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# **NOvA Prototype Detectors**

## **WBS 1.8.5 & 1.8.8**

June 5, 2007

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# WBS 1.8.5 – Integration Prototype Near Detector - Overview

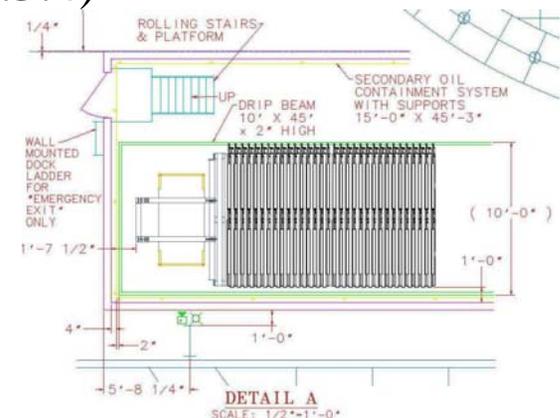
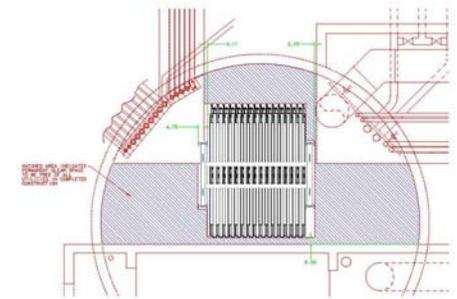
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- **IPND Purpose**
  - (Evaluate mechanical techniques)
    - Some aspects of this goal now assumed by the FSAP – see slides 9-12
  - Evaluate integration of actual detector parts
  - Deliver a detector capable of producing data and meeting physics goals
  - Complete the detector in time to be useful for all the above
- **IPND Structure** (see NOvA DocDB 1114)
  - Overall footprint is ~ 3m w x 4m h x 8.5 m l
    - 4 blocks of prototype extrusions, 31 planes each, alternating v & h planes
    - 2 "A" blocks – 16 v &, 15 h planes 2 "B" blocks – 16 h &, 15 v planes
    - 2 bookends for stability, no Muon Catcher
- **IPND Location Requirements**
  - Block assembly occurs at Argonne National Lab in Bldg. 366
  - MINOS Service Building provides proper physics environment
    - Requires a new enclosure in the building



# WBS 1.8.5 – Integration Prototype Near Detector - WBS Breakdown

- **ND design requirements in the IPND WBS? (1.8.5.1)**
  - IPND & ND were designed jointly for economy of tooling & block usage
  - ND is the "real" detector, so its design constraints came first
    - Physics requirements
    - Sub-assemblies must fit down the MINOS shaft
- **IPND Systems Design & Fabrication**
  - MSB Infrastructure design & construction (1.8.5.2 & 1.8.5.6)
    - Enclosure – FESS Project Definition Report – ( see NOvA DocDB 1422)
    - Some detector systems require input from other L2s – APD Cooling e.g.
  - ANL Block assembly facility (1.8.5.2 & 1.8.5.4)
  - Detector structure (1.8.5.2 & 1.8.5.3)
- **Construction of IPND (1.8.5.5)**
- **Commissioning of IPND (1.8.5.7)**



