

DUNE PRR: TPC Electronics LArASIC

LArASIC Procurement Plan

H. Chen on behalf of DUNE TPC electronics team
Brookhaven National Laboratory

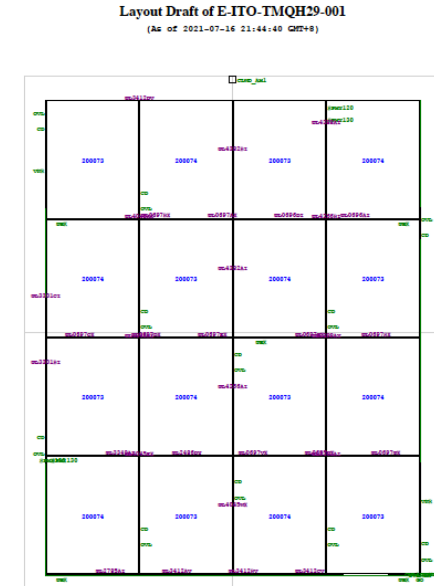
03/07/2022

Outline

- LArASIC Production Procurement Plan
- Response to Charge Questions

LArASIC Procurement Plan

- FDR Document
 - ASIC production and QC plans on EDMS
 - <https://edms.cern.ch/document/2604783/1>
 - FD1-HD has 3,000 FEMBs
 - 24,000 LArASIC, 24,000 ColdADC, and 6,000 COLDATA chips
 - FD2-VD BDE has 1,920 FEMBs
 - 15,360 LArASIC, 15,360 ColdADC, and 3,840 COLDATA chips
- Original procurement plan
 - P5+P5B ENG run reticle: 310 P5 and 310 P5B dies
 - <https://edms.cern.ch/document/2314428/2>
 - **4 batches of 25 wafers** for FD1-HD in Fall 2022
 - ~85% yield to cover 10% spares
 - **2 to 4 batches of 25 wafers** for FD2-VD BDE in Fall 2023
 - ~93% to ~70% overall yield to cover 10% spares for both FD1-HD and FD2-VD BDE



LArASIC Procurement Plan

- News from Europractice in late January
 - TSMC will stop offering access to 8 inch technologies in the Europractice program as of September 2022
 - The last MPW/Mini@sic run on TSMC 8 inch Logic/Mixed-Signal or BCD will take place end of August 2022
- Fabrication of LArASIC has been going through MOSIS in the past decade
 - Inquiries sent to MOSIS for both quote and business model with TSMC
 - Quote of 250 wafers for a total cost of \$317k received in mid February
 - Fabrication will likely be done in multiple lots
 - Wafers will likely be delivered in batches from TSMC
 - No change of business model between TSMC and MOSIS is expected so far
- Risk of losing access to TSMC 8 inch technologies remains
 - Large impact if realized → mitigate now
 - Seeking approval from this PRR to procure 250 wafers using the same mask of P5+P5B ENG run
 - ~56% overall yield to cover 10% spares for both FD1-HD and FD2-VD BDE
 - P5 chips are available as spares
 - Finance of this procurement to be worked out, given it happens before the approval of the construction of the far detector (CD-3 of US DOE project)

Charge Questions

- 1c. Do measurements of chip yields from the engineering run support estimates for the minimum number of wafers required to populate the FEMBs for FD1 and FD2 within a comfortable safety margin?
 - Yes
 - 366 P5B chips tested at room temperature, only 2 chips failed, overall yield is ~99.5%
 - 221 P5B chips tested at LN2 temperature, all passed with a yield of 100%
 - 49 P5 chips tested at room temperature, all passed with a yield of 100%

Charge Questions

- 1d. Do these measurements indicate that the reticle used for the engineering run and the masks obtained from that reticle are adequate for the proposed production run?
 - Yes
 - The reticle from ENG run has been used for packaging of P5B and P5 chips with GTK
 - As reported, the overall yield is quite good > 99%
 - Based on what we learned so far, the same reticle and masks are appropriate for the production run

Charge Questions

- 2. Are the order specifications well-determined? Is the cost and production schedule understood?
 - Yes
 - ENG run masks are reused to order 250 production wafers, no new technical specification to be developed
 - Cost of \$317k is confirmed by the quote from MOSIS
 - Schedule is impacted by the global semiconductor shortage
 - Fabrication will likely be done in multiple lots
 - Wafers will likely be delivered in batches from TSMC
 - Given the early procurement (~1 year) of production wafers, the impact of batched delivery on the construction schedule of DUNE far detector is minimum

Charge Questions

- 3. Is there an adequate plan for procurement and fabrication oversight?
- a. Are the details of the required Purchase Order (PO) for MOSIS/TSMC understood and can the PO be ready to submit on the needed time scale?
 - Yes
 - Assuming the [authorization](#) is obtained to procure production wafers with DUNE project fund at BNL, the PO can be submitted from BNL with green light from PRR review panel and DUNE management
- b. Have any special concerns associated with large-scale production been adequately addressed?
 - Yes
 - [Prepayment and single source justification](#) are in place with BNL procurement system from the past MPW and ENG run submissions