

WBF 4/8/91



# Lawrence Berkeley Laboratory

1 Cyclotron Road Berkeley, California 94720

(415) 486-4000 • FTS 451-4000

3 April 1991

## MEMORANDUM

To Bill Fowler, FNAL

From Paul Hernandez

Subject 15-ft Bubble Chamber Papers sent to LBL Archives

I recently sent my personal papers to LBL Archives. These papers included the my notes and the FNAL material I collected while working on the 15-ft FNAL Bubble Chamber. They are in four boxes, numbered 2 including 5.

Each box contains numbered books or files and each book or file is numbered. A separate LBL Records Transmittal form was filled out for each box. The transmittal form lists each numbered book or file and briefly describes the contents of each book. Each box contains a copy of its Record of Transmittal and contents.

This binder contains a copy of each Record of Transmittal for each of the 4 boxes.

Best regards.

A handwritten signature in cursive script, appearing to read "Paul", is located below the typed name "Paul Hernandez".

## FERMILAB 15-FOOT BUBBLE CHAMBER

Box 2

### Book 2, Correspondence

These are a random selection of topics going through the 2 1/2-inch thick book from back to front.

### Status Reports

- 24-Hour and 48-Hour Chamber Cooldown Status Reports for the First Liquid Hydrogen Pulsing with Magnetic Field
  - 21 Jun 73 PV 190 tested - start chamber cooldown
  - ~2 Jul 73 Start liquid hydrogen fill
  - ~10 Jul 73 Chamber filled
  - 17 Jul 73 Started SC Magnet helium cooldown
  - 14 Aug 73 Started helium liquid fill of SCM dewar
  - 7 Sep 73 Magnet at 48°K starting warm up
  - 17 Sep 73 Chamber warm run, main vacuum broken
  - 24 Sep 73 Starting another chamber cooldown
  - 27 Sep 73 Tested expansion system with cold H<sub>2</sub> in chamber; magnet cooldown started
  - 10 Oct 73 Chamber filled with liquid hydrogen, first pulses and tracks first observed of cosmic rays at 1715, chamber pressure 60 psia; pictures reasonably clean
  - 12 Oct 73 More pulsing, four hours
  - 15 Oct 73 Chamber and expansion system parametric studies
  - 22 Oct 73 Magnet charged to 2000 Amps, then to 5000 A, Magnet Net liquefying rate 20-25 l/hour
  - 29 Oct 73 Magnet liquid helium and chamber liquid hydrogen being transferred back to dewar; the first pulsing run is over; two months of maintenance and improvement start now

### Correspondence

- Letter from R. Wilson to Brooks, AEC, November 13, 1970 - appointed H.P. Hernandez as Hydrogen Safety Engineer
- NAL Correspondence by Bill Fowler, NAL, 15-Foot Bubble Chamber Project Manager

- 30-Inch Bubble Chamber Correspondence, NBS Cryogenic Laboratory, Battelle Memorial Institute Stress Analysis, Halsey Allen, Tim Toohig, G. Mulholland, Russ Huson, Paul J. Reardon, Peter C. VanderArend, Ralph Neimann, R.A. Nickerson, Edwin L. Goldwasser, K.C. Brooks, W. Rich, F. Mattmueller, AEC, Hooper, Moser, William D. Walker, Glenn Eckman
- Allen to Wilson, Safety Responsibility in the Neutrino Laboratory
- Wilson to Hernandez, 16 February 1973, Request for Safety Assurance
- Fowler to Wilson, 2 March 1973, Reviews, Procedures and Responsibility
- Fowler, 20 March 1973, 31 pages, Bare Bones Report on 15-Foot Bubble Chamber Safety
- Fowler to Wilson, 20 March 1973, Brief Safety Summary, Hernandez' Responsibilities
- Hernandez to Reardon, 2 April 1973, Comments on Bare Bones Report, "Increase the Use of NAL Corn Field Area Rather than the Energy Density"
- Allen, Senior Safety Officer, to Hernandez, 27 April 1973, Hernandez invited to become outside consultant to NAL Cryogenic Safety Subcommittee
- Wilson to Mattmueller, 7 May 1973, Safety Reviews
- Fowler to Wilson, 7 June 1973, Request for First Liquid Hydrogen Cooldown
- Hernandez to Wilson, 7 June 1973, ESC Safety Clearance for 15-Foot Bubble Chamber First Operation with Liquid Hydrogen without Pulsing
- Hydrogen gas release on June 9, 1973
- Notice of intent to pressure test 15-Foot Bubble Chamber at LN temp, tested successfully to 135 psia on Saturday, 30 June 1973
- R. Wilson letter to P. Hernandez, 16 November 1973, thanking me for my contribution to the 15-Foot Bubble Chamber
- Index of P. Hernandez' file at NAL
  - 84 letters or reports written by Hernandez, December 1970 - September 1973
  - 32 letters or reports written to Hernandez

#### Cost

- Work for Others LBL Account 8013-17
- Many invoices covering Hernandez' time and travel
  - \$29,000 charges for July 1972 - July 1973

Phone Log

- 8 Jul 1970 Joe Ballam asks for Rod Byrns and Yo Maruyama to help SLAC with design of NAL 15-Foot Bubble Chamber Expansion System
- 10 Sep 1970 W. Fowler, Kromarc Optics nozzle ready for procurement
- 13 Nov 1970 D. Chelton will be glad to review NAL Chamber
- 3 Feb 1971 HPH recommends 135 psi rupture disc on main vacuum tank, Peter VanderArend recommends 16-inch diameter vent line
- 29 Apr 1971 Carl Goodzeit, BNL, working on stress analysis of SC Magnet Bridge
- 1 Jun 1971 Milt Vagins, Battelle, performing stress analysis on chamber vessel
- 28 May 1971 Dick Kropschot and Jess Hord reviewing hydrogen circulating pump
- 4 Oct 1971 H. Daley, Bur of Mines helium gas cylinders
- 11 Oct 1971 R. Byrns, concern for hydrogen embrittlement
- 26 Oct 1971 Hurson, T. Toohig, mineral oil storage, 23000 gal.
- 9 Nov 1971 Lynn Stevenson, detectors
- 17 Jan 1972 M. Vagins, chamber skirt thermal stress
- 12 Mar 1972 Y. Maruyama needed at NAL
- 20 Apr 1972 Conti, AEC, Chicago; 15-Foot Bubble Chamber Formal Review
- 8 May 1972 H. Allen, will test vacuum tank to 60 psig
- 12 Jun 1972 HPH to Allen, emergency power, deluge fire system, HP cylinders

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 2

Book 1, Trip Reports

These are a random selection of topics going through the 2 1/8-inch thick book from back to front.

- Relocation of the 12-Foot Hydrogen Bubble Chamber from the Argonne National Laboratory to the National Accelerator Laboratory, Batavia, Illinois, W. Brobeck, December 1969
- NAL 15-Foot Liquid Hydrogen Bubble Chamber, First Trip to NAL, August 1970
- NAL 15-Foot Liquid Hydrogen Bubble Chamber, Second Trip to NAL, October 1970; November 13, 1970, R. Wilson's letter appointing Paul Hernandez as Hydrogen Safety Engineer
- NAL 15-Foot Liquid Hydrogen Bubble Chamber, Third Trip to NAL, December 1970
- NAL 15-Foot Liquid Hydrogen Bubble Chamber, Fourth Trip to NAL, January 1971
  - Superconducting Magnet Design Review, ANL, January 1971
  - Main Vacuum System Review
  - Hazard Evaluation
- NAL 15-Foot Liquid Hydrogen Bubble Chamber, Fifth Trip to NAL, March 1971
  - 30-Inch Bubble Chamber
  - 15-Foot Superconducting Magnet
  - 15-Foot Bubble Chamber Vessel
- Review of Chicago Bridge and Iron Company preliminary drawings of 15-foot chamber vessel
- Sixth Trip to NAL, March 1971
  - Neutrino Lab Phase II and V
  - A-286 and Vacuum Tank Bolts
  - Optical System Conical Washers
  - Review of Chamber Stress Analysis Battelle Report
  - Superconducting Magnet NAL Meeting, April 1971
- Seventh Trip to NAL and Visit to NBS Cryo Lab, June 1971
  - Chamber Vessel Meeting
  - Vacuum Tank Bolts