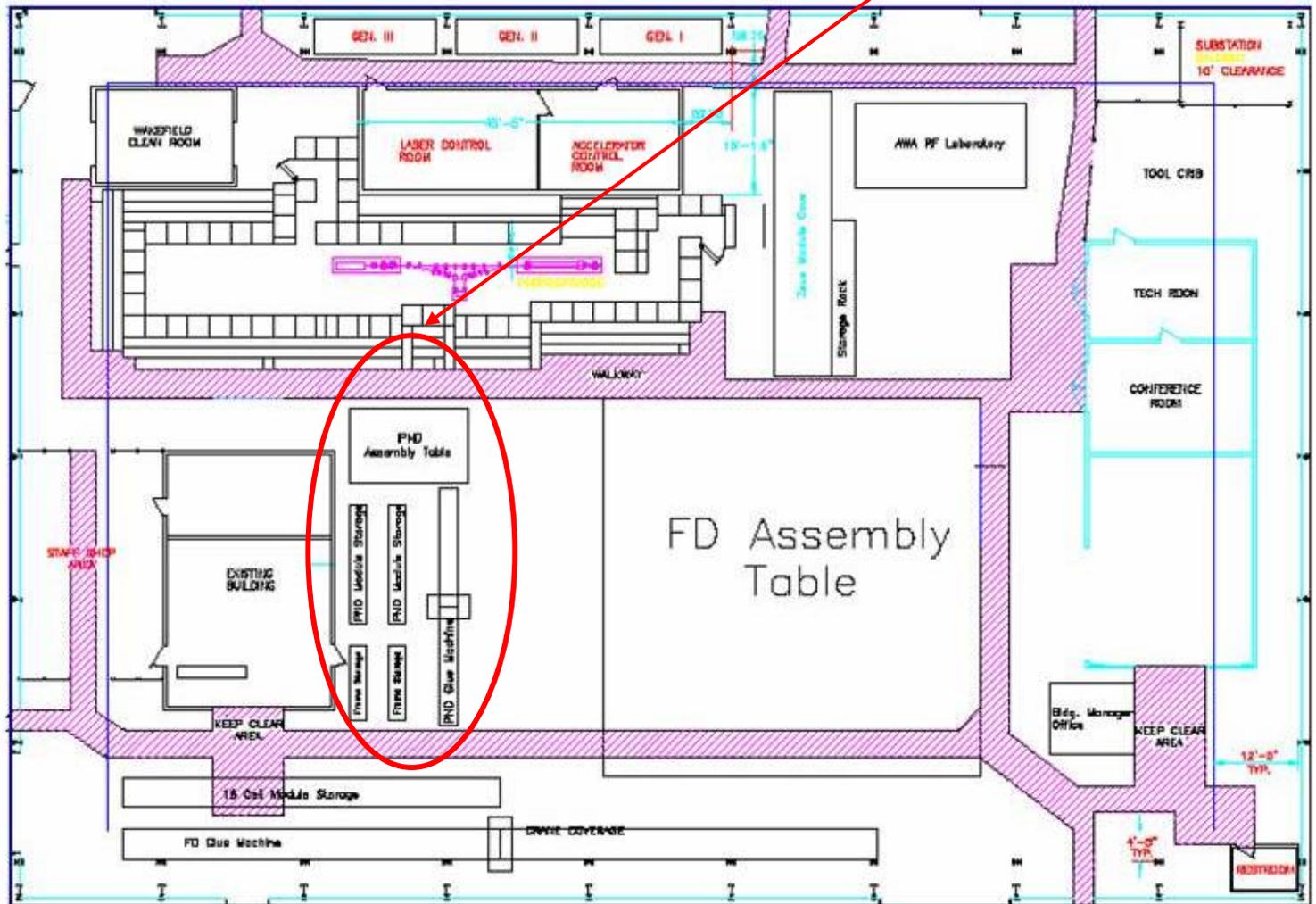


# WBS 1.8.5 – Integration Prototype Near Detector - Location

- IPND Construction Location in Bldg 366 @ ANL

Bldg 366 will host construction of all 3 prototypes, and can construct the IPND blocks concurrently with the FSAP and/or the FHEP

