

NOvA

Total Active
Liquid Scintillator
Detector Installation

First Pass Estimate

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U of M

NOvA

- Simple comparison to baseline detector
- Installation Numbers
- Liquid delivery system
- Problems associated with longer modules
- Conclusion

Simple Installation Comparison

- Basically just number of movements, distance covered and crane speed equals the time it takes to complete detector
- Baseline had 144,000 pieces (9000 stacks)
- All Scintillator has 28,000 pieces
- Peak Crew size Baseline Det. -41 FTE's
- Peak Crew size All Scintillator -38 FTE's

Simple Scintillator Comparison

- Gallons of mineral oil
 - Baseline Detector 2.1M gallons - 6.8 kilotons
 - All Scintillator Det. 7.1M gallons - 23.1 kilotons
- Trucks of Oil
 - Baseline Detector 2.2/week-325 total
 - All Scintillator Det. 2.2/day -1100 total
- Trucking cost
 - Baseline Detector \$1.08M
 - All Scintillator Det. \$3.66M

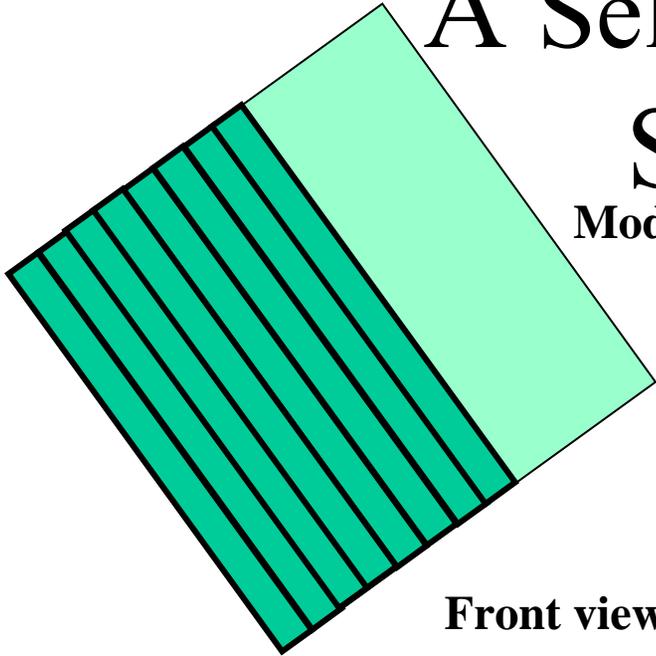
All Oil and Shipping costs based on last fall numbers!

Simplify Design

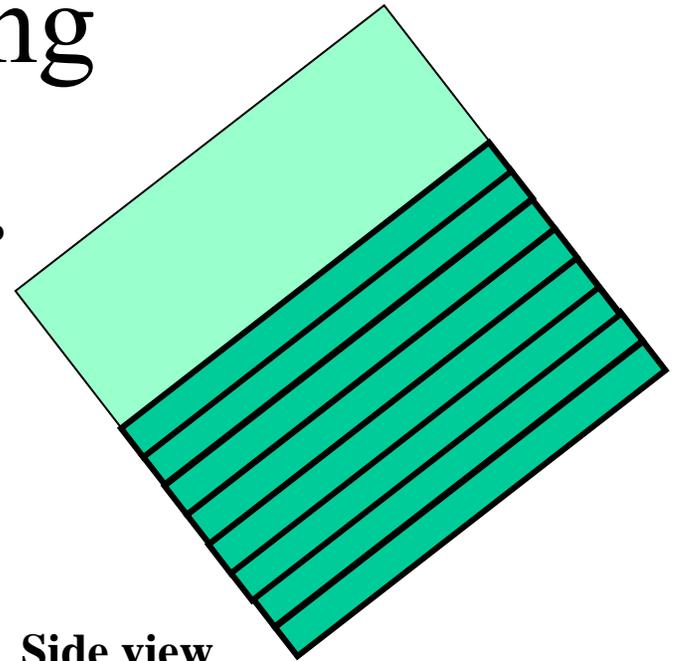
- The installation estimate is based on a combination of Stan's concept and Ken Heller's self supporting design
- Combined concept would be a simple steel support structure that would allow access to the lower end of each module.
- Every module only gets moved once right from shipping container to detector face

