scope for the recovery project. The “Super Chit” were then budgeted as one WBS element of the NSTX-U Recovery Project, which was then called “NTC Shielding”. The chits listed in the above table (Title: CR-NTC-01 – Out of Scope DVVR Chits) were the out of scope chits for the NTC Shielding scope.*

*Therefore, these chits shall be assigned to the proper engineering function and closed from the NTC Shielding scope.*

**CR-NTC-02 - *Radiation Issues due to penetrations and insufficient shielding***

Disposition	Review	ID	Chit
A	Test Cell DVVR	SuperChit #TCSC1	Radiation Issues due to penetrations and insufficient shielding
	Test Cell DVVR	TCACS05	Some drawings related to the HIS may not be fully up to date (I am told). Since this is a human safety system, it seems to me like this may be one place where we need to ensure fully up to date documentation.
	Test Cell DVVR	TCMISC06	The penetration drawings and log need to be updated.
	Test Cell DVVR	TCRMS01	Data from the Radiation Monitoring System will need to be reviewed, as it becomes available, to determine if penetration shielding needs to be improved.
	Test Cell DVVR	TCRMS02	Reassign and restart the neutronics calculation Bob Woolley was working on? It might help identify significant future effects that aren't apparent yet in measured data.
	Test Cell DVVR	TCRMS03	Shielding, especially local shielding of penetrations may be insufficient for future operations. Restart design and analysis of local shielding around penetrations. A survey of penetrations could identify a few bad actors.
	Test Cell DVVR	TCRMS04	Consider using D-T generator to assess which penetrations or features of the NTC walls/ceiling/floor are causing the worst dose (after appropriate review of course...)
	Test Cell DVVR	TCRMS05	Please consider moving the card reader on the south door to the door to the south high bay.
	Test Cell DVVR	TCRMS09	Develop an experimental plan to utilize low dose Bubble Detectors during neutron shielding experiments to help quantify the errors occurring in He-3 based detectors due to scatter, energy and dose

	Test Cell DVVR	TCRMS06	Continue process to identify and shield penetrations that are most problematic.
	Test Cell DVVR	TCRMS10	Identify penetrations such as water, laser guides, fiber optic bundles, RF Feeds and shield the entry and exit sides of the penetration with additional shielding.
	Test Cell DVVR	TCRMS11	Consider adding a labyrinth to the south high bay door to mitigate southeast gallery radiation issues.
	Test Cell DVVR	TCRMS12	Consider ways to improve the shielding at the North door. Poly sheets, other concrete, or close the battleship door?

*The “Super Chit” was numbered as TCSC1 and budgeted to be addressed by the NTC Shielding scope. The chits included in the Super Chit # TCSC1 included all of those chits listed in the above table (Title: CR-NTC-02 - Radiation Issues due to penetrations and insufficient shielding).*

*The individual chit resolution is addressed as follows.*

### CR-NTC-03 – *Update HIS Drawings*

Disposition	Review	ID	Chit
O	Test Cell DVVR	TCACS05	Some drawings related to the HIS may not be fully up to date (I am told). Since this is a human safety system, it seems to me like this may be one place where we need to ensure fully up to date documentation.

*The Access Control and HIS scope was separated from the Shielding scope.*

*Thus, this chit shall be assigned to the proper engineering function and closed from the NTC Shielding scope.*

**CR-NTC-04 – *Update the penetration drawings***

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCMISC06	The penetration drawings and log need to be updated.

*The penetrations drawing # E-FA1030 has been updated and ready for final signature.*

*Thus, this chit is closed.*

## CR-NTC-05 – *Analyze data from the Radiation Monitoring System*

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS01	Data from the Radiation Monitoring System will need to be reviewed, as it becomes available, to determine if penetration shielding needs to be improved.

