TLM as a detection device for mu2e RSS

T. Leveling – mu2e ES&H L3

6/16/11

Motivation

- Shielding at pbar designed for ~13 watts of beam power
- Mu2e requires 25 KW
- Shielding improvements are either:
  - Impractical
  - Impossible
  - Expensive

Options for mu2e

- Option 1 – all chipmunks
  - 130 additional required (175 total)
    - They don't exist
    - R&D program to develop the next generation
    - Estimated to be $10K each (including RSS and installation costs)
- Option 2 – chipmunks plus eberm
  - Requires additional 30 chipmunks for Debuncher Ring
  - Eberm system
    - Approximately $100k
      - Requires R&D
      - 18 months to develop
      - Eberm does not provide protection from Debuncher Ring beam loss

Options for mu2e

- Option 3 – TLMs
  - No eberm required
  - No additional chipmunks required
  - Perhaps some existing chipmunks could be re-purposed for non-mu2e purposes

TLM status

- In use at NuMI and Linac (see logger and FTP)
  - Uncalibrated devices
  - No heartbeat
  - Not failsafe
  - Not presently usable as an input to RSS

TLM History

- Long history as Panofsky detector developed at SLAC in the 1960s
  - Also used at AGS Booster
  - Fermilab (organ pipe)
  - Recently at NuMI and LINAC
  - And others
- Use restricted to machine diagnostics/machine protection

Why not for personnel protection?

- Principal reason is that long detector response is not calibrated
- Typical output is in rads/s or in units of charge or charge current
- Not readily translatable to personnel protection outside of thick (or in the case of mu2e, not so thick) shielding

Why not for personnel protection? (continued)

- Radiation Safety Systems require:
  - Heartbeat
  - Failsafe
  - Calibrated response
- TLM heartbeat and failsafe capabilities should be readily achievable with safety PLCs developed for existing RSS and other safety systems such as eberm
  - Use PLCs to monitor cable condition online
    - Resistance, capacitance, gas pressure, gas flow, thermal conductivity (gas type)
    - TDR challenge/detector
  - Use PLCs to monitor TLM electronics online

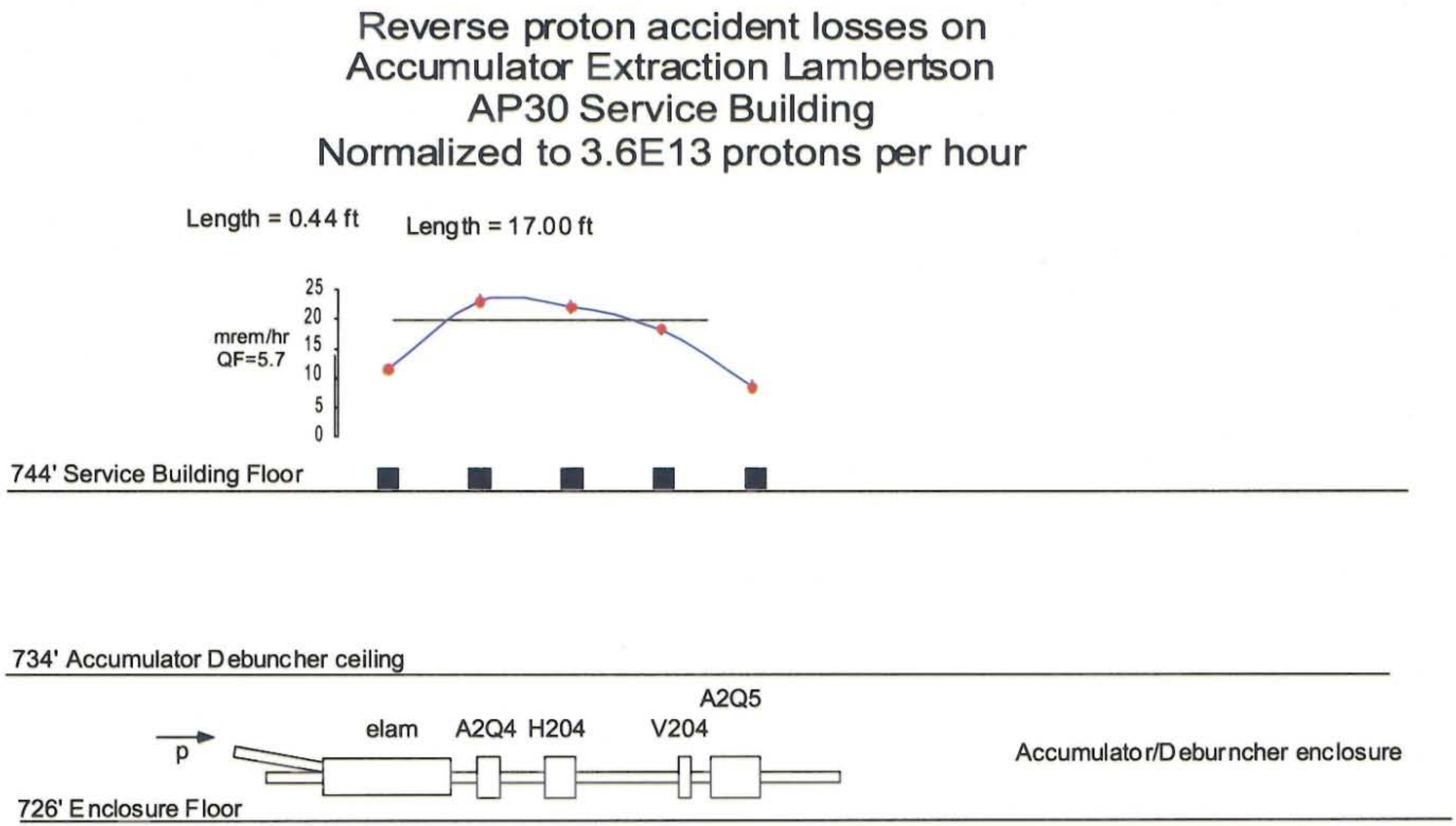
Calibration

- Calibration of TLMs is not readily available
  - Extreme neutron source might be required
  - Even then, highly variable, high energy particle flux ≠ neutron calibration source response