- Battelle Impact Test
- Instrument Air Tubing
- Halon 1301
- Review Chamber Drawing
- NBS Cryo Division Visit
- High-Pressure Helium Gas Storage (railroad tank cars were used in the 1930's to supply the Akron and Macon dirigibles)
- Eighth Trip Report, NBS Cryo Lab and NAL, September 1971
  - Cold Box Test
  - 71-Inch Piston Seal
  - 30-Inch Bubble Chamber
  - Tank Can Cylinder Stand
  - Low-Pressure Gas Storage
- Ninth Trip Report, NAL, October 1971
  - Cold Box
  - 30-Inch Bubble Chamber Inspection
  - 15-Foot LP Gas Storage
  - 15-Foot HP Cylinder
  - 15-Foot Vessel
- Tenth Trip Report, November 1971
  - 30-Inch Before Hydrogen Review
  - Mineral Oil Tank
  - Lab "B" Compressor Room
- Expansion System Test Meeting, SLAC, November 1971
- Eleventh Trip Report, December 1971
  - Hydrogen Refrigeration Test Preparation
  - Expansion Bolts
  - Review of Chicago Bridge and Iron Vessel Record
  - Bubble Chamber Vessel Documentation

- Meeting at Berkeley, January 1972
  - Safety Inspection and Test
  - Brunswick Project
- Twelfth Trip to NAL, March 1972
  - I. 15-Chamber
    - Hydrogen Compressor Room
    - Low-Pressure Storage Tanks
    - Main Vacuum System
    - Superconducting Magnet
    - 15-Foot Chamber
  - II. Experiment No. 36A Meeting
  - III. Experiment 104 Meeting
- Review of CCI Chamber Cooling Long Report and Drawings, April 1972
- Thirteenth Trip Report, NAL, May 1972
  - Main Vacuum Relief System
  - Vessel Relief System
  - Crew
  - SC Magnet Interface
- Fourteenth Trip Report, NAL, July 1972
  - Safety Review Meeting, NAL, May 1972
  - 15-Foot Bubble Chamber Safety Report, Volumes I, II and III
  - NAL Safety Inspection List
  - Safety Work to be Done Prior to First Liquid Hydrogen Operation
- Review of Operating Instructions for First Bubble Chamber Cooldown, August 1972
- Fifteenth Trip Report, NAL, September 1972
  - NAL 15-Foot Bubble Chamber Safety Report Appraisal by AEC
  - First Liquid Hydrogen Operation Safety Review Checklist

- Krol Engineering Company Fire Protection Survey, October 1972
- PV 190
- Sixteenth Trip Report, NAL, December 1972
  - Review of External Safety Committee Checklist
  - AEC Safety Review Meeting
- Appointment of NAL Cryogenic Safety Committee by Robert R. Wilson, NAL, March 14, 1973
- Safety Responsibility in the Neutrino Laboratory, Reardon, January 1973
- Letter to Bill Fowler from Bob Wilson, February 15, 1973, asking Paul Hernandez to submit readiness and safety of 15-Foot Bubble Chamber
- Liquid Hydrogen Usage at NAL in 1972
- Seventeenth Trip Report, NAL, February 1973
  - First Liquid Hydrogen Run Objectives with Dummy Piston
  - Procedures to be Completed
  - Work to be Performed
  - Operating Recommendations for First Liquid Hydrogen and Dummy Piston Operation
- Eighteenth Trip Report, NAL, March 1973
  - Procedures, Work and Recommendations for First Liquid Hydrogen Run with Dummy Piston
  - Notes from March 1973 Trip Report
  - Review of 15-Foot Bubble Chamber Emergency Procedure
- Nineteenth Trip Report, NAL, April 1973
  - Tentative Schedule
  - ESC Worklist for First Liquid Hydrogen Run
  - Operating Recommendation
  - Bubble Chamber Visit
  - Krol Letter, April 1973

- Twentieth Trip Report, NAL, June 1973
  - General Safety Meeting
  - 15-Foot Bubble Chamber Status Meeting
  - NAL Cryogenic Safety Committee Meeting
  - Meeting with R. Wilson
- Twenty-First Trip Report, NAL, July 1973
  - 15-Foot Bubble Chamber First Run Review with Dummy Piston (no pulsing), June 17, 1973 - July 17, 1973
  - Chamber First Pulsed Operation Safety Review Checklist
- Twenty-Second Trip Report, September 1973
  - General
  - LBL Counters, Lynn Stevenson, LBL
  - Deoxo
  - Lab C Meeting
  - Worklist
- Twenty-Third Trip Report, November 1973
  - Review of First Pulsing Run, September 1973 to October 29, 1973
  - Safety Meeting: Transfer of Safety Responsibility from ES to NAL-CSC
  - External Safety Committee Dissolved with this Meeting:  
P. Hernandez, Chairman; R. Watt, SLAC; D. Chelton, NBS;  
A. Schlafre, BNL; and T. Tamosaitis, ANL



## FERMILAB 15-FOOT BUBBLE CHAMBER

Box 2

### Book 7, Bolts

These are a random selection of topics going through the 2-inch thick book from back to front.

### Vacuum Tank

- o The Evolution of the 150-Psig Pressure Test for Liquid Hydrogen Bubble Chamber Vacuum Tanks, Hernandez, March 1968 - From 14-Foot Bubble Chamber Project Safety Review
- o Special Report on a Stress Analysis on Proposed 30,000-Liter Bubble Chamber Vacuum Tank, NAL, Battelle, October 1970
- o Battelle Review of Chicago Bridge and Iron Company's Design Drawings for the Vacuum Tank
- o Main Tank Vacuum System, C. Palaver, January 1971
- o Flange Drilling of Vacuum Tank, I. Halpern, LBL, February 1971
- o Stress Report Certification, Vacuum Tank, CB&I, February 1972
- o 15-Foot Bubble Chamber Meeting, Safety Review of Vacuum System, etc., October 1970
- o Pneumatic Test of Vacuum Tank, Battelle, April 1972
- o Additional Penetrations in Vacuum Tank, BMI, March 1972
- o Back-Up Seals in Lower Regions of the 15-Foot Bubble Chamber Vacuum Vessel, NAL, February 1973

### Bolting Materials

- o Bolting Material Properties, A-286, etc.
- o Copies of ASTM Alloy Steel Bolting Materials for Low-Temperature Service, 1970
- o Cryo Space, Metals Handbook, Copy of Ferrous Alloys, 1967
- o Unified Screw Threads, American Standard, ASA B1.1, 1960
- o SA-320 Socket Screw Test Reports, January 1972

### Expansion

- o NAL Expansion System Drawing List, 1971
- o Design Report of the Expansion System Actuator for the 15-Foot Bubble Chamber at NAL, Watt, et al, November 4, 1971
- o Design Report Modifications per Hernandez, SLAC, December 1971

- o Justification for Using Petroleum Oil as a Driving Media in the Expansion System, R.D. Watt, November 1971
- o Stress Analysis Report on Chamber Expansion Piston for NAL 30,000-Liter Hydrogen Bubble Chamber, BR 311-23-001, Brunswick Corporation, November 1971
  - oo Glass Fabric Reinforced Epoxy Laminate Integrally Bonded to a Laminated Wood Core of End Grain Balsa and Fir
- o 30,000-Liter Bubble Chamber Valve and Instrument List for Expansion System, March 1972
- o Expansion System Initial Start-Up Procedure for the NAL 30,000-Liter Bubble Chamber, SLAC and NAL, March 1972
- o Piston Seal Test, NAL, Morgan, December 1972

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 2

Book 6, Chamber/Piston

These are a random selection of topics going through the 2-inch thick book from back to front.

Chamber

- o Special Report by Battelle Memorial Institute on Stress Analysis of the 30,000 Liter Bubble Chamber (partial draft, December 10, 1970), J. Groom and M. Vagins
  - oo Final Report, Received April 22, 1971
- o Special Report on Suggested Procedures for Welding Type 316L Stainless Steel for Large Bubble Chamber, BMI, H.W. Mishler, January 29, 1971
- o Stainless Steel Plate, NAL, February 1971
- o Letter from F.C. Hull, Westinghouse, to Hernandez, M<sub>s</sub> for 316L, February 16, 1971
- o ASME VIII Div 2, Sections Applicable to Bubble Chamber Vessel Design, April 1971
- o Chicago Bridge and Iron, Chamber Vessel Specification and Plate Work Breakdown, February 1971
- o 150" Round Stainless Bubble Chamber, Welding Procedure 1421, Chicago Bridge and Iron Company, April 30, 1971
- o Shock on Legs
- o Impact Tests of Vessel Specimens, BMI, H. Mishler, June 21, 1971
- o Chamber Weldment Safety Report, Letter from Fowler to Brooks, AEC, June 9, 1971
- o Vessel Weld X-Ray Report, Letter from R. Meister, BMI, to Fowler, June 29, 1971
- o Hydrostatic Test Letter, Vagins to Fowler, October 8, 1971
- o Materials Certification and Heat Treat Charts, Letter from J. Ryan, Wisconsin Centrifugal, to Fowler, March 19, 1971
- o CBI Test Reports on Ferrite, McNair, CBI, to Fowler, January 11, 1972
- o Chamber Support Skirt Thermal Analysis, Report Workman and Vagins to Fowler, January 12, 1972
- o BMI Inspection at NAL on Various Bubble Chamber Components, Vagins to Russ Huson, August 3, 1972

- o Strain Gage Test in Vessel Nose Cone, Hans Kautsky to Fowler, et al, April 30, 1973
- o CBI Design Report 12'6"-Diameter 30,000 Liter Hydrogen Bubble Chamber, March 14, 1971
- o Theoretical Elastic Stress Distributions Arising from Discontinuities and Edge Loads in Several Shell-Type Structures, R. Johns and T. Orange, NASA Technical Report R-103, 1961

Piston

- o Status Letter on Analysis of Piston Assembly, Vagins to Fowler, April 3, 1973
- o Piston Seal/Piston Rod Seizing Failure Report, M.W. Morgan, NAL, to R. Huson, February 5, 1973
- o Stress Analysis of Expansion Piston (prototype I) 2621 ME-26272 Rev. D, Fiberglass Shell with Stainless Structure, Preliminary Report, July 2, 1973, source unknown, may be BNL
- o Balsa Wood Piston Write Up in Materials Engineering

FERMILAB 15-FOOT BUBBLE CHAMBER

*Box 2*

Book 5, Welding

These are notes, letters and reports relating to the welding of the vacuum vessel, chamber vessel and superconducting magnet cryostat system. The notes relate to welding, magnetic and cryogenic properties of 304, 304L, 305, 310, 316, 316L and possibly others.

These are indexed going through the 1-inch thick book from front to back.

## FERMILAB 15-FOOT BUBBLE CHAMBER

Box 2

### Book 4, Buildings

These are a random selection of topics going through the 2-inch thick book from back to front.

This book relates to reducing the exposure of personnel and facilities to the risks associated with the 15-Foot Bubble Chamber Liquid Hydrogen. Distance between crew and 15000-Gallon Liquid Hydrogen Dewar and 30000 liter Hydrogen filled Bubble Chamber. Building design, ventilation, reduction of ignition devices, fire safety, code compliance, etc.

### Buildings and Site

- o LBL Bevatron External Proton Beam Experimental Hall, Safety Recommendations, M3612B, October 5, 1965.
- o NAL Experimental Area 2, Title I Report, September 1970, DUSAF
- o Title I Report, Preliminary Design for Neutrino Laboratory, November 1970, DUSAF
- o Improved Risk, AEC, 1970
- o ANL Wind Roses in Period 1950 - 1964
- o Rescue Truck, Protective Clothing, 1971
- o Hydrogen Venting System

### Old Drafts

- o Mostly Old Drafts of Hernandez' Trip Reports

### Operation

- o Selection and Training of Nuclear Power Plant Personnel, ANSI N18.1, 1971
- o Bubble Chamber Crew Chief Job Description
- o Bubble Chamber Group Crew Lists and Assignments, 1972 - 1973

### Inspections

- o 15-Foot Bubble Chamber Yard, H. Allen, 1972
- o Hydrogen Test Condition Meeting, 15-Foot Bubble Chamber Group and NAL Safety, January 1972
  - oo Area: Work area control, traffic control, communications.
  - oo Building: Hydrogen detection, ventilation, motor control center, utilities.
  - oo Test: Fire out of control, personnel injury, localized hydrogen leak.

- o 15-Foot Bubble Chamber and Liquid Hydrogen Bubble Chamber Safety Reviews, Allen, February 1972
- o Safety Inspection Punch Lists, Several From October 1972 - May 1973
- o Safety Review, Zernoski, Brown, February 1973

Appraisal

- o AEC, Chicago, Draft of Hooper's Safety Reviews, sent 1972

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AEC was trying to apply the very rigid nuclear power reactor criteria to the 15-Foot Bubble Chamber.

- o AEC, Chicago, General Comments and Recommendations, September 1972
- o General Comments on AEC Appraisal (draft), Hernandez, September 1972

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At one point AEC, J. Hooper, took the ANS power reactor procedure and substituted the words Bubble Chamber for power reactor. This document was totally unacceptable to all working on the Bubble Chamber and was dropped by AEC.

- o Fire Drill, May 1973

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 2

HERNANDEZ  
FEB 87

Book 3, Corrections and Additions to the 15-Foot Bubble Chamber Safety Report

The contents of this 1-inch thick book (NAL calls it a booklet) are explained in Russ Huson's April 5, 1973, letter to Fred Mattmueller, AEC. These changes and additions were made before the first liquid hydrogen operation of the 15-Foot Bubble Chamber without pulsing, June 17 to July 17, 1973.

The July 1972 Safety Report is a three-volume set of 6 1/4 x 8 1/4 books (cover attached). There is a fourth book of this same set published in November 1970 to show that the 15-Foot Bubble Chamber is safe and to provide information for the design of buildings and facilities and description of the Bubble Chamber equipment, systems and failure mode analysis.



Paul Hernandez  
June 30, 1987

WPH

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

15-Foot Bubble Chamber Expansion Systems SLAC Drawings

Jacket 30

Assembly Elevation, 5A 915-708-04R0, 1973

NAL Assembly - SLAC

Expansion System Elev, SA 915-708-01 R0

Compressor-Oil and Air Schematic, SD 915-706-18 R0

9-Inch Valve, Check Valve, GP 915-705-19 R0

Compressor-Oil and Air Floor Plan, GP 915-706-03 R3, 1971

Pit Area Schematic, SD 915-706-18 RD

Pit Area Plan

Expansion System Subassembly, SA 915-708-01 R0

Expansion Piston Rod Seal, Lower, 2621 MD 86533, 1979

The Chamber Piston Shaft Failure Report, BCN-10-GTM, March 27, 1979

Paul Hernandez  
June 30, 1987

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

15-Foot Bubble Chamber Expansion System Drawings

Jacket 29

Upper Piston Lip Seal, 2621 MB 25974, July 1972  
Expansion System, 2621 MB 25128, 1971  
Lip Seal Section, 2621 MC 25336, 1971  
Piston Rod Fitting, 2621 MC 25369, 1971  
Piston Wood Cord, 2621 MD 25461, 1971  
Cylinder and Rod Guide, 2621 ME 25163, 1970  
General Assembly, 2629 ME 25308, 1971  
Piston Rod Guide Assembly, 2621 MD 25378, 1971  
Piston Rod Seal, Lower, 2621 ME 25534, 1971  
Lip Seal Ring, 2621 MC 25934, 1973  
Upper Piston Rod Seal Assembly, 2621 MC 25940, 1972  
Actuator Coupler Assembly, 2621 MC 26012, 1972  
Expansion System Schematic, 2621 ME 26071, 1972  
Expansion System Assembly, 2621 ME 26254, 1972  
Expansion Rod Prototype I, 2621 ME 26274, 1973  
Expansion Structure Assembly Piston Prototype I and Piston Assembly, 2621 ME 26275, 1973  
Cyl and Rod Guide with Fiberglass Piston, 2621 MD 26315, 1973  
Expansion Piston Assembly, Metal, 2621 ME 26316, 1973  
Cyl and Rod Guide with Metal Piston, 2621 MD 26351, 1973  
CERN BEPTS Bubble Chamber Piston Seal Details, Ten Drawings, 1970

Paul Hernandez *KB*  
June 30, 1987

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

15-Foot Bubble Chamber Flow Diagrams

Jacket 27

Hydrogen Engineering Flow Diagram<sup>s</sup>, April 1978, 2625 ME 25050 inc 25055

Engineering Flow Diagram<sup>s</sup>, Helium System, April 1978, 2625 ME 33424 inc 33427

Expansion System Schematic<sup>s</sup>, 717'-6" Elev, April 1978, 2621 ME 26071 and 26072

Jacket 28 *15 FT BC Flow Diagrams*

Hydrogen Engineering Flow Diagram<sup>s</sup>, May 24, 1977, 2625 ME 25050 inc 25055

Piston Rod Seal, Lower, May 24, 1977, 2621 ME 26488

Optic Window Assembly, May 24, 1977, 2623 MD 86135

Paul Hernandez *HPH*  
June 3, 1987

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

Book 26 *BATTELLE REMARKS*

These are a random selection of topics going through the 1-inch thick book from back to front.

This 1-inch thick book contains:

- 1V equipment, C. chamber vessel, 2 special reports by Battelle Memorial Institute of the stress analysis of the 30,000-Liter Bubble Chamber. Prepared by M. Vagins, R. Prause, G. Workman. Reviewed January 1972.
- A detailed stress analysis of National Accelerator Laboratory's chamber expansion piston assembly to National Accelerator Laboratory. F. Simonen, M. Vagins, Battelle Columbus Laboratories. May 22, 1972.

Paul Hernandez  
June 3, 1987 *130 U*

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

Book 25

This 1 1/2-inch thick book contains:

- About 9 safety articles and copies of NFPA Codes applicable to the 15-Foot Bubble Chamber installation.
- Appraisal of 15-Foot Bubble Chamber at National Accelerator Laboratory, Batavia, Illinois, prior to the first hydrogen cooldown. Conducted by the Safety Division, AEC, Chicago Operations Office, December 4-6, 1972.
- Bubble Chamber Data Sheets, NAL 30,000 Liter Bubble Chamber. This report lists instruments and gives the specification of pumps, vessels, condensers, etc. Revised April 13, 1973.

Paul Hernandez *PH*  
June 3, 1987

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

Book 24

This 1 1/2-inch thick book contains:

- Title 1 Report Preliminary Design for Neutrino Laboratory
- Amendment No. 1 to Subcontract No. 71-8-2-6 (C-67)
  - Drawing List
  - Schedule
  - Description of Work (Labs C and D)

Paul Hernandez *PH*  
June 2, 1987

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

Book 23

These are a random selection of Fermilab Monthly Activity Reports or similar items going through the 1 1/4-inch thick book from back to front.

- 15-Foot Bubble Chamber site from the air, photo #75-414-2, July 2, 1975
- Bubble Chamber track photo
- Cern Courier, Batavia, first tracks in 15-foot chamber, 1973
- Two new bubble chambers, last big ones, Physics Today, January 1974
- CERN Courier on Batavia 15-foot chamber, early 1973
- University Research Association, Inc., Annual Report, 1973
- NAL Monthly Report of Activities, NAL-71, May 31, 1972
- Main Ring Magnet Insulation, Bob Avery - LBL, April 7, 1972
- 200 Bev Status, Paul Hernandez, November 1972
- AMAX Copper News, OFHC Copper, November 1971
- NAL Monthly Report of Activities, NAL-63, October 31, 1971
- NAL Monthly Report of Activities, NAL-57, April 30, 1971
- Procedures for Experimenters, 1977-1978
- Fermilab Safety Handbook
- NAL REP, September 1974
- NAL REP, October 1973
- NAL REP, August 1973

Paul Hernandez *HW*  
June 2, 1987

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

Book 22, ASME Boiler and Pressure Vessel Code, Section VIII, 1971

- Pressure Vessels, Division 1
- Pressure Vessels, Division 2 - Alternative Rules

This 1 3/4-inch thick book contains the pressure vessel codes that were current during the design of the 15-Foot Bubble Chamber design.

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 4

2814  
19/12/87

Book 21, Fowler Committee

These are a random selection of topics going through the 1 1/2-inch thick book from back to front.

Minutes of the 15-Foot Bubble Chamber Safety Review Subcommittee (Fowler Committee, this is a Fermilab subcommittee of the External Safety Committee). Also included are meeting agendas, policy statements, Cryogenic Safety Committee minutes, operation procedures, safety policies, crew lists, work lists, monthly reports, inspections, RR tank car recertifications, lab B laster.

Copy of pages from Design Handbook for Liquid and Gaseous Helium Handling Equipment, U.S. Department of Commerce, Office of Technical Service, AD 410935. Covers HP cylinders mounted on railroad tank cars with reference list.

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

HSW  
19 May 87

Book 20, 15-Foot Letters and Log of Phone Calls

These are a random selection of topics going through the 1-inch thick book from back to front.

Letters

Safety Correspondence, 1973 - 1984.

Log of Phone Calls

Handwritten notes of phone calls to or from Paul Hernandez regarding the 15-Foot Bubble Chamber safety. From July 12, 1972 through and including October 21, 1986.

FERMILAB 15-FOOT BUBBLE CHAMBER  
Box 4

*Sheila*  
18 MAY 87

Book 19, 15-Foot Letters and Notes

These are a random selection of topics going through the 2-inch thick book from back to front.

Correspondence, notes, reports and procedures regarding the 15-Foot Bubble Chamber safety meetings, drafts, Bubble Chamber characteristics, optics, glass window seal analysis, operational tests, vapor pressure thermometer system, shaft seal rework, removal of deuterium from chamber, special welding procedures in liquid storage area, safety committee members, appointment letters.



FERMILAB 15-FOOT BUBBLE CHAMBER

P. HERNANDEZ  
16 March 1987

Box 3

Book 8 - Magnet, Optics and Gas Storage

These are a random selection of topics going through the 3/8-inch thick book from back to front.

Magnet

- o 12-Foot Hydrogen Bubble Chamber, Superconducting Magnet, Failure Mode Analysis, Argonne National Laboratory, D.L. Hillis, June 1969
- o Superconducting Magnet for the 15-Foot NAL Bubble Chamber, ANL, Desportes, Jones, Purcell, December 1970 (This was the group from ANL that designed the Fermilab magnet.)
- o NAL 15-Foot Bubble Chamber SC Magnet Design Review Meeting, ANL, P.G. Marston, Mag. Eng. Assoc., January 1971
- o A Superconducting Magnet System for the NAL 30,000-liter Bubble Chamber, ANL, December 1970
- o 15-Foot Bubble Chamber Magnet Test, December 1972
- o 15-Foot Bubble Chamber SC Magnet Liquid Helium Tested to 62.5 psig, Kautzky, February 1973
- o Limits on Human Exposure in Static Magnetic Field, W. Panosky, SLAC, May 6, 1970
- o Sterns-Roger Design Calculation for Magnet Cryostat, Reviewed by Battelle, November 1970

Optics

- o Design of Optics for the NAL 15-Foot Bubble Chamber, Russ Huson, NAL, April 1971
- o Optics Safety Report, R. Huson, NAL, March 1973
- o Letter Report Documenting Quartz Chipping Mechanism, M. Vagins, BMI, January 1974
- o 15-Foot Windows Quartz Chipping, several letters and phone calls, W. Smart, NAL, February 1974
- o Several Papers of Quartz Chipping Caused by Adhesives
- o Cryogenic Seals Copied from Cryo Mat Data Handbook, AFML-TDR-64-280, August 1968
- o Results of Literature Survey on the Behavior of Epoxies at Liquid Hydrogen Temperatures
- o Last Phase of Quartz Chipping Failure Mechanism, M. Vagins, BMI, June 1974

High-Pressure Storage

- Safety Analysis Report, High-Pressure Gas Storage Facility for 30,000-liter Bubble Chamber, M. Morgan, NAL, July 1971
  - oo Notes by Hernandez and Partial Copy of Dangerous Article Tariff 14 MF-ICC 15 FMC 13, Dot Regulated Specification for Tank Cars
- High-Pressure Gas Tubes for NAL Bubble Chamber, Letter, H. Daley, Cryo Consultants, August 1971
- Tank Car Data Sheets for Helium Tank Cars, MHAX 1009, 1010, 1011, 1013 and 1014, Department Interior, Bureau of Mines, Amarillo, Texas, H. Gerstner, September 16, 1971 (These tubes mounted on railroad flatbeds were manufactured in 1932 to transport helium gas for the dirigibles USS Akron and USS Macon.)
- HP Tank Car Test Data from Bureau of Mines, Letter, Daley, Cryo Consultants, October 1971
- Ultra Sonic Thickness Measurements of HP Tube Banks, Continental Testing Report, October 1971

Low-Pressure Storage

- Low-Pressure Hydrogen Gas Storage Vessels (150 psig design pressure), Correspondence April and May 1972 Regarding Testing and Operating Pressures

FERMILAB 15-FOOT BUBBLE CHAMBER

P. HERNAUER  
MAR 1987  
Box 3

Book 9, Refrigerator

These are a random selection of topics going through the 1 1/4-inch thick book from back to front.

Refrigeration

- o Safety Criteria for the Design of the Cryogenic Systems for the NAL 30,000-Liter Bubble Chamber
- o Failure Mode Analysis, Distance Between Storage Tanks, P. VanderArend, October 1970
- o Operating Instructions for the Hydrogen Bubble Chamber, P. VanderArend
  - oo Refrigerator and Storage Tank, March 1971
  - oo Cold Box H and LH Tank A, September 1971, Revised October 1971
  - oo Valve, Instrument and Line List, October 1971
- o Comments on Operating Instructions, D. Chelton, September 1971
- o Comments on Comments, P. VanderArend, October 1971
- o System Check-Out Procedure, M. Morgan, October 1971
- o Hydrogen Refrigerator Test Considerations, G. Mulholland, November 1971
- o Heat Loads, P. VanderArend, November 1971
- o Bubble Chamber Operator Instruction Program, P. VanderArend, December 1971
- o Failure Mode Analysis of Hydrogen Pump Loop, P. VanderArend, March 1973

Operating Procedures

- o 15-Foot Bubble Chamber Emergency Procedure (draft), 53 pages, March 1973

P. HERWAUER  
MAN 1987

Book 10, 15-Foot Cooling Loop Calculation

Box 3

This 3/4-inch thick book contains:

- Cooling Loop Calculations for the 30,000-Liter Hydrogen Bubble Chamber, P. VanderArend, 113 pages, January 28, 1972
- Cooling Loops of the 30,000-Liter Hydrogen Bubble Chamber, P. VanderArend, 35 pages, February 1972

P. HERNANDEZ  
MARCH 1987

Book 11, Operating Instructions

Box 3

This 1-inch thick book contains:

- Expansion System Actuator, Operating Procedure for the 30,000-Liter Bubble Chamber, SLAC and FNAL, June 1972
- Operating Instructions for the Helium System, Cryogenic Consultants, June 1972
- Cooling Loops for the 30,000-Liter Hydrogen Bubble Chamber, Cryogenic Consultants, February 1972
- Operating Procedures for Optics Vacuum System
- Operating Procedures for Magnet Vacuum Systems
- Operating Instructions for Main Vacuum System, March 1973
- Operating Instructions for First Bubble Chamber Cooldown, FNAL, March 1973
- Operating Instructions for Second Bubble Chamber Cooldown, FNAL, September 1973

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 3  
P. HERNANDEZ  
MARCH 1987

Book 12, Emergency Procedures

This 1/2-inch thick book contains:

- I. General Precautions
- II. Safety Checklist
- III. General Emergency Procedures
- IV. Vacuum Emergency Procedures
- V. Hydrogen System Emergency Procedures
- VI. Helium System Emergency Procedures
- VII. Interlocked and Alarmed Instrumentation

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 3  
P. HERNANDEZ  
MANU 1985

Book 13, NAL Targets

These are a random selection of topics going through the 1/2-inch thick book from back to front.

- o Hydrogen Safety in the Beam Transport Enclosure, NAL, (draft), 1971
- o Hydrogen Policy Guide, R. Fast, (draft), June 1971
- o Design Criteria Guide for Liquid-Filled Targets, R. Fast, (draft), June 1971
- o Review of NAL Design Guide for LH-Filled Targets, Hernandez, July 1971
- o Lynn Stevenson's Proportional Counters in 15-Foot Bubble Chamber Main Vacuum, Hernandez, August 1971

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 3

*And Monthly*  
Book 14, 15-Foot Trip, *REPEATS*

These are a random selection of topics going through the 1 1/2-inch thick book from back to front.

Monthly Reports

- o Bubble Chamber Cooldown Review, March 14, 1975
- o Camera, Lens and Flash Tube, April 1975
- o Neon Mixture Letter, May 1975
- o Transient Pressure Letter, Vagins, August 1971
- o Operation Meetings and Procedures, Mulholland, 1975
- o Monthly Reports, March 1974 to January 1978

Trip Reports

- o External/Internal Cryogenic Safety Committee  
First Meeting: October 13-14, 1975
- o External/Internal Cryogenic Safety Committee  
Second Meeting: May 18-19, 1976
- o External/Internal Cryogenic Safety Committee  
Third Meeting: October 27-28, 1976
- o External/Internal Cryogenic Safety Committee  
Fourth Meeting: May 23-24, 1977
- o External/Internal Cryogenic Safety Committee  
Fifth Meeting: April 6-7, 1978

FERMILAB 15-FOOT BUBBLE CHAMBER

Box 3

April  
1987

Book 15, Safety Review Meetings

These are a random selection of topics going through the 1 1/4-inch thick book from back to front.

- o External/Internal Cryogenic Safety Committee, Fifth Meeting, April 6-7, 1978
- o Bubble Chamber Safety Review Committee, First Meeting, October 25, 1987 (6th meeting in old series)

FERMILAB 15-FOOT BUBBLE CHAMBER

NEW  
May 87

Box 3

Book 16, Safety Review Meetings

These are a random selection of topics going through the 1 3/4-inch thick book from back to front.

- o Bubble Chamber Safety Review Committee, Second Meeting, June 5-6, 1979  
(7th meeting in old series)
- o Bubble Chamber Safety Review Committee, Third Meeting, April 30 - May 1, 1980  
(8th meeting in old series)
- o Bubble Chamber Safety Review Committee, Fourth Meeting, November 6, 1980  
(9th meeting in old series)

FERMILAB 15-FOOT BUBBLE CHAMBER

HPH  
May 87

Book 17, Safety Review Meetings

These are a random selection of topics going through the 1 3/8-inch thick book from back to front.

- o Bubble Chamber Safety Review Committee, Fifth Meeting, October 29, 1982 (10th meeting in old series)
- o Bubble Chamber Safety Review Committee, Sixth Meeting, December 8-9, 1983 (11th meeting in old series)

FERMILAB 15-FOOT BUBBLE CHAMBER

*Handwritten:*  
Klud  
May 87

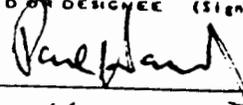
*Handwritten:*  
Box 3

Book 18, Safety Review Meetings

These are a random selection of topics going through the 1 3/4-inch thick book from back to front.

- o Bubble Chamber Safety Review Committee, Seventh Meeting, November 14-15, 1984 (12th meeting in old series)
- o Bubble Chamber Safety Review Committee, Eighth Meeting, June 13, 1986 (13th meeting in old series)
- o Bubble Chamber Safety Review Committee, Ninth Meeting, November 19-20, 1986 (14th meeting in old series)

RECORDS TRANSMITTAL

|  |  |                             |                    |  |                  |
|--|--|-----------------------------|--------------------|--|------------------|
| DEPARTMENT / DIVISION<br><b>BL ENGINEERING DIVISION</b>  |  | BLDG.<br><b>90</b>          | RM.<br><b>2148</b> | RECORDS MANAGEMENT USE ONLY              |                  |
| ON-GROUP-PROJECT<br><b>MECHANICAL ENGINEERING DEPARTMENT</b>   |  | EXT.<br><b>5275</b>         |                    | FILE UNIT CODE                           | DATE             |
| PERSON TO CONTACT<br><b>PAUL HERNANDEZ</b>   |  | EXT.                        |                    | ERDA MANUAL REF                          | LBL SCHEDULE REF |
| DEPARTMENT HEAD OR DESIGNEE (Signature Required)<br><br><b>TED KOZMAN</b> |  | DATE<br><b>28 July 1987</b> |                    | RMA BLDG LOCATION/INCLUSIVE SHELF SPACES |                  |
|  |  |                             |                    | TRANSFERRED TO                           | DATE             |
|  |  |                             |                    | RETENTION PERIOD                         | REVIEW YEAR      |

|   |   |
|---|---|
| TITLE OF RECORDS OR FILE UNIT<br><b>FERMILAB 15-FOOT LIQUID HYDROGEN BUBBLE CHAMBER - BOX 5</b> | INCLUSIVE DATES<br><b>AUG 1970 to JULY 1987</b>   |
| ARRANGEMENT OF RECORDS<br><b>CHRONOLOGICAL BY SUBJECT</b>                                       | CLASSIFICATION<br><input checked="" type="checkbox"/> UNCL. <input type="checkbox"/> CLASS. |

BRIEF DESCRIPTION OF RECORDS  
 THIS BOX CONTAINS MATERIAL THAT I (HERNANDEZ) COLLECTED OR WROTE WHILE I WAS THE HEAD OF THE FERMILAB 15 FT BUBBLE CHAMBER EXTERNAL SAFETY REVIEW COMMITTEE FROM AUGUST 1970 TO PRESENT JULY 1987.

| NO.   | INCLUSIVE CONTENTS                                     | SEAT LOCATION | NO. | INCLUSIVE CONTENTS | SEAT LOCATION |
|---|--|---------------|-----|--------------------|---------------|
| JACKET  |  |               |     |                    |               |
| 31  | NAL VESSEL DRAWINGS                                    |               |     |                    |               |
| 32  | CHICAGO BRIDGE & IRON PIPES                            |               |     |                    |               |
| 33  | NAL FLOW DIAGRAM & PV-190 PIPES                        |               |     |                    |               |
| 34  | MAIN VACUUM TANK                                       |               |     |                    |               |
| 35  | OPTICAL SYSTEM DRAWINGS                                |               |     |                    |               |
| 36  | DRAWINGS & SPECS<br>HYDROGEN REFRIGERATOR              |               |     |                    |               |
| 37  | HIGH PRESSURE GAS STORAGE FAC                          |               |     |                    |               |
| 38  | FIRE PROTECTION SYSTEM                                 |               |     |                    |               |
| 39  | CONTROL ROOM GRAPHIC PANELS                            |               |     |                    |               |
| 40  | SITE LAYOUT<br>BUILDING ARRANGEMENT AND                |               |     |                    |               |
| ALSO INCLUDED IN BOX 5 ARE DRAWINGS AND REPORTS I COLLECTED DURING THE 1950'S AND 60'S WHEN I WAS PROJECT ENGINEER FOR ALVAREZ. |  |               |     |                    |               |
| 41  | AND REPORTS<br>BRITISH BUBBLE CHAMBER NOTES            |               |     |                    |               |
| 42  | CERN 2m HYDROGEN BUBBLE CHAMBER DESIGN REPORTS & NOTES |               |     |                    |               |
| 43  | A FEW NOTES<br>FRENCH BUBBLE CHAMBER                   |               |     |                    |               |
| 44  | RUSSIAN 1.5 BC PROPOSAL REPORT AND DRAWINGS            |               |     |                    |               |

Paul Hernandez  
28 July 1987

## Russian Bubble Chambers

### Box 5

#### Jacket 44, Russian report and drawings

##### Russian Chamber drawings of an LBL look-a-like

o These drawings are of a chamber that is a small replica of the LBL Alvarez 72-inch Chamber. I do not know if this chamber was ever built.

- o Chamber assembly section, 837
- o " " , side and end elevation 839
- o Expansion Piston cross section 857
- o Chamber assembly end section unnumbered

##### Nikitin's 25 cm Hydrogen Bubble Chamber

- o Liquid Hydrogen Bubble Chamber with a diameter of 25 cm.  
S. Ya. Nikitin et al, 5 Feb 1960. LBL , BNL and Russian literature cited.

##### 4-inch (approximate) Chamber

- o An article in Russian describes a bubble chamber about 4 inches in diameter. The photo looks much like the LBL 4 inch.

##### 1.5 meter Chamber proposal

Bubble Chamber one-and-a-half meters in diameter with a superconducting magnet, filled with hydrogen, deuterium, or helium. report number 496, Moscow, 1967. Translated for Slac. I do not believe this chamber was ever built as by 1967 Cern and Fermilab were starting the design on 3 m and 15 ft chambers.

Paul Hernandez  
28 July 1987

## French Bubble Chambers

### Box 5

Jacket 43, French Bubble Chamber a few notes

- o Saclay 81 cm hydrogen bubble chamber report, possibly Cern Courier
- o Etude sur les possibilites de construction et l'interet d'une chambre mixte a haut taux de repetition. 1 September 1965, DESY, CEA, CERN
- o 2 letters to Hernandez from Saclay/
- o Mixed Helium and Hydrogen Liquifier offer from T. B.T. Grenoble, France., 8 March 1960.
- o Chambre a bulles de 35 cm corps, section, 18 Mar 1958 801

Paul Hernandez  
28 July 1987

Cern 2 metre Hydrogen Bubble Chamber

Box 5

Jacket 42, Cern 2 m Hydrogen Bubble Chamber drawings, reports and notes.

Sulzer Cryogenics, 4 articles on the Hydrogen refrigerator system.

Cern Scientific Policy Committee 25 May, 1958, meeting notes.

Technical aspects of Hydrogen Bubble Chambers for use with the  
Cern Proton Synchrotron.

Assembly drawings of 2 m Chamber. 11 x 17 inch 6 drawings

Cern engineering notes on BC systems, 14 notes.

Cern 59 - 20 report, Some of the expansion mechanisms considered for liquid  
hydrogen bubble chambers.

Cern CB 2000 Ensemble III, chamber cross section, Dec 1958 P42 102-0

Cern EBCB Section, cross section of building, May 1959 11018

Cern CB 2000 Ensemble II, chamber assembly section, 9 Apr 59 P42 101-0

Cern CB 2000 Ensemble I, " " long. " 2 Apr 59 P42 100-0

Beam Separator photos, 7 each

Paul Hernandez  
27 July 1987

## British Bubble Chambers

### Box 5

Jacket 41

British Bubble Chamber notes and reports (about 1-1/2 inch stack)

A.E.R.E. Harwell drawings, 1962:

Dimensional Parameters of Helium Bubble Chamber CR 2230-001

Dimensional Arrangement Helium Bubble Chamber CR 2240-002

Letter D. Shaw to Hernandez, 8 Nov 1960, Clarendon 4-3/4 inch liquid  
deuterium bubble chamber with 2 reports.

4 letters Shaw to Hernandez, 1961 - 62

Helium BC Vacuum Pumping System Specification, 26 Oct 1962

Magnet specification for Helium Bubble Chamber

Refrigerator " " " " " 7 mar 1962

British National Hydrogen Bubble Chamber

7 photos 8x10 b & w of Hydrogen BC

4 test reports " " "

Expansion valve note and letter 4 Jan 1960

British National "Bubble Chamber, arrangement perspective drawing.

Imperial College drawing Nat. BC, expansion valve .

" " " " " spool valve details

University of Liverpool arrangement of Vacuum Tank & Magnet drawing

" " " proposed 60" B>C> Vacuum Tank

" " " 60" Bubble Chamber body assembly

2 chamber notes

Liverpool expansion piston assembly , Mar 1958

Letter M>J Moore to Hernandez 21 July 1962 with 10 photos of 60" BC  
Bubble Chamber model, 60", 3 photos

Nimrod 7 Gev Proton Synchrotron, Rutherford Laboratory Booleet

Rutherford Laboratory Technical Leaflet

80 cm Helium Bubble Chamber

The 1.5 Metre Liquid Hydrogen Bubble Chamber

1.4 Metre Heavy Liquid Bubble Chamber

Spark chambers

Bubble Chamber Data Reduction  
Visit to the Rutherford Laboratory, 14 July 1967  
(printer for the magnet conference at Oxford)

Paul Hernandez  
22 July 1987

Fermilab 15 - ft Bubble Chamber

Box 5

15 ft Bubble Chamber Drawings

Jacket 40 = Building Arrangement and Site Layout

|  |                   |
|--|-------------------|
| <u>Bubble Chamber General Assembly, Illustration</u> | 2629 ME 25308     |
| <u>Neutrino Beam Line</u>                            | <u>unnumbered</u> |
| Site Plan  | 2625 ME 25027     |
| Neutrino Beam Line Berms & Structures                | 2961 ME 30368     |
| Neutrino II Fence Site Plan                          | PA - 1            |
| " " " Elevations & Details                           | PA - 2            |
| Neutrino Lab - Phase V Area Plan                     | PA - 1            |
| " " " " Lab "C" Plan, Elev & Sec                     | PA - 2            |
| " " " " Lab "D" Plan, Elevations                     | PA - 3            |
| " " " " Compressor Bldg Plan                         | PA - 4            |
| Neutrino Labs "A" & "B" Plan View                    | 2629 ME 25630     |
| Lab "B" Site Plan                                    | 2625 ME 25027     |
| Bldg "B" (Neutrino Lab) 20 Nov 1970                  | unnumbered        |
| Plan View at 730' 0 Elevation                        | "                 |
| 742' 6 El  | "                 |
| Bubble Chamber Building Cross Section 12 Aug 70      | "                 |
| Bubble Chamber Works Area                            | 2629 LE 2A        |
| Neutrino Area Beam Lines, Proposed Shielding         | 2961 ME 31018     |
| " " " " , Structures Labs A,B,D                      | 2961 ME 30714     |
| Barry Controls Isolation Element Report              | A-40108A          |

Paul Hernandez  
22 July 1987

Fermilab 15 - ft Bubble Chamber

Box 5

15-ft Bubble Chamber Drawings

Jacket 39 - Control Room Graphic Panels

Fermilab Graphic Control Panel Layout Drawings

|  |                |
|--|----------------|
| Hydrogen Refrigerator " H "                    | 2628 ED 25396A |
| Storage Tank "A", "B". "B-B" System            | " " 25401B     |
| Storage Tank "D" System                        | " " 25418A     |
| Storage Tank "C" System                        | " " 25419A     |
| Main Tank Vacuum System                        | " " 25424      |
| Cryostat Vacuum System                         | " " 25426      |
| Optics Vacuum System                           | " " 25984A     |
| Fermilab Bubble Chamber Cooling Loops Drawings |                |
| Bubble Condenser Graphic Panel                 | " " 26129A     |
| Target Condenser Graphic Panel                 | " " 26131A     |
| Piston Plenum Heat Exchanger Panel             | " " 26131A     |
| Chamber Skirt & Plenum Graphic Panel           | " " 26132A     |
| Main Chamber, Cone and Window Graphic Panel    | " " 26140      |
| Expansion System Control                       |                |
| Graphic Panel                                  | " " 26138      |
| Bubble Chamber Valves                          |                |
| Graphic Control Panel                          | " " 26150      |

Paul Hernandez  
21 July 1987

Fermilab 15 - ft Bubble Chamber  
Box 5

15-ft Bubble Chamber Drawings

Jacket 38 - Fire Protection System

NAL Drawings

|   |              |
|---|--------------|
| Fire Alarm System Plan Layout                 | PE _ 1       |
| Fire Alarm System Conduit & Wiring Diagram    | PE - 2       |
| Plumbing and Fire Protection Plans & Sections | PM - 10 rev2 |

Pyrotronics company Drawings

|                                |        |             |
|--------------------------------|--------|-------------|
| Nal Wiring Diagram for BC Area | 1 of 2 | EWPC - 1507 |
| " " " " " "                    | 2 of 2 | " "         |

Gus Berthold Electric Co. Drawings

|                              |               |
|------------------------------|---------------|
| Annunciator Panel = 16 Point | 72 - 1078 - 1 |
|------------------------------|---------------|

Viking Fire Protections Company

|                                       |            |
|---------------------------------------|------------|
| Neutrino Lab B, Phase II 1 of 1       | Unnumbered |
| Neutrino Lab B, Phase II 1,2,3,4 of 4 | "          |
| Neutrino Lab A, Under Deck            | "          |
| Air - Neon Compressor Building        | "          |

Krol Engineering Company Report

Fire Protection Survey I of the Neutrino Laboratory, October 18, 1972

Ferrous 15 - Bubble Chamber  
Box 5

Compressor M Oct 23, 1970  
NAL Specifications for the Hydrogen Refrigerator  
Cold Box "H": Dec 3, 1970

•••

Jacket 37 - Hydrogen High Pressure Storage Drawings and Papers

NAL High Pressure Gas Storage Facilities (2 copies) 2625 MD 25561

General American Tank Car Corporation Drawings

High Pressure Gas Cylinders originally mounted on Railroad Cars to carry High Pressure Helium Gas for the dirigibles Akron and Macon. The drawings are dated March 1929.

|  |         |
|--|---------|
| Helium Tank and Flange Assembly                                  | 5- 717  |
| Blind Flange Safety Device End                                   | 2- 3478 |
| Ring Flange  | 2- 3481 |
| Tank Locking Ring  | 2- 3600 |
| Tank Support Ring  | 2- 3605 |
| Tank Anchor Ring   | 2- 3616 |
| Floating End Support   | 4- 1741 |
| Cross Section Helium Gas Tank Car, U.S. Navy                     | 3- 2405 |
| Vogt Flange #2709 for type #2 Helium Valve                       | 2- 3994 |
| Helium Tank Gasket   | 1- 5918 |
| Flange Stud  | 1- 5920 |
| Steel Plug for Tank Car Cylinder, U.S. Bur of Mines (unnumbered) |         |

Related Papers

Recertification of the Railroad Car High Pressure Gas Storage on the 15' Bubble Chamber, memo J. Kilmer to W. Fowler, Dec 29, 1982

Design Handbook for Liquid and Gaseous Helium Handling Equipment, 8 pages describing the Railroad Transport of Gaseous Helium. U.S. Dept of Commerce AD410935.

Specification for Carbon and Alloy Steel Forgings for Pressure Bessel Shells, ASTM Specification SA- 372

Steel Analysis for Railroad Car Cylinders manufactured by the National Tube Company for cars MHAX-1009, MHAX-1010, MHAX-1011, MHAX- 1013, and MHAX-1014. Letter from US Bur of Mines to W. Fowler, Sep 30, 1971.

Steels for Seamless Hydrogen Pressure Vessels, A.W. Loginow and E.H. Phelps,  
Corrosion-Nace, Nov, 1975.

Steels for Hydrogen Service at Elevated Temperatures and Pressures in  
Petroleum Refineries and Petrochemical Plants. American Petroleum Institute  
API Publication 941, July 1970.

/

Paul Hernandez  
20 July 1987

Fermilab 15 - ft Bubble Chamber

Box 5

15-Ft Bubble Chamber Drawings

Jacket 36 Hydrogen Refrigerator Drawings and Specifications

|  |                |
|--|----------------|
| Leak Detector Specification                          | 2629 MB 25159  |
| Valve Welding Specification                          | 2629 MB 25160  |
| Vacuum Jacketed Male Bayonet & Cap, 3/4 x 2          | 2625 MC 25198  |
| "H" Dimensional Data Hydrogen Refrigerator           | 2625 MD 25039  |
| "V - V" Main Hydrogen Vent Stack                     | 2625 MD 25079  |
| Vacuum Jacketed Bayonet Connection, 1/2x2 1/2,       |                |
| 1/2x2 1/2, 1x2 1/2                                   | 2625 MD 25169  |
| " " " " " 1 1/4x3, 1 1/2x3                           | " " 25170      |
| " " " " " 2x5, 2 1/2x5, 3x5                          | " " 25171A     |
| LH2 Chamber Fill Pump, Piping Assembly               | 2621 MD 86432  |
| Modification of W - W Piping for Installation of     |                |
| LH2 Fill Pump  | 2621 MD 86436  |
| Transition Line, Pump Cold Box / Transfer Line "W-W" | 2621 MD 86439  |
| Chamber Fill Pump Assembly                           | 2661 MD 86441  |
| Liquid Hydrogen Storage Tank - A                     | 2625 ME 25035A |
| Hydrogen Engineering Flow Diagram Shut-Down Comp.    | 2625 ME 86674A |
| " " " " " " " "                                      | 2625 ME 86675  |
| Schematic Arrangement of Bubble Chamber Fill Pump    | unnumbered     |

Lotema Corporation Hydrogen Compressor Drawings

|                     |          |
|---------------------|----------|
| General Arrangement | C-0042-1 |
| Foundation Layout   | C-0043-1 |
| P & I Diagram       | C-0046-1 |

NAL Specifications for Liquid Hydrogen Storage Tank "A", Nov 18, 1970

NAL Specifications for a Motor Driven Reciprocating Hydrogen  
Compressor M Oct 23, 1970

NAL Specifications for the Hydrogen Refrigerator  
Cold Box "H": Dec 3, 1970

Paul Hernandez  
20 July 1987

Fermilab 15-ft Bubble Chamber

Box 5

15- ft Bubble Chamber Drawings

Jacket 35 Optical System Drawings

|   |                |
|---|----------------|
| Leak Detecting Specifications                     | 2629 MB 25159  |
| Check Valve Assembly                              | 2627 MD 25799  |
| Optic Window Assembly ( 2 copies )                | 2623 MD 86135  |
| Optical Fish - Eye Assembly ("Section)            | 2623 ME 25250A |
| " " " " #2 Window Flange Section                  | 2623 ME 25256B |
| " " " " " " " Plan                                | 2623 ME 25257  |
| " " " " " " " Machine                             | 2623 ME 25250g |
| Optical Fish _ Eye Port                           | 2623 ME 25437  |
| Optics Vac System - Monitor & Control Schematic   | 2628 EE 26178  |
| Camera Installation Layout (received 28 June 1971 | unnumbered     |
| OPTICS VACUUM SYSTEM SCHEMATIC                    | 2627 MD 25258  |

Paul Hernandez

20 July 1987

Fermilab 15-ft Bubble Chamber

Box 5

15-Ft Bubble Chamber Drawings

Jacket 34 Main Vacuum Tank

Chicago Bridge and Iron Company Drawings

This is a set of 12 drawings for the 22 foot diameter Vacuum Tank. The General arrangement and the fabrication details are shown most are dated October 1970. There is a second set, revision 1 that has a 13th drawing showing the lugs for lifting, dated 12/1/70. These two sets are reduce size about 11 x 17 inches. There is one full size of the General Plan, drawing 1, revision 3.

National Accelerator Laboratory Drawings.

|  |                      |
|--|----------------------|
| <u>Main Vacuum System Schematic</u>                      | <u>2627 MD 25197</u> |
| <u>Vacuum Chamber- Lower Half</u>                        | <u>2627 ME 25002</u> |
| <u>Cylinder and Rod Guide Blank Cover, Upper</u>         | <u>2621 ME 26202</u> |
| <u>Bottom Vacuum Cover Final Detail</u>                  | <u>2627 ME 25224</u> |
| <u>Assembly floor Vacuum &amp; 150 psi Pressure Test</u> | <u>2627 ME 25230</u> |
| <u>Cylinder &amp; Rod Guide Blank Cover - Lower</u>      | <u>2621 MC 26258</u> |
| <u>Manway Window Assembly</u>                            | <u>2621 MC 26312</u> |
| <u>Optical Fish - Eye Port Plug</u>                      | <u>2628 ME25421</u>  |

Paul Hernandez

14 July 1987

Fermilab 15-ft Bubble Chamber

Box 5

15-Ft Bubble Chamber Drawings

Jacket 33 Nal Flow Diagrams & PV-190 Drawings

Hydrogen System, Engineering Flow Diagrams

|                   |   |   |   |   |                |
|-------------------|---|---|---|---|----------------|
| "                 | " | " | " | " | 2625 ME 25050C |
| "                 | " | " | " | " | 25051C         |
| "                 | " | " | " | " | 25052C         |
| "                 | " | " | " | " | 25053C         |
| "                 | " | " | " | " | 25054F         |
| "                 | " | " | " | " | 25055C         |
| Expansion System, | " | " | " | " | 2621 ME 26071B |
| "                 | " | " | " | " | 26072B         |
| Helium System,    | " | " | " | " | 2625 ME 33424B |
| "                 | " | " | " | " | 33425F         |
| "                 | " | " | " | " | 33426G         |
| "                 | " | " | " | " | 33427B         |

The above set of Drawings were current in October, 1978 and are taped together into one long flow sheet. This set is reduced in size. There is also a second partial set in this file that are 34 x 44 inches.

|   |                |
|---|----------------|
| "H", Flow Schematic, Hydrogen Refrigerator            | 2625 MD 25058A |
| General Arrangement, Inter-Connecting Piping, H2 Pump | 33440          |
| Chamber Area-el 730'-0", Piping Plan View             | 2625 ME 33416  |
| Engineering Flow Diagram, Helium System               | 33424          |
| Sub-Assy #5 and Plug & tip assy, B C Valve PV-189     | 2625 MD 33401A |
| Bubble chamber Valve Assembly, PV-189                 | 33402A         |
| Vacuum Sphere, 12" Vent Stack & 18" Manway            | 33445C         |
| Control Schematic for Helium Operated Chamber Valves  | 33462A         |
| 30K liter BC, Vent System, Flow Diagram               | 2625 ME 33488A |
| Main Chamber Relief (PV-190), Flow Diagram            | 2625 MC 33487D |
| Bubble Condenser & Chamber Valve PV -190              | 2625 MD 25092C |
| Flange Details, Bubble Condenser & PV-190             | 25102B         |
| Sub-assemblies 1 & 2, Bubble chamber Valve            | 25103B         |
| Sub-assembly #3, Bubble Condenser & PV -190           | 25104B         |

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## Fermilab 15- ft Bubble Chamber

Box 5

15-Ft Bubble Chamber Drawings

Jacket 32 Chicago Bridge & Iron Company Drawings

30K Liter Weldment, contract 71-2025

|  |           |
|--|-----------|
| General Plate  | Drawing 1 |
| Detail of Shell  | " 2       |
| Shell Plate Detail                                     | " 2A      |
| Reenforcing Cone                                       | " 2B      |
| Expansion Cylinder Flange                              | " 3       |
| Dome and Knuckle Detail                                | " 5       |
| Proposed Cone to Skirt Joint                           | " L08     |
| Camera Mounts 2&3                                      | " 7       |
| " " 1 &4   | " 8       |
| " " 5 &6   | " 9       |
| Condenser Port   | " 10      |
| Beam Window Flange                                     | " 4       |
| Main Sphere , Heat, Slab, Radiograph                   | " HS      |
| As Built Drawing                                       | " AB1     |
| Fabrication Instructions, Outer cone                   | " S4D     |
| " " Sphere Assembly                                    | " S4F     |
| " " " " 1A   | " S4G     |
| " " Camera Nozzle                                      | " S4M     |
| " " Beanie Fabrication                                 | " S4N     |
| " " Nozzles to Head                                    | " S4P,R   |
| " " Cleaning Instructions                              | " S6      |
| Proposed Drilling for 1/8 Hole in Expansion Flange     | " LQ7     |
| Pressure Vessel Record, contract 71-2025, serial B4928 |           |

This report contains:

Manufacturers` Partial Data Report

Heat treat furnace charts

Bolt Chemical Analysis

Material Analysis Certifications

" Test Certifications

Vessel Seam Welder and Radiograph Schedule

Vessel Drawings (reduced copies of some of the above)

A list of Aerospace Material Specifications

The following Fermilab Drawings are also included:

|   |                             |
|---|-----------------------------|
| 30K liter Hydrogeen B. C. Beam Window Asembly | 2621 ME 25305               |
| 30K liter Hydrogen BC,Disc & Support Assembly | 2629 MC 86390               |
| 30K liter Hydrogen BC,Internal Chamber Plates | 2629 MD 86389               |
| Section thru 15 ft BC ,Lexon Disc & Piston    | Engr Note 9-29-78           |
| Beam Support Plate Column                     | Engr Note 4-3-78            |
| Beam Support Column                           | Engr Note 3-24-78           |
| Extension Beam Column Support                 | Engr Note 4-1-78            |
| Cut-away view of 15 ft Bubble Chamber         | " " 4-18-78                 |
| Chamber Plate to Beam Support Attachment      | SK-CP-1.1                   |
| General Layout Chamber Plate Project          | SK-CP-1.3                   |
| Hard Plate and Disc Installation              | unnumbered drawings 12-2-77 |

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Fermilab 15-ft Bubble Chamber

Box 5

15-Ft Bubble Chamber Drawings

Jacket 31 NaI Vessel Drawings

|   |               |
|---|---------------|
| Cyl and Rod Guide Spacer Ring                 | 2621 MC 25248 |
| Lip Seal Section                              | 25336         |
| Chamber Bubble Condenser Port Detail          | 2621 MD 25368 |
| Window Cooling Loop                           | 2625 MD 25089 |
| Pump Loop Heat Exchanger                      | 25091         |
| Bubble Condenser & Valve, PV-190              | 25092         |
| Flange Detail, Condenser & PV-190             | 25102         |
| Sub Assembly 3, Condenser & PV-190            | 25104         |
| Lower Piston Ring Cooling Loop                | 33418         |
| Upper " " " "                                 | 33419         |
| Support Skirt Exchanger                       | 33420         |
| Main & Window Heat Exchanger Mounting Details | 33435         |
| Main Heat Exchanger                           | 2625 ME 25094 |
| Bubble Chamber Head                           | 2521 ME 25134 |
| Cylinder and Rod Guide                        | 25163         |
| Chamber Head                                  | 25171         |
| Stainless Steel Chamber Weldment              | 25172         |
| Chamber Support Assembly                      | 25486         |