A Self Supporting Structure

Modules at alternating at 45°

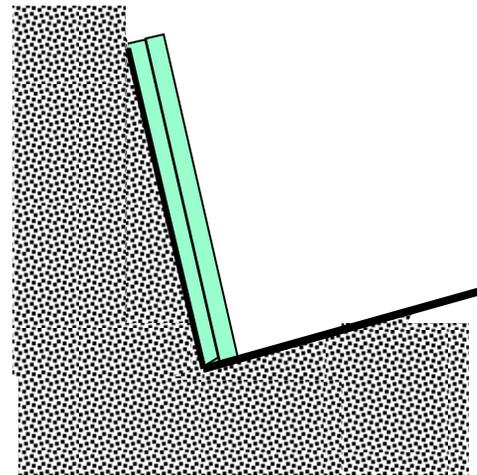
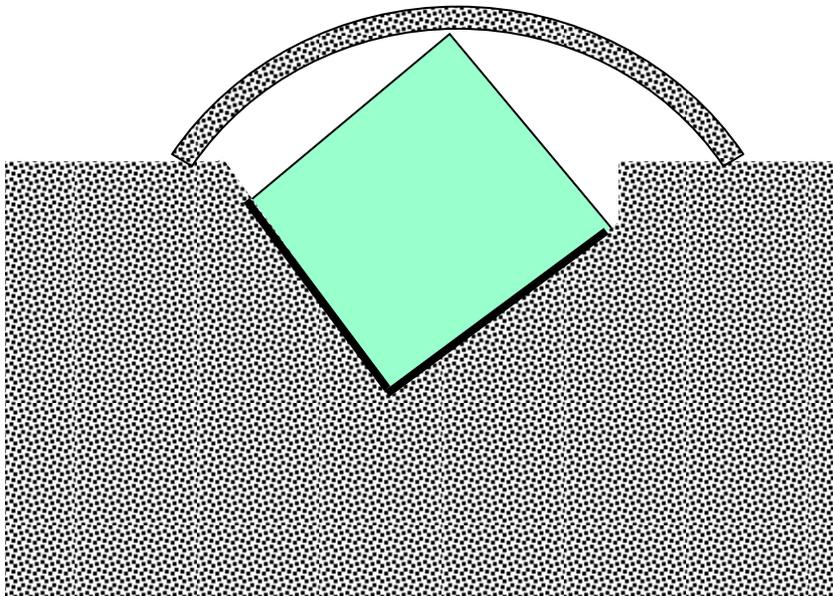


