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 H₂ 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
-2-


- Allen to Wilson, Safety Responsibility in the Neutrino Laboratory


- 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 Goodzeitdt, 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
- 5 -

- 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
RECORDS TRANSMITTAL

DEPARTMENT/DIVISION

LBL ENGINEERING DIVISION

IN-GROUP-PROJECT

MECHANICAL ENGINEERING DEPARTMENT

PERSON TO CONTACT

PAUL HERNANDEZ

DEPARTMENT HEAD OR DESIGNEE (Signature Required)

TED Korman

RECORDS MANAGEMENT USE ONLY

FILE UNIT CODE

DATE

FILE UNIT CODE

DATE

REVIEW YEAR

REVIEW YEAR

TITLE OF RECORDS OR FILE UNIT

Fermilab 15-foot Liquid Hydrogen Burner Chamber - Box 2

INCLUSIVE DATES

Aug 1970 to July 1987

ARRANGEMENT OF RECORDS

CHRONOLOGICAL

BRIEF DESCRIPTION OF RECORDS

Box 2 contains materials that I collected or wrote while I was the head of Fermilab's 15-foot burner chamber External Safety Committee from August 1970 to present, July 87.

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<td>Correspondence and Additions</td>
<td>To NAL 15 at BC Safety Report</td>
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<td>Burner Site Draft, Operation, Inspections, Appraisal</td>
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</table>
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

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

Bolting Materials

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

Expansion

- NAL Expansion System Drawing List, 1971
- Design Report Modifications per Hernandez, SLAC, December 1971
-2-

- Justification for Using Petroleum Oil as a Driving Media in the Expansion System, R.D. Watt, November 1971

- Stress Analysis Report on Chamber Expansion Piston for NAL 30,000-Liter Hydrogen Bubble Chamber, BR 311-23-001, Brunswick Corporation, November 1971

- Glass Fabric Reinforced Epoxy Laminate Integrally Bonded to a Laminated Wood Core of End Grain Balsa and Fir

- 30,000-Liter Bubble Chamber Valve and Instrument List for Expansion System, March 1972

- Expansion System Initial Start-Up Procedure for the NAL 30,000-Liter Bubble Chamber, SLAC and NAL, March 1972

- 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

- 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
  - Final Report, Received April 22, 1971
- Special Report on Suggested Procedures for Welding Type 316L Stainless Steel for Large Bubble Chamber, BMI, H.W. Mishler, January 29, 1971
- Stainless Steel Plate, NAL, February 1971
- Letter from F.C. Hull, Westinghouse, to Hernandez, Ms for 316L, February 16, 1971
- ASME VIII Div 2, Sections Applicable to Bubble Chamber Vessel Design, April 1971
- Chicago Bridge and Iron, Chamber Vessel Specification and Plate Work Breakdown, February 1971
- 150° Round Stainless Bubble Chamber, Welding Procedure 1421, Chicago Bridge and Iron Company, April 30, 1971
- Shock on Legs
- Impact Tests of Vessel Specimens, BMI, H. Mishler, June 21, 1971
- Chamber Weldment Safety Report, Letter from Fowler to Brooks, AEC, June 9, 1971
- Hydrostatic Test Letter, Vagins to Fowler, October 8, 1971
- CBI Test Reports on Ferrite, McNair, CBI, to Fowler, January 11, 1972
- Chamber Support Skirt Thermal Analysis, Report Workman and Vagins to Fowler, January 12, 1972
- BMI Inspection at NAL on Various Bubble Chamber Components, Vagins to Russ Huson, August 3, 1972
-2-

- Strain Gage Test in Vessel Nose Cone, Hans Kautsky to Fowler, et al, April 30, 1973

- CBI Design Report 12'6"-Diameter 30,000 Liter Hydrogen Bubble Chamber, March 14, 1971


Piston

- Status Letter on Analysis of Piston Assembly, Vagins to Fowler, April 3, 1973

- Piston Seal/Piston Rod Seizing Failure Report, M.W. Morgan, NAL, to R. Huson, February 5, 1973

- Stress Analysis of Expansion Piston (prototype !) 2621 ME-26272 Rev. D, Fiberglass Shell with Stainless Structure, Preliminary Report, July 2, 1973, source unknown, may be BNL

- Balsa Wood Piston Write Up in Materials Engineering
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

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

- NAL Experimental Area 2, Title I Report, September 1970, DUSAf
- Title I Report, Preliminary Design for Neutrino Laboratory, November 1970, DUSAf
- Improved Risk, AEC, 1970
- ANL Wind Roses in Period 1950 - 1964
- Rescue Truck, Protective Clothing, 1971
- Hydrogen Venting System

Old Drafts

- Mostly Old Drafts of Hernandez' Trip Reports

Operation

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

Inspections

- Hydrogen Test Condition Meeting, 15-Foot Bubble Chamber Group and NAL Safety, January 1972

  - Area: Work area control, traffic control, communications.
  - Building: Hydrogen detection, ventilation, motor control center, utilities.
  - Test: Fire out of control, personnel injury, localized hydrogen leak.
15-Foot Bubble Chamber and Liquid Hydrogen Bubble Chamber Safety Reviews, Allen, February 1972

Safety Inspection Punch Lists, Several From October 1972 - May 1973

Safety Review, Zernoski, Brown, February 1973

Appraisal

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

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

AEC, Chicago, General Comments and Recommendations, September 1972

General Comments on AEC Appraisal (draft), Hernandez, September 1972

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.