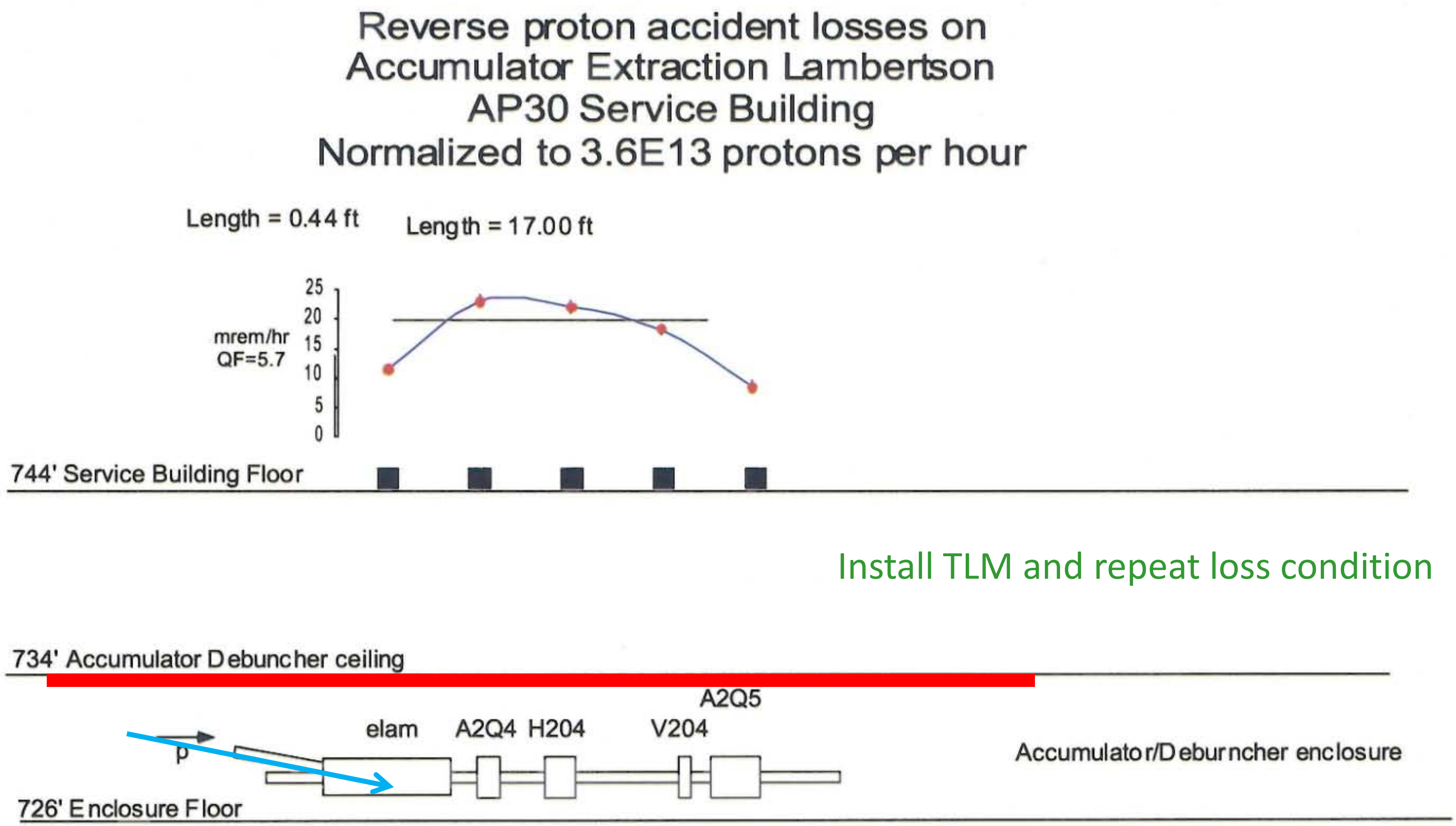
What’s different about TLMs for a mu2e RSS?

- We have a collection of measurements of known beam losses
- See:
    - http://mu2e-docdb.fnal.gov:8080/cgi-bin/ShowDocument?docid=1232
- We know:
    - Loss locations
    - Effective dose/p delivered outside of shield

TLMs for mu2e



TLMs for mu2e



Install TLM and repeat loss condition

An approach

- Install TLMs at a convenient location with know loss pattern (elam to start, and eventually others)
- Recreate the loss condition(s) and determine TLM response
  - As a function of
    - Gas parameters (type, pressure, flow)
    - Voltage
    - TLM length(e.g., 10 m, 30 m, 100 m)
  - Some experimentation should be possible to determine a reasonable combination
- Develop a standard TLM
  - Length, gas type, applied voltage, etc. for input to a mu2e RSS

When?

- Pbar source scheduled to run through 9/30/11
  - We could take advantage of this operating period
    - Reverse proton tune ups occur every 45 minutes
      - Up to 10% losses occur during these transfers
    - Taking an extra cycle or 2 occasionally should be possible
      - With elam on
      - With elam off
      - With higher proton intensity
- Otherwise, we'll have to find study time in the new fiscal year – not so convenient!