*The data from the Radiation Monitoring System from the time when NSTXU experiment was operational were analyzed and the results were used to determine the penetrations needed to be sealed as part of the recovery project. Also, a Neutron Generator Test was performed to collect additional data to evaluate the radiation level on the penetrations of the test cell walls and floor. These were documented in the NSTX-U Recovery Project Shielding Plan (# NSTX-U-RQMT-PLAN-017-01). The results from the data analyses were then used to develop System Requirements Document (# NSTX-U-RQMT-SRD-010-01) and Requirements Document (# NSTX-U-RQMT-RD-007-01).*

*Thus, this chit is closed.*

**CR-NTC-06 - *Reassign and restart the neutronics calculation***

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS02	Reassign and restart the neutronics calculation Bob Woolley was working on? It might help identify significant future effects that aren't apparent yet in measured data.

*The neutronics analysis was performed using MCNP software to help in the evaluation of the neutron radiation level in each penetration of the test cell walls and floor. The analysis results were documented (# NSTXU-CALC-81-02-00). The results from the deta analyses were then used to develop scope of the penetrations shielding work.*

*Thus, this chit is closed.*

**CR-NTC-07 - *Restart design and analysis of local shielding around penetrations***

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS03	Shielding, especially local shielding of penetrations may be insufficient for future operations. Restart design and analysis of local shielding around penetrations. A survey of penetrations could identify a few bad actors.

*A Neutron Generator Test was performed to collect data to evaluate the radiation level on the penetrations of the test cell walls and floor. The results were documented in the NSTX-U Recovery Project Shielding Plan (# NSTX-U-RQMT-PLAN-017-01). The results from the deta analyses were then used to develop System Requirements Document (# NSTX-U-RQMT-SRD-010-01) and Requirements Document (# NSTX-U-RQMT-RD-007-01). Also, the recovery project will conduct phase-2 of the neutron generator test at completion of the shielding installation. If there is a need for additional shielding, the project registered a risk and allocated money for design and installation of the additional shielding.*

*This chit is closed.*

**CR-NTC-08 - *Use D-T generator to assess penetrations***

Disposition	Review	ID	Chit
R	Test Cell DVVR	TCRMS04	Consider using D-T generator to assess which penetrations or features of the NTC walls/ceiling/floor are causing the worst dose (after appropriate review of course...)

*This chit (# CR-NTC-08) is redundant to chit # CR-NTC-07. The resolution for the chit # CR-NTC-08 also addresses this chit # CR-NTC-08.*

*Thus, this chit is closed.*

**CR-NTC-09 - *Move the card reader on the south door to the door to south high bay***

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS05	Please consider moving the card reader on the south door to the door to the south high bay.

*This scope is part of our design and plan is underway to move the card reader to the south door.*

*Thus, this chit is closed.*

**CR-NTC-10 - *Develop an experimental plan to utilize low dose Bubble Detectors during neutron shielding experiments***

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS09	Develop an experimental plan to utilize low dose Bubble Detectors during neutron shielding experiments to help quantify the errors occurring in He-3 based detectors due to scatter, energy and dose

*This chit is being rejected. PPPL does not have a bubble detector program and bubble detectors will not quantify scatter, energy and dose due to their very small cross section vs. the extremely large area to monitor. MCNP produces very detailed mesh results for energy, dose and scatter and is considerably more accurate than any other measuring device.*

*Thus, this chit is closed.*

**CR-NTC-11 - *Identify and shield penetrations that are most problematic***

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS06	Continue process to identify and shield penetrations that are most problematic.

*The list of penetrations needed to be shielded were identified and documented in the System Requirements Document (# NSTX-U-RQMT-SRD-010-01) and Requirements Document (# NSTX-U-RQMT-RD-007-01). The data from the Radiation Monitoring System from the time when NSTXU experiment was operational were analyzed and the results were used to determine the penetrations needed to be sealed as part of the recovery project. Also, a Neutron Generator Test was performed to collect additional data to evaluate the radiation level on the penetrations of the test cell walls and floor. These were documented in the NSTX-U Recovery Project Shielding Plan (# NSTX-U-RQMT-PLAN-017-01). Further, neutronics analysis was performed using MCNP software to help in the evaluation of the neutron radiation level in each penetration of the test cell walls and floor. The analysis results were documented (# NSTXU-CALC-81-02-00). The shielding design for the penetrations is documented in drawing # B-5A2991.*

*Thus, this chit is closed.*

**CR-NTC-12 - *Identify penetrations such as water, laser guides, fiber optic bundles, RF Feeds and shield the entry and exit***

Disposition	Review	ID	Chit
R	Test Cell DVVR	TCRMS10	Identify penetrations such as water, laser guides, fiber optic bundles, RF Feeds and shield the entry and exit sides of the penetration with additional shielding.

*This chit (# CR-NTC-12) is redundant to chit # CR-NTC-011. The resolution for the chit # CR-NTC-11 also addresses this chit # CR-NTC-12.*

*Thus, this chit is closed.*

**CR-NTC-13 - *Add a labyrinth to the south high bay door***

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS11	Consider adding a labyrinth to the south high bay door to mitigate southeast gallery radiation issues.

*Done. This scope is being implemented as part of the NTC Shielding WBS per the System Requirements Document (# NSTX-U-RQMT-SRD-010-01) and Requirements Document (# NSTX-U-RQMT-RD-007-01). The labyrinth design is documented in drawing # E-AE2019. The labyrinth structural calculation is documented in # NSTXU-CALC-81-01-01.*

*Thus, this chit is closed.*

### CR-NTC-14 - *Improve the shielding at the North door*

Disposition	Review	ID	Chit
A	Test Cell DVVR	TCRMS12	Consider ways to improve the shielding at the North door. Poly sheets, other concrete, or close the battleship door?

*Done. The north door shielding has been improved by planning to close the battleship door and shield the penetrations on the north wall. This work scope is documented in the System Requirements Document (# NSTX-U-RQMT-SRD-010-01) and Requirements Document (# NSTX-U-RQMT-RD-007-01). The shielding design for the penetrations is documented in drawing # B-5A2991.*

*Thus, this chit is closed.*

## **B. NTC Shielding PDR – II Chits and Resolutions**

**CR-NTC-15 - *HVAC control and fire protection Equipment in the MER was likely not designed to be hardened and should be reviewed for susceptibility to expected radiation***

Disposition	Review	ID	Chit
O	NTC Shielding PDR - II	NTCSPDRII01	HVAC control and fire protection Equipment in the MER was likely not designed to be hardened and should be reviewed for susceptibility to expected radiation.

*This chit is out of scope for test cell shielding. It is being considered for radiation damage discussions of equipment inside NSTX-U and in DARM. This will be added to the list of concerns.*

*Thus, this chit shall be assigned to the proper engineering function and closed from the NTC Shielding scope.*

**CR-NTC-16 - *The shield wall should be solid block rather than poured***

Disposition	Review	ID	Chit
NA	NTC Shielding PDR - II	NTCSPDRII02	The shield wall should be solid block rather than poured to allow for future modifications. Also block will be easier to install.

*.The review team evaluated this chit and concluded that they disagree with the objective of the chit.*

*Thus, this chit is closed.*

**CR-NTC-17 - *Consider cost, schedule and functionality of restoring the battleship door***

Disposition	Review	ID	Chit
NA	NTC Shielding PDR - II	NTCSPDRII03	Consider cost, schedule and functionality of restoring the battleship door. The TFTR test cell south west door may fit; or we have the drawings so a new door can be fabricated.

- *The TFTR test cell south west door is just a seal door, not a shield door.*
- *Fabricating and installing a new door would require the following tasks:*
  - *Design new shield door*
  - *Re-design and re-install the Pulsed Burst Power Supplies (the existing cables are too short to relocate)*
  - *Relocate diagnostic power lines*
  - *Relocate other numerous conduits*
  - *Relocate Fire sprinkler pipe*
- *Re-location of the access control work will still need to be done*
- *Replacing the man door will still need to be done*
- *Another PDR and FDR would also be required since these are A-1 classification*
- *Re-doing the design and completing all the tasks listed above would increase cost and schedule delay to the project*
- *These facts were discussed with the chits originator and agreement chieved*
- *Therefore, the project concluded the current design is the preferred path*

*Thus, this chit is closed.*

**CR-NTC-18 - *polyethylene will need to be encapsulated***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR1104	polyethylene will need to be encapsulated to meet flame and smoke rating. allow for buildup of wall and ceiling to meet egress and access

*Polyethylene has been eliminated from the shielding design. The improved value-engineering work performed by Geogre Ascione using MCNP calculation concluded that 2' thick standard concrete labyrinth installed in front of the south-east door will meet ALARA principle and reduces the neutron energy to a level much lower than a dose limit requirement. The calculation is documented in # NSTXU-CALC-81-02-00.*

*Thus, this chit is closed.*

**CR-NTC-19 - *Check the neutron flux at the south east corner of the TFTR test cell basement***

Disposition	Review	ID	Chit
O	NTC Shielding PDR - II	NTCSPDR1105	Check the neutron flux at the south east corner of the TFTR test cell basement where the cable trays go through to the MER.

*This chit is out of scope for the NTC Shielding WBS. The task will be completed when NSTX-U restarts. Real time measurements will be made.*

*Thus, this chit is closed.*

**CR-NTC-20 - *Please submit NSTX-U shielding calculations for independent review***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDRII06	Please submit NSTX-U shielding calculations for independent review

*All NSTX-U shielding calculations have been checked by an independent engineer and then approved by the PPPL Technical Authority. The neutronics analysis was performed using MCNP software, reviewed by independent expert and documented in # NSTXU-CALC-81-02-00. Further, the labyrinth structural calculation is documented in # NSTXU-CALC-81-01-01 following the standard PPPL review process.*

*Thus, this chit is closed.*

**CR-NTC-21 - *Also shielding calculations will require a calculation tracking number***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDRII07	Also shielding calculations will require a calculation tracking number ( assigned by the Ops Center )

*The neutronics analysis was performed using MCNP software, reviewed by independent expert and documented in # NSTXU-CALC-81-02-00. Further, the labyrinth structural calculation is documented in # NSTXU-CALC-81-01-01 following the standard PPPL review process.*

*Thus, this chit is closed.*

**CR-NTC-22 - *Include QA test stop point***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR1108	Include QA test stop point to confirm density, and strength, of newly poured concrete including aggregate content

*Done. Pouring the concrete wall will not begin prior to an acceptable concrete strength test report is provided to PPPL from an independent test laboratory. Also included into the statement of work is periodic inspection to be performed by PPPL PTR, QA and ES&H.*

*Thus, this chit is closed.*

**CR-NTC-23 - *Please ensure this is accounted for in the seismic qualification***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR1109	The 0.13g lateral acceleration applies to the ground, and calculations need to include the amplification associated with elevation and the walls. Please ensure this is accounted for in the seismic qualification.

*This chit was addressed by the PPPL Structural Engineer via E-mail as follows:*

*Email Title: South High Bay Labyrinth Construction: Structural Design Calculation  
Date of Email: 8/7/2018*

*Neway/Mike*

*Within ASCE 7-10, equation 13.3-1 allows a horizontal seismic load factor of 0.08. Equation 13.3-3 allows a horizontal load factor of 0.09 (governs). Parameters assumed include:  $S_{ds} = 0.189g$ ,  $A_p = 1.0$  (rigid),  $I_p = 1.5$ ,  $R_p = 1.5$  (low deformity),  $z = 0$  (attached at ground level). Since the wall is attached at ground level there is no amplification factor.*

*Not taken into consideration is the additional reduction factor of 0.7E allowed within the allowable load combinations of section 2.4. Ultimately the horizontal seismic load factor could be taken as low as 0.06. The value of 0.13 used within the calculation is conservative.*

*David Pryor  
PPPL Structural Engineer*

*Thus, this chit is closed.*

**CR-NTC-24 - *Need to ensure Dave's calculations are also reviewed***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDRII10	It was noted during the structural calculations that Dave Pryor was reviewing Neway Atnafu's calculations. Dave Pryor also performed calculations. Need to ensure Dave's calculations are also reviewed.

*Done. Dave Prior's calculation was checked by Neway Atnafu and approved by Dave Carle (the PPPL TA for Civil Structures).*

*Thus, this chit is closed.*

**CR-NTC-25 - *Please ensure that the places with Polyethelene have reinforcement***

Disposition	Review	ID	Chit
R	NTC Shielding PDR - II	NTCSPDRII11	Please ensure that the places with Polyethelene have reinforcement to ensure that it does not creep over time (gravity, thermal cycles)

*This chit (# CR-NTC-25) is redundant to chit # CR-NTC-18. The resolution for the chit # CR-NTC-18 also addresses this chit # CR-NTC-25.*

*Thus, this chit is closed.*

**CR-NTC-26 - *Work with Scott Decker to determine need for and requirements of encapsulation of the polyethylene shielding***

Disposition	Review	ID	Chit
R	NTC Shielding PDR - II	NTCSPDR112	Work with Scott Decker to determine need for and requirements of encapsulation of the polyethylene shielding sheets.

*This chit (# CR-NTC-26) is redundant to chit # CR-NTC-18. The resolution for the chit # CR-NTC-18 also addresses this chit # CR-NTC-26.*

*Thus, this chit is closed.*

**CR-NTC-27 - *The shielding requirement is that the dose outside of the shielding be less than 50 microrem. How is the calculated transmission related to this***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR113	The shielding requirement is that the dose outside of the shielding be less than 50 microrem. How is the calculated transmission related to this at maximum neutron production to ensure the shielding modifications will result in a dose below 50 microrems in areas with occupancy?

*The dose in the gallery is discussed in the revised shielding calculation and documented (# NSTXU-CALC-81-02-00). Confirmation measurements will be made during the next NSTX-U run.*

*Thus, this chit is closed.*

**CR-NTC-28 - *Need to incorporate proper shielding construction techniques to include overlapping joints on poly sheathing***

Disposition	Review	ID	Chit
R	NTC Shielding PDR - II	NTCSPDRII14	Need to incorporate proper shielding construction techniques to include overlapping joints on poly sheathing, interlocking inside and outside corner joints, mortar joints on any flat meeting surfaces

*This chit (# CR-NTC-28) is redundant to chit # CR-NTC-18. The resolution for the chit # CR-NTC-18 also addresses this chit # CR-NTC-28.*

*Thus, this chit is closed.*

**CR-NTC-29 - *Please ensure that the employed configuration, including all non-conformances, are well documented***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR115	Please ensure that the employed configuration, including all non-conformances, are well documented at the end of the construction project. (for Dave, Richard)

*Done. The project has planned tasks for updating as-built changes, and for documenting all closeout reports including ECNs, NCRs and procedures in the closeout phase of the project.*

*Thus, this chit is closed.*

**CR-NTC-30 - *Assess gamma generation as part of the shielding calculations***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR116	Assess gamma generation as part of the shielding calculations (for Franz G.)

*Gamma dose has been addressed and is summarized in the revised shielding calculation document (# NSTXU-CALC-81-02-00).*

*Thus, this chit is closed.*

**CR-NTC-31 - *Ensure that there is a good process***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDRII17	Ensure that there is a good process to ensure that there is a good method to check the status of shielding configurations before operations. (For Dave F.)

*The team is ensuring that the project is complying fully with the PPPL policies and procedures for ensuring the shielding configuration. The design has gone through proper reviews, and drawings and calculations are formally documented and read off of each other; SOWs and procedures were developed and referenced to the drawings. A test will be performed at the completion of the shielding installation for validation of the performance.*

*Thus, this chit is closed.*

**CR-NTC-32 - *Check the design against ALARA requirements***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR118	Check the design against ALARA requirements from 835. (For Dave. F)

*There are no "ALARA requirements". ALARA is a concept to insure that you maintain dose as low as reasonably achievable. ALARA does not address dose from a regulatory standpoint. We are well below any recommended ALARA actions with the implementation of the new shielding upgrades to NSTX-U.*

*Thus, this chit is closed.*

**CR-NTC-33 - *Assess means to ensure or demonstrate that there are no large voids in poured concrete***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDR119	Assess means to ensure or demonstrate that there are no large voids in poured concrete. (For Dave F.)

*Done. There is a plan to perform strength test on the concrete mix prior to starting work.  
There are also plans for performing periodic inspection during construction.*

*Thus, this chit is closed.*

**CR-NTC-34 - *Ensure that the drawings are of sufficient quality for appropriate configuration management***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - II	NTCSPDRII20	Ensure that the drawings are of sufficient quality for appropriate configuration management. Allocate resources to ensure that there are good as-built drawings.

*Done. The fabrication and construction drawings are prepared, reviewed and documents per the PPPL standard.*

*Thus, this chit is closed.*

### **C. NTC Shielding PDR – I Chits and Resolutions**

#### **CR-NTC-35 – *Add appropriate fall protection tie off points***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - I	NTCSHIELDPDR02	Recommend adding appropriate fall protection tie off points for construction and future use on the top of the new South shield blocks.

*Done. Two 5K Mega Swivel Anchors will be installed on the east wall at 4 feet above the elevation of the labyrinth roof.*

*Thus, this chit is closed.*

**CR-NTC-36 – *Show description of each penetrations for the FDR***

Disposition	Review	ID	Chit
A	NTC Shielding PDR - I	NTCSHIELDPDR05	For the FDR, have a description for each penetration or window; how each will be filled, inside or outside of the shield glass; assess impact of the obstructions on the windows that can impact ability to get concrete or beads into the volume.

*Done. A successful FDR was conducted. The FDR presentation included slides showing detail description of each penetration and the planned shielding design.*

*Thus, this chit is closed.*

## **D. NSTX-U Recovery CDR Chits and Resolutions**

### **CR-NTC-37 – *Assess Gamma rays and provide appropriate shielding***

Disposition	Review	ID	Chit
A	NSTX-U Recovery CDR	RPCDR061	I understand that when the protons in plastic neutron shielding absorb a neutron (creating deuterium), there is a 2.23MeV prompt gamma ray emitted as a result. This needs to be shielded against with something other than more plastic, of course, like a good thickness of metal with lots of electrons per m3. Probably Eric etc. already know this - sorry!

*Done. The NSTX-U Test Cell Shielding MCNP analysis and calculation was completed, reviewed by independent reviewers and documented # NSTXU-CALC-81-02-00. This chit was also addressed at following reviews including PDR and FDR.*

*Thus, this chit is closed.*

## **E. NTC Shielding FDR Chits and Resolutions**

### **CR-NTC-38 – *Verify the scale in the Dose Scaling Charts***

Disposition	Review	ID	Chit
A	NTC Shielding FDR	NTCFDR01	"Requirements and Plans Overview - Gerhardt The Dose Scaling charts show some significant outliers. To verify the scaling is appropriate those outliers should be understood in more detail."

*Outlier's in the Gallery SE Corner, East Gallery, MER and NSTX-U High Bay are all due to equipment malfunctions. Scalers and detectors in those locations were changed during the measurement period due to suspicious arbitrary count rates not related to actual shots. These detectors also exhibited an unusually high background neutron count rate not associated with any neutron production during the overnight read cycle.*

*Thus, this chit is closed.*

### CR-NTC-39 – *Out of Scope Chits for the Shielding FDR*

Disposition	Review	ID	Chit
O	NTC Shielding FDR	NTCFDR02	"MCNP Calculations - Ascione Even though the scope of this FDR focuses on the shielding around the test cell (how to mitigate the transport of neutrons into key areas), activation of material is a concern. A path forward to detail out how activation will be calculated and dealt with should be created and covered by some part of the project."
		NTCFDR03	The neutron data was created using a D-T generator (14 MeV neutron energy), yet the neutrons produced from NSTX-U are generally around 2.4 MeV. A D-D generator would allow for data to be collected that mimics the NSTX-U neutron energies. It is recommend that a D-D generator to be procured for the project (and the lab).

*The FDR review committee decided that these chits are out of scope for the Shielding WBS.*

*Thus, this chit shall be assigned to the proper engineering function and closed from the NTC Shielding scope.*

**CR-NTC-40 – *Update HAR to ensure the installed material is the same as the designed and presented at the FDR***

Disposition	Review	ID	Chit
A	NTC Shielding FDR	NTCFDR04	Use of Clay or Putty as a modeled moderator. The review by MCNP (modeled material) and the HAR effort (reviewed/analyzed material) should ensure material used is the same. HAR supports the the SAD and referenced materials in Design Reviews should be the same.  RBC: We are updating the HAR

*Done. The HAR has been updated and is in the process of being signed. Page 15 of the HAR includes the following: "As part of this Project WBS element, the shielding of these penetrations and doors will be improved. MCNP models have been created for each penetration to be shielded, and have been run with both the base legacy configuration and proposed shielding upgrades. These analyses have resulted in key designs. In the southeast corner of the test cell (the so-called south high bay), a concrete labyrinth will be constructed. At the north door, a legacy concrete-filled, and previously abandoned-in-place, "battleship" door will be closed. The shielding of the legacy windows and circular penetrations will be improved by targeted additions of borated polyethylene, cement grout, and other neutron shielding materials."*

*Thus, this chit is closed.*

**CR-NTC-41 – *Define the material specification of Grout***

Disposition	Review	ID	Chit
A	NTC Shielding FDR	NTCFDR05	"Grout is referenced as a modeled material and the specification is not provided.  RBC: See page 32 of calculation report. Table 2."

*Done. The grout specification to be used for shielding the equipment and vision windows is SIKAGROUT 328.*

*Thus, this chit is closed.*

**CR-NTC-42 – *HASP shall be approved by PPPL prior to begin work***

Disposition	Review	ID	Chit
A	NTC Shielding FDR	NTCFDR06	A Health and Safety Plan (HASP) is required to be approved by PPPL for all demolition and construction activities prior to the start of work per the PPPL Safety Manual Chapter 1 and 10CFR851.

*Done. The BOW SOW requires contractor to provide HASP for PPPL approval. A hold point is mentioned on the SOW to ensure this deliverable has been met prior to beginning work.*

*Thus, this chit is closed.*

**CR-NTC-43 – *Carry a risk response plan if Shieldwerx don't meet PPPL's procurement qualification***

Disposition	Review	ID	Chit
A	NTC Shielding FDR	NTCFDR07	"Design - Atnafu The neutron putty is coming from Shieldwerx, which is still in the process of being qualified as a valid A-1 component vendor. A risk should be included into the Risk Register that covers this single point of failure. ""If Shieldwerx cannot be qualified, then..."

*Done. The project has registered risks related to suppliers not meeting procurement and QA qualifications. Also, potential alternative supplier has been identified.*

*Thus, this chit is closed.*

**CR-NTC-44 –As-built Field Changes shall be Approved by  
Reevaluating the Shielding Analysis**

Disposition	Review	ID	Chit
A	NTC Shielding FDR	NTCFDR08	"Put in a requirement for a post construction shielding analysis to reflect each shielded penetration as built.  RBC: Apply to all shielding. Assessment and verification. Action Ascione."

*Done. QC inspects construction work and, if there is any change, fills out non-conformance report. The NCR will have to be approved by the QC/QA, RE and CE. These reviewers enforce the requirement of appropriate evaluation of the shielding analysis. The project has put in place a plan (budget, time and resource allocation) to formally approve and implement field changes.*

*Thus, this chit is closed.*

**CR-NTC-45 – *Remove the word “equivalent” from drawings***

Disposition	Review	ID	Chit
A	NTC Shielding FDR	NTCFDR09	Configuration Mgmt. requirements will not allow for a phrase like "or equivalent" with regard to shielding, shielding putty, grout, etc. Remove from drawings, etc.

*Done. The drawing has been updated using these changes.*

*Thus, this chit is closed.*