Physical area will be ready to accept NOvA in July





# WBS 1.8.5 – Integration Prototype Near Detector - Location

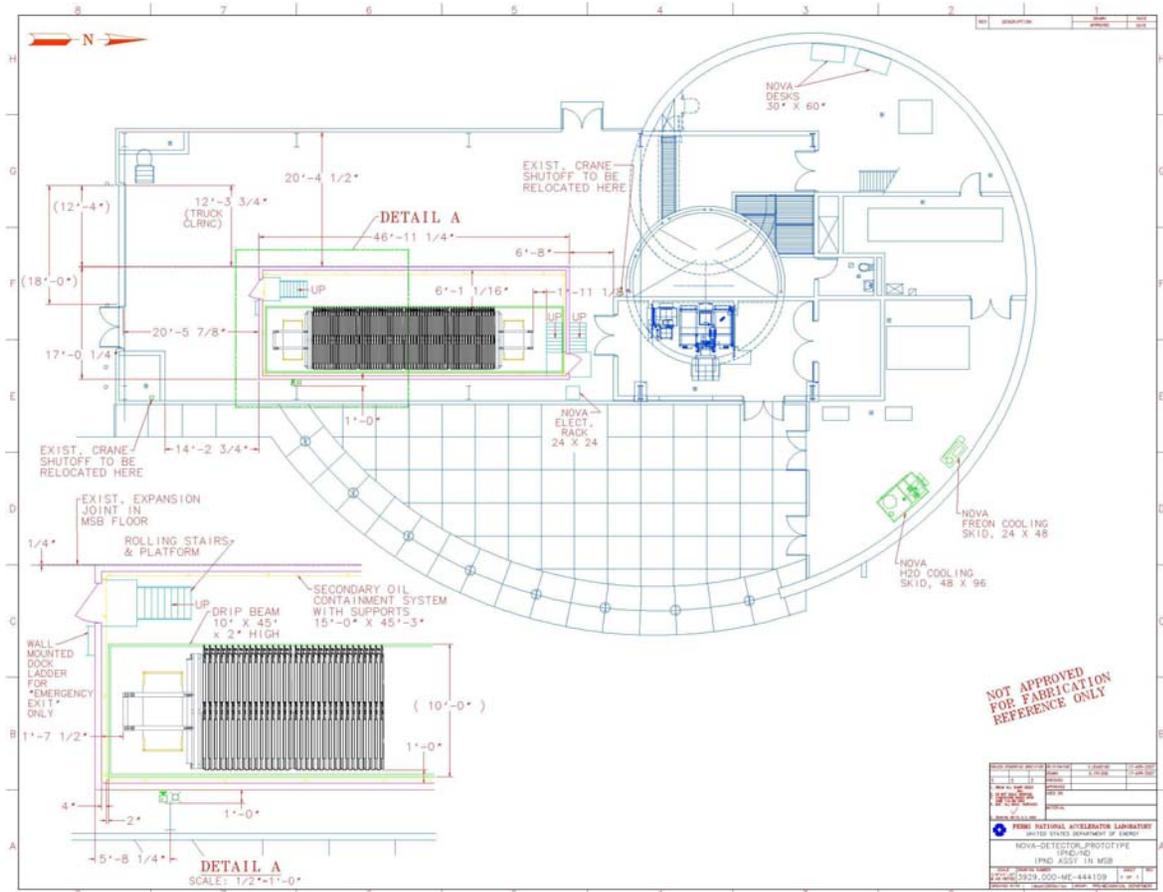
## • IPND Operating Location in MSB @ FNAL

– Two weeks labor to clear building

– FESS has produced a draft PDR for the enclosure (see NOvA DocDB 1422)

- Wall structure
- Fire suppression
- Secondary containment
- Electrical modifications
- Access/Egress
- Ventilation

