



**Report of the Production Readiness Review of the
DUNE Single Phase Indiana University Photon
Detector Bars and Plates**

March 15, 2017

1.0 PURPOSE/ SCOPE

The purpose of this review is to ensure there is a fabrication process in place and documented. The fabrication process should include the fabrication steps taken to complete the component and the define the quality control inspections and tests that will be performed to ensure the component meets its design and intended function.

The scope of the review included a review of the applicable documentation that had been uploaded to an Indico site and Docdb. The documentation reviewed is listed at the end of this report in Attachment A. These documents were reviewed by the Project Electrical and Mechanical Engineers, the Project ESH Manager, the Project QA Manager and the DUNE-US Project Manager. Comments and questions were provided to the DUNE QA Manager to discuss during the review. The DUNE QA Manager held the review at Indiana University on March 15, 2017.

2.0 Comments

The DUNE Single Phase Photon Detector Bar and Plate team at Indiana University are very experienced and very knowledgeable. The bars and plates are fabricated by vendors, inspected at receipt for dimensions and surface defects by the IU Team. The drawings, travelers, draft of the QC Plan, hazard analysis and summary of the fabrication process have been uploaded into Docdb. Fabrication, Testing, Handling, Storage and Packaging procedures are to be developed along with the Shipping Plan.

The bars are fabricated by an outside vendor and receipt inspected by IU for visual imperfections and dimensional tolerances. After receipt inspection, the bars are measured for attenuation length. The bars will be wrapped in protective wrapping supplied by the original vendor after the attenuation measurement and shipped to CERN in the original box received from the vendor.

The plates are fabricated by an outside vendor and receipt inspected by IU for visual imperfections and dimensions. After receipt inspection, the plates are coated with 1144Tetraphenyl, 1-3 Butadiene (TPB) and Dichloromethane (DCM). The plates are baked after coating in a vacuum oven at 80 C to allow the TPB to be incorporated into the plate so that it does not flake off in the Lar. The plates are tested for brightness in a VUV monochromator as a measure of brightness for each plate. After passing the brightness measurement, the plates will be packaged and shipped in a specially designed box to protect them during shipment to CERN.

IU Environmental Health and Safety has evaluated the engineering controls in place at the lab where the fabrication is taking place. A dichloromethane exposure assessment was performed to evaluate the spraying and dipping activities. Short term and full shift dichloromethane monitoring was performed to evaluate potential employee exposure to dichloromethane during the mixing and spraying of the plates with dichloromethane and the subsequent drying of the samples. The result was the dichloromethane exposure concentrations were less than their corresponding OSHA Exposure Limit and no noticeable odor was detectable verifying the adequacy of the current ventilation controls.

It was observed during the review of the laboratory space that two glass jars contained the 1144 Tetraphenyl, 1-3 Butadiene and the Dichloromethane (DCM) that were not original containers. One container had been marked with its contents but the marking had begun to wear off and was not easily identifiable. The other container had no markings as to what chemicals were in the container. When

transferring chemicals into another container from the original container the container needs to be marked with its ingredients and any hazards associated with the chemical.

3.0 Recommendations

- 3.1 Complete the QC Plan, the fabrication and testing procedures and the Handling, Storage and Packaging procedures along with the Shipping Plan.
- 3.2 Calibrate the instruments used in the dimensional inspections and update the travelers to include the instrument type, Serial Number and calibration due date.
- 3.3 Refine the metrology acceptance criteria in order that it is a realistic expectation that can be met and is acceptable for the intended function of the component.
- 3.4 When the metrology tolerances cannot be met but the component is deemed acceptable for its function, document the engineering justification for its acceptance and maintain the record as a QC Record.
- 3.5 The Travelers acceptance criteria for the visual inspection specify Slight Imperfections but Usable. These criteria needs to be defined in the procedure or on the traveler as what is meant by a Slight Imperfection.
- 3.6 The coating lot number should be placed on the traveler for the plates to ensure traceability to the coating in the case there is an issue with that coating lot later.
- 3.7 The final drawing package in the Docdb needs to have revision number, preparer and approver signature and date prior to use for fabrication to ensure the latest drawings are being used for fabrication.
- 3.8 When mixing the 1144 Tetraphenyl, 1-3 Butadiene and the Dichloromethane (DCM) into a larger container for use in the application, label that container in order that it is readily recognizable as to what liquid is in the container.

4.0 IU Photon Detector Bars and Plates Production Readiness Review Team

Name	Title
Kevin Fahey	LBNF/DUNE QA Manager
Michael Andrews	LBNF /DUNE ESH Manager
Theresa Shaw	DUNE Project Electrical Engineer
Jack Fowler	DUNE Project Mechanical Engineer
Jolie Macier	DUNE-US Project Manager

4.0 IU Photon Detector Bars and Plates Team

Name	Title
Stuart Mufson	IU Faculty - DUNE
Jon Urheim	IU Faculty – DUNE Collaborator
Brice Adams	Instrumentation Engineer
Brian Baugh	Electronics Tech Master
Bruce Howard	Grad Student Research Assistant
Christopher Macias	Grad Student
Denver Whittington	Post Doc

5.0 Summary

The Review Team recommends the IU Photon Detector Bars and Plates Team begin production once the travelers and fabrication procedures have been finalized. The remaining recommendations do not affect the ability of the IU Photon Detector Bars and Plates Team to go into full production. A written response to the recommendations is requested within two weeks of the receipt of this report. The response should be sent to Kevin Fahey at Kfahey@fnal.gov. If there any questions or a need for more information, contact Kevin Fahey at 630-840-2693.

Attachment A

CPA Production Readiness Review Documentation

- IU Document Readiness Review – March 2017
- Proposed IU Bar Traveler
- Proposed Radiator Traveler
- IU Photon Detector Quality Control Plan
- IU Photon Detector Drawings

Note: These documents are filed in Docdb 2622