Front view



Side view

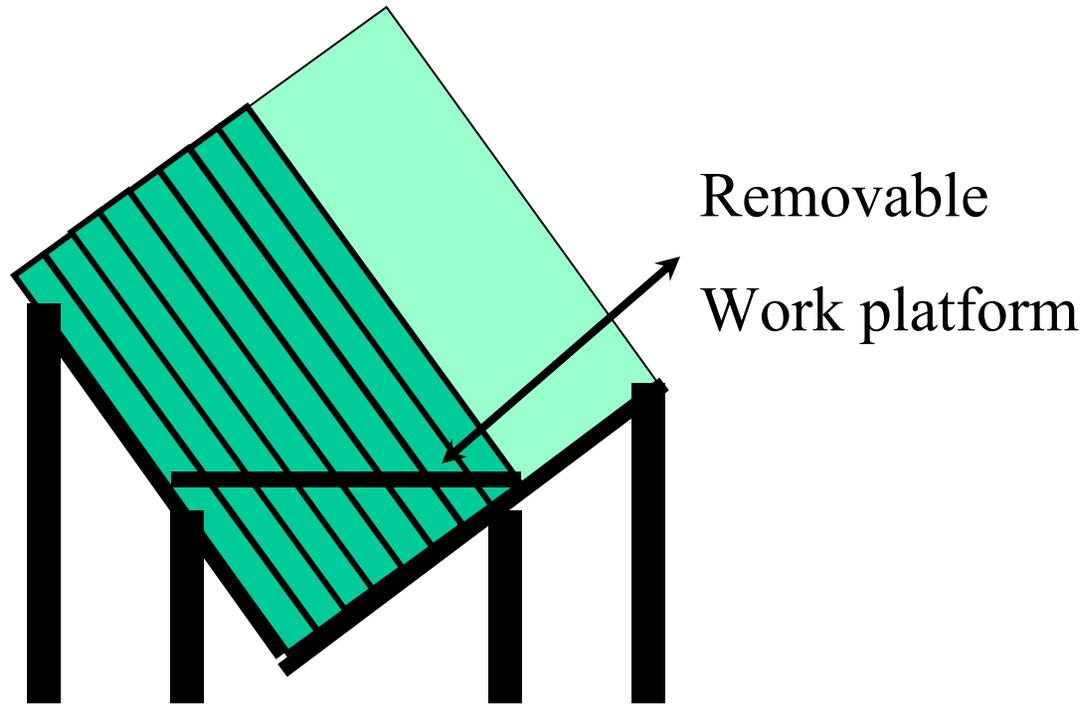
Sealed bottoms



1° slope

Modified Self Supporting

Removable work platform is strong enough to support shipping containers of modules so the crane movement is short



Installation Numbers

- Plane is 17.5m x 17.5m containing 14 modules
- 2000 planes with alternating views
- Total of 28,000 modules
- Each module is taken straight from shipping container right onto detector face
- 2 overhead cranes one for unloading trucks, one with rotating vacuum lifting fixture

Installation numbers

- Put module in place every 8 minutes
- 2 hours for each plane
- 1 hour/plane to survey and spray light layer of glue if needed
- Could easily build 5 planes/day with two 10 hour shifts.
- Installation 2 years (Baseline 4.3)

Crew Size-Very Conservative #'s

- Receiving Team
 - 1 module truck, 2 oil trucks, 1 misc. shipment per day this is easily handled by crew 3 on day shift. Also keep module crates in position on work platform
- Module installation team
 - Modules are long but light, team of 3 FTE/shift. One for crane operator, two module locators
- Survey/Glue Team
 - Team of 3 FTE/shift to survey modules and glue if needed
- Scintillator Oil Mix/Test Team
 - Baseline detector had 4- Double team to 8
- QA team
 - Baseline was 4-APD boxes double so team size to 8
- Support Staff
 - Same size as baseline 7
- Baseline total was 41 FTE-4.3 years
- All Scintillator Detector 38 FTE-2 years

Scintillator Delivery System

- 14,200 gallons/day to be mixed! Inline mixing system design would help
- Fill rate of roughly 15 gal./min. this is 3 times the rate for the MACRO Detector
- Bigger mixing tanks? Or more of them?
- Must fill multiple modules at once, moving manifold system to deliver oil
- Delivery/Mixing system needs some R&D for both detectors

Module Factory's

- Baseline 12 modules/shift/factory 3.5 FTE
- Scale up to 14 modules/shift/factory by adding $\frac{1}{2}$ FTE
- Need 2000 shifts- 200+ shifts/year
- If you run 2 shifts/day
- Need roughly 5 factories to complete modules in 2 years to match installation

LONG Module Trucks

- Modules will not fit on a standard truck a special permit will be needed. As long as you need a permit for length, you can add width for no extra cost up to 110”
- Quotes (Thursday) got estimate is \$2/mile compared to \$1.50/mile
- If module keep narrow can get about 96 modules on a truck load
- Four Shipping boxes per load- 60 ft long by 4 ft tall by 4 ½ ft wide

Conclusions

- Needs lots more work but design is simple, likely to cut more off crew size
- Scintillator mixing/testing system needs serious design work
- Access issues with diagonal detector
- Glue/not glue modules
- Between $\frac{1}{2}$ size building and $\frac{1}{2}$ installation time overall schedule is much faster