– Does not include electronics cooling system skids or piping



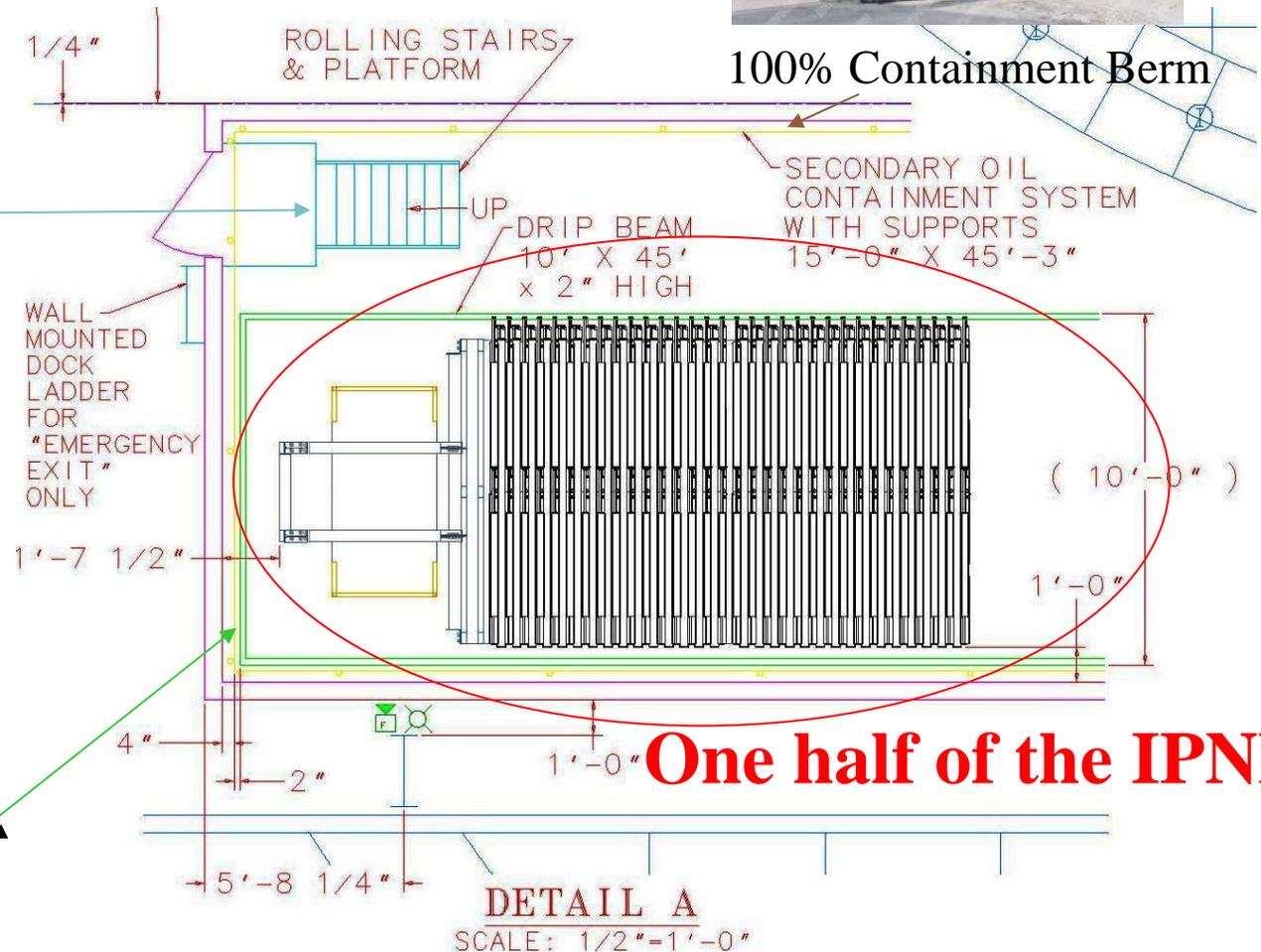


# WBS 1.8.5 – Integration Prototype Near Detector - Structure

- IPND Structure



Access Ladder  
  
(Ladders approved by ES&H for egress)



Drip Berm

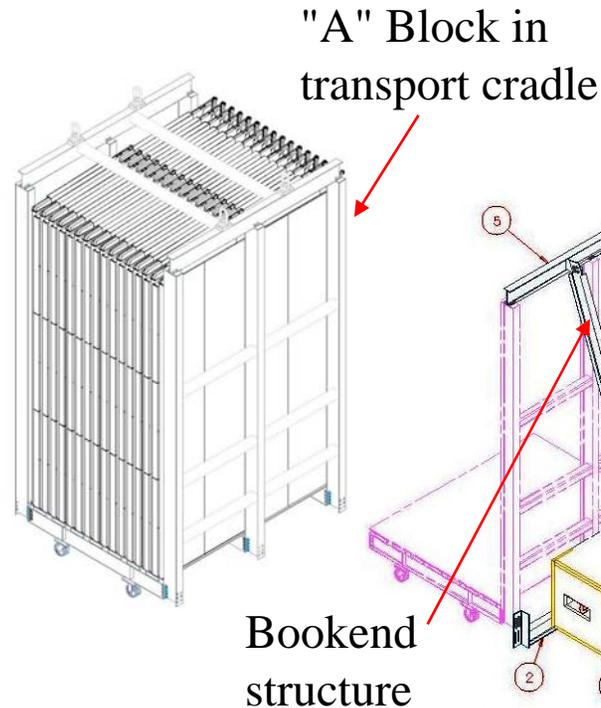
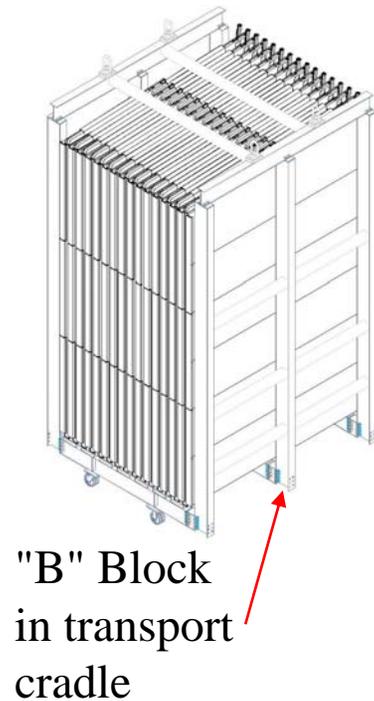
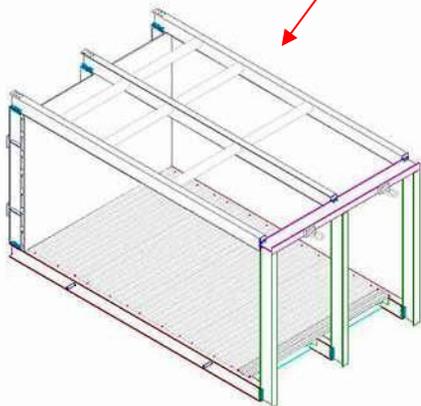


# WBS 1.8.5 – Integration Prototype Near Detector - Structure

## • IPND Structure

- Blocks are constructed @ ANL; then transported to the MSB @ FNAL
  - Vertical cradle members are removed when blocks are joined together
  - Cradle stands are bolted together for stability

View of Near Detector cradle / lifter in horizontal position as used for assembly and transport





# WBS 1.8.5 – Integration Prototype Near Detector - Schedule

- IPND Schedule by WBS element
  - 1.8.5.1 – Requirements documents complete
  - 1.8.5.2 – Systems designs completed – drawings being checked
    - 1.8.5.2.10 MSB FESS PDR completed for civil construction portion
    - Final elements due in July
  - 1.8.5.3 – IPND equipment due in July–Oct '07
    - Some elements dependent on other L3s – none on critical path
  - 1.8.5.4 – Assembly location due in May–Sept '07 – in process
  - 1.8.5.5 – Block assembly – May '07–Sept '08
    - Adhesive order only in FY '07
    - Construction schedule dependent on deliveries of modules (WBS 2.5)
  - 1.8.5.6 – MINOS Service Building enclosure – Mar–May '08
  - 1.8.5.7 – Installation & Commissioning of IPND – Sept–Dec '08
    - Installation dependent on successful completion of 1.8.5.5 & 1.8.5.6
    - Delivery of liquid scintillator dependent on WBS 1.2
    - Installation of all electronics and DAQ dependent on WBS 1.6 & 1.7



# WBS 1.8.8.1 – Full Scale Assembly Prototype - Overview

## • FSAP Purpose

- Time and motion studies for full sized extrusions/modules
  - Adhesive application
  - Positioning of modules on block stack
- Sizing and Survey
  - Measurements of planes to understand flatness wrt adhesive strength requirements & tolerance build-up
  - Study of plan to survey module and plane positions in the FD
  - Study of grout application at the base of the vertical planes
  - Study of horizontal module placement & angle shimming

## • FSAP Structure

- Eight planes of prototype full-sized extrusions
  - Alternating vertical and horizontal planes as in the Far Detector
  - Planes begin simple and progress to fully outfitted as the stack grows

## • FSAP Location

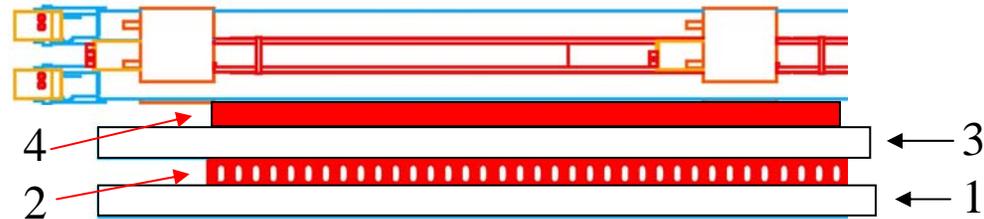
- Argonne National Lab, Bldg 366 has the requisite space
  - Need to study floor flatness – must match Block Pivoter flatness tolerance



# WBS 1.8.8.1 – Full Scale Assembly Prototype - Structure

- **FSAP Structure** (see NOvA Doc DB 1954)
  - Structural elements & studies are additive as planes are assembled
    - First 2 planes (#1V, #2H) – 24 extrusions only per plane - no endcaps or manifolds – extrusions horizontal (thin-walled)
      - Handling and positioning of ~52' long PVC with vacuum fixturing
      - Alignment stability of 1<sup>st</sup> plane with no adhesive

7 of the 8 planes  
for the FSAP



- Second 2 planes (#3V, #4H) – 24 extrusions glued into 12 modules – no endcaps or manifolds – extrusions horizontal (thin-walled)
  - Timing studies of gluing, flipping & positioning module sized objects
  - Measurements of gaps and tolerance build up caused by the "banana" effect
  - Alignment system based on targets is actuated and timed



# WBS 1.8.8.1 – Full Scale Assembly Prototype - Structure (cont.)

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- **FSAP Structure** (see NOvA Doc DB 1954)
  - Plane #5 (V) - 11 modules with endcaps both ends, one with mock manifold – extrusions vertical (thick-walled)
    - Edge stiffeners added to outer sidewall of modules 1 & 12
    - First time & motions studies with heavy vertical modules
  - Plane #6 (H) – 12 modules with endcaps and manifolds – extrusions horizontal (thin-walled)
    - First time positioning of modules with manifold snout overhangs
    - Manifolds must be on side with single manifold from plane #5
    - Measurements of free space between ends of manifolds and surface of #5
  - Plane #7 (V) – 12 modules with endcaps and manifolds
  - Plane #8 (H) – 12 modules with endcaps and manifolds
    - Study potential APD box fit problems in corner with 3 layers of manifolds
  - Measure block segment for overall dimensions & skew
    - Block segment will not be raised or filled



# WBS 1.8.8.1 – Full Scale Assembly Prototype - Schedule

- FSAP Schedule by WBS elements
  - 1.8.8.1.1 – Specifications Documents - complete
  - 1.8.8.1.2 – Assembly site selection – complete
  - 1.8.8.1.3 – Design assembly platform & tooling – May–June '07 – in process
  - 1.8.8.1.4 – Design adhesive dispensing machine – May-July '07 – in process
  - 1.8.8.1.5 – Review of Prototype design - July '07 – Milestone
  - 1.8.8.1.6 – Site Infrastructure – July-Aug '07
  - 1.8.8.1.7 – Fabricate assembly platform & tooling - Sept '07
  - 1.8.8.1.8 – Install assembly platform & tooling - July-Sept '07
  - 1.8.8.1.9 – Fabricate adhesive dispensing system - July-Sept '07
  - 1.8.8.1.10 – Install adhesive dispensing system – Sept '07
  - 1.8.8.1.11 – Perform Assembly Prototype studies – Sept '07-Jan '08
    - Construction schedule dependent on deliveries of components - WBSs 2.4(PVC) & 2.5(Modules)
  - 1.8.8.1.13 – Studies complete – Jan '08 – Milestone
    - Prototype available for outfitting mock-ups – Feb '08
    - Decommission end of Feb '08



# WBS 1.8.8.2 – Full Height Engineering Prototype - Overview

- **FHEP Purpose**

- Measure deflections and stresses in filled full height vertical extrusions
  - Measure short term excursions as modules are filled
  - Track creep over longer term (~2 years)
  - Match experimental data to FEA
- Gain experience with lifting full-height structure
  - Measure stresses when being raised
  - Evaluate stiffness of block during raising
- Mate 2 blocks to evaluate how closely it can be done
  - Measure loading/swelling transfer between blocks

- **FHEP Structure**

- All elements made of prototype extrusion
- Vertical modules made of thick-walled extrusion
- Prototype is 2 full width, full height\* verticals
- Horizontals cut to fit the two verticals
- Only endcaps required
- Edge stiffeners required

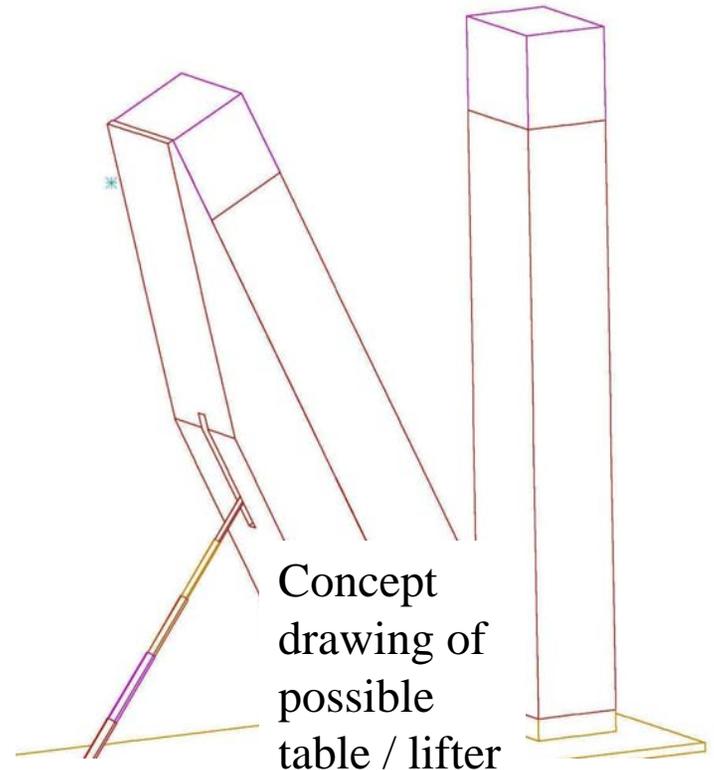


# WBS 1.8.8.2 – Full Height Engineering Prototype - Location

- FHEP Assembly Location

- Argonne location used for the FSAP
  - FSAP will be cut into pieces for removal from the construction position
  - All tooling for production of the FHEP is in place

- Assembly table / lifting strongback is critical to success
  - Must be designed to be transported fully loaded with a block structure on a truck from ANL to FNAL
  - Must be capable of lifting the blocks one at a time into their vertical positions
  - Must function as a "bookend" once the second block is lifted