Fire Drill, May 1973
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.
RECORDS TRANSMITTAL

DEPARTMENT / DIVISION
LBL ENGINEERING DIVISION

IN-GROUP PROJECT
MECHANICAL ENGINEERING DEPARTMENT

PERSON TO CONTACT
PAUL HERNANDEZ

DEPARTMENT HEAD OR DESIGNEE (Signature Required)
TED KOZMAN

FILE UNIT CODE
90 2148

END MANUAL REF
5275

LABEL SCHEDULE REF

CUBIC FEET

RECORDS MANAGEMENT USE ONLY

RECEIVED TO DATE

FILE LOCATION / INCLUSIVE SHELF SPACES

TRANSFERRED TO

FILE ACTIVITY

REVIEW YEAR

INCLUSIVE DATES
JULY 1970 TO JULY 1987

CLASSIFICATION
UNCL.

BRIEF DESCRIPTION OF RECORDS


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THE ABOVE RECORDS WERE RECEIVED AND ARE AVAILABLE FOR REFERENCE.
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 RO

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

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

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 RO

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

The Chamber Piston Shaft Failure Report, BCN-10-GTM, March 27, 1979
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 BEPIS Bubble Chamber Piston Seal Details, Ten Drawings, 1970
FERMILAB 15-FOOT BUBBLE CHAMBER
Box 4

15-Foot Bubble Chamber Flow Diagrams

Hydrogen Engineering Flow Diagram, April 1978, 2625 ME 25050 inc 25055
Engineering Flow Diagram, Helium System, April 1978, 2625 ME 33424 inc 33427
Expansion System Schematic, 717'-6" Elev, April 1978, 2621 ME 26071 and 26072

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

This 1-inch thick book contains:


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.
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)
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
- Main Ring Magnet Insulation, Bob Avery - LBL, April 7, 1972
- 200 Bev Status, Paul Hernandez, November 1972
- AMAX Copper News, OFHC Copper, November 1971
- Procedures for Experimenters, 1977-1978
- Fermilab Safety Handbook
- NAL REP, September 1974
- NAL REP, October 1973
- NAL REP, August 1973
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.
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 laser.

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


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.
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.
## Records Transmittal

### Department/Division
LBL Engineering Division

### Section-Group-Project
Technical Engineering Department

### To Contact
Paul Hernandez

### Records Management Use Only

<table>
<thead>
<tr>
<th>File Unit Code</th>
<th>Date</th>
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<td>BLDG-90 RM 2148</td>
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### Records to Contact

**Ted Kozman**

<table>
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<tr>
<th>Title of Records or File Unit</th>
<th>Arrangement of Records</th>
<th>Brief Description of Records</th>
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<tr>
<td>Fermilab 15-Foot Liquid Hydrogen Bubble Chamber - Box 3</td>
<td>Chronological By Subject</td>
<td>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.</td>
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### Arrangement of Records

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<tr>
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<td>Magnet, Optics and Gas Storage</td>
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<td>9</td>
<td>Refrigerator</td>
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<td>10</td>
<td>15-Ft Cooling Loop Calculation</td>
</tr>
<tr>
<td>11</td>
<td>Operating Instructions</td>
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<td>12</td>
<td>Emergency Procedures</td>
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<td>13</td>
<td>NAL Targets</td>
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<td>Trip/Monthly Reports</td>
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<td>Safety Review Meetings</td>
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### Inclusive Dates

| Inclusive Dates | Jan 1970 - Jul 1987 |

### Notes

- The above records were received and are available for reference.
- See reverse side for disposal certificate.
- (Signature of Records Center Head or Designee) (Date)
These are a random selection of topics going through the 3/8-inch thick book from back to front.

Magnet

- 12-Foot Hydrogen Bubble Chamber, Superconducting Magnet, Failure Mode Analysis, Argonne National Laboratory, D.L. Hillis, June 1969
- 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.)
- A Superconducting Magnet System for the NAL 30,000-liter Bubble Chamber, ANL, December 1970
- 15-Foot Bubble Chamber Magnet Test, December 1972
- 15-Foot Bubble Chamber SC Magnet Liquid Helium Tested to 62.5 psig, Kautzky, February 1973
- Limits on Human Exposure in Static Magnetic Field, W. Panosky, SLAC, May 6, 1970
- Sterns-Roger Design Calculation for Magnet Cryostat, Reviewed by Battelle, November 1970

Optics

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

Book 9, Refrigerator

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

Refrigeration

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

Operating Procedures

- 15-Foot Bubble Chamber Emergency Procedure (draft), 53 pages, March 1973
Book 10, 15-Foot Cooling Loop Calