

DESIGN REVIEW DOCUMENTATION – RESULTS

**Title:** Shorted Turn Protection CDR

**WP#:** (ENG-032)

**CAT:** ☐ A1 ☒ A2 ☐ A3

**Type of Review:** ☐ Peer ☒ CDR ☐ PDR ☐ FDR

**Cognizant Individual:** F. Hoffmann

**Date of Review:** 5/09/19

**Review Board Members:**

Chair: T. N. Stevenson  
RE: F. Hoffmann  
D. Boyer  
S. Horst  
P. Sichta  
G. Tchilinguirian  
R. Rosenblat  
QA\_A. Casteneda  
ESH\_n/a

**Invited Attendees:**

C. Neumeyer  
T. Jernigan  
S. Gerhardt (R)  
Y. Zhai (R)  
P. Dugan  
P. Titus  
C. Freeman  
J. Petrella, Jr.

**Attendees:**

T. Indelicato (DOE-PSO)  
K. Lukazik  
  
  
  
(R) remote

**Items Reviewed:**

	<b>Sat.</b>	<b>Unsat.</b>	<b>Comments or n/a if not applicable</b>
Appropriate requirements identified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Development plans and schedules	<input type="checkbox"/>	<input type="checkbox"/>	n/a
Reg. compliance incl. USI/USID and NEPA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	NSTX-U
Disposition of CHITS from previous reviews	<input type="checkbox"/>	<input type="checkbox"/>	n/a
Cost objectives	<input type="checkbox"/>	<input type="checkbox"/>	n/a
Other review objectives addressed	<input type="checkbox"/>	<input type="checkbox"/>	n/a

**SUMMARY OF RESULTS:**

Initiated and driven by a DVVR chit, this review assessed the possibility of a concept to detect a turn to turn or coil to lead arc fault and to declare a FCPC rectifier level 1 fault if limit values are exceeded. Requirements were developed which in many cases are similar to and in keeping with DCPS. Two variations of the system concept (A & B) were developed, presented, and compared, with A as recommended design. The proposed shorted turn algorithm improves on the existing algorithm in PSRTC as defined by a gap analysis and 5 key points addressed, namely, coil, vessel, sensor, power supply, and fault modeling. By using the voltage input, plasma current, and coil currents processed through low pass filters, a Kalman filter, and a fault detector stage to compare residuals and measurements, fault indication can be gleaned from uncertain states and noisy measurements. Simulation indicates that this approach will meet requirements. Plasma modelling with uncertainty assumptions could simplify the envisioned real time software effort; preliminary assessments indicate acceptable calculation times. The real time System A proposal leaves as much intact as possible with an extension of the FPDP stream for new measurements. Thus, a credible hardware and software concept for real time detection of shorted turn or coil to lead arcs has been formulated and is ready for proposed next steps. Thirteen chits were generated and accepted for concurrence or consideration.

**Disposition:** [check one]

☒ **Acceptable**  
☐ **Acceptable pending resolution of concerns-** CHITS identified above must be resolved prior to installation.  
☐ **Incomplete** - Additional design work is required prior to another design review.  
☐ **Unsuccessful** – Corrective actions must be taken and another review process must be initiated.

**Design Review Chairperson** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cognizant Individual Acceptance** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Distribution:** Review Board Members, Operations Center, Responsible Engineer, Cognizant Individuals, Project Manager, Project Director, relevant Technical Authorities, Chief Engineer, Fire Protection Engineer, Attendees, QA, ES&H, Security, Requesting & Performing Dept. Head

Revised 2/19/2018