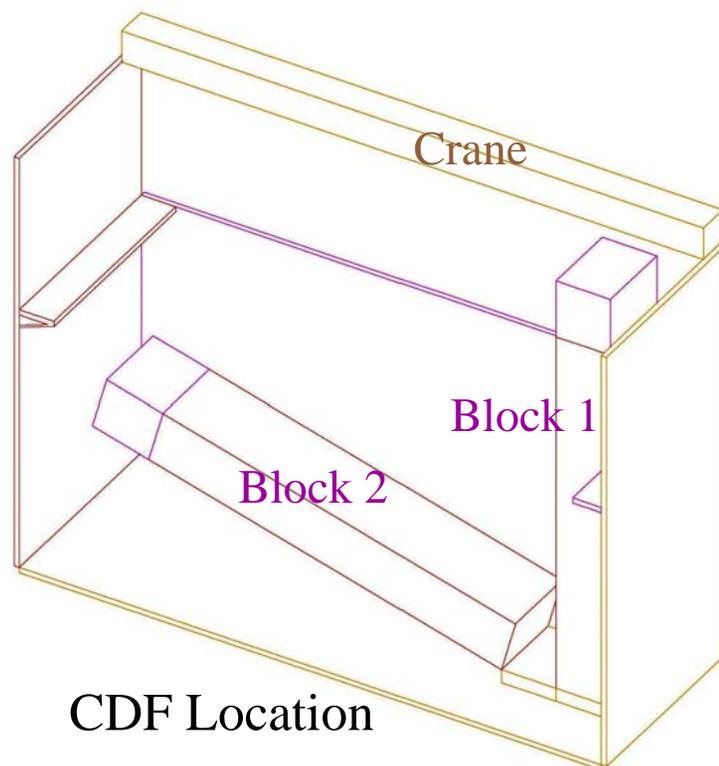
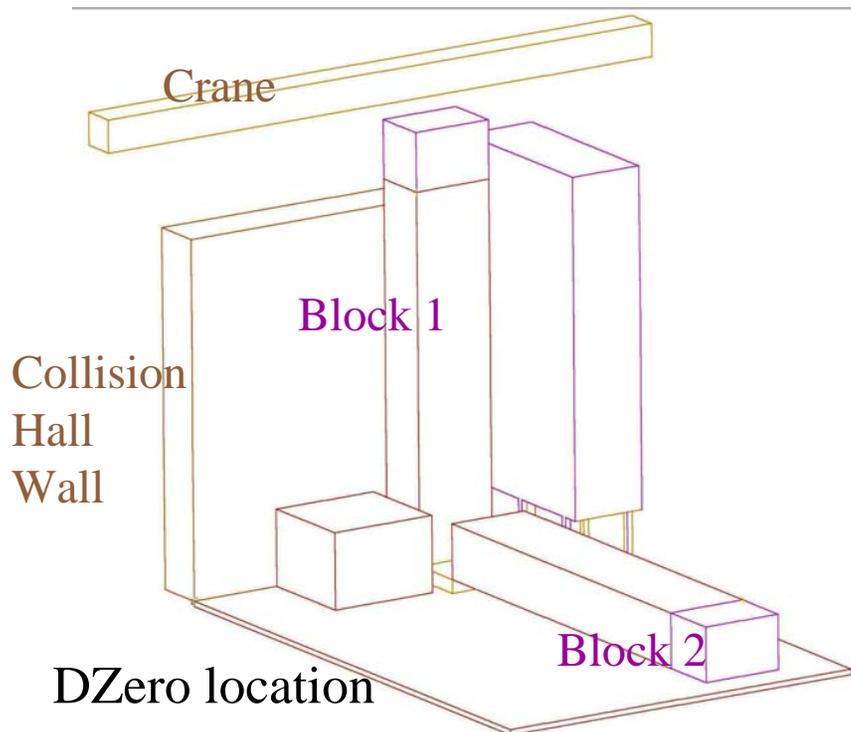




# WBS 1.8.8.2 – Full Height Engineering Prototype - Location

- FHEP Testing Location

- DZero & CDF both have space **close** to useful
  - CDF not quite full height, but achieves 19 psi with H<sub>2</sub>O
  - DZero missing location for the long-term element – up against Collision Hall wall





# WBS 1.8.8.2 – Full Height Engineering Prototype - Schedule

- FHEP Schedule by WBS element

- 1.8.8.2.1 - Specifications documentation complete
- 1.8.8.2.2 - Site selection – assembly location complete; test loc. – Sep '07
- 1.8.8.2.3 - Design strongback / block raiser, fixtures & tooling – June '07
- 1.8.8.2.4 - Review FHEP design – Sep '07
- 1.8.8.2.5 - Prepare assembly site – Jul –Sep '07
- 1.8.8.2.6 - Fabricate strongback / block raiser – Jul – Oct '07
- 1.8.8.2.7 – Prepare test site infrastructure – Jan – Mar '08
- 1.8.8.2.8 - Assemble first FHEP block @ ANL – Mar '08
  - Construction schedule dependent on deliveries of components - WBSs 2.4(PVC) & 2.5(Modules)
- 1.8.8.2.9 - Ship first block to FNAL – Mar '08
- 1.8.8.2.10 - Install first block @ test site – Mar '08
- 1.8.8.2.11 - Assemble second FHEP block @ ANL – Jun '08
- 1.8.8.2.12 - Ship second block to FNAL – Jun '08
- 1.8.8.2.13 - Install second block @ test site – Jun '08
- 1.8.8.2.14 - Fill blocks with water – Jul '08
- 1.8.8.2.15 - Test Prototype – Jul '08 – Jul '10

Current schedule  
not yet updated  
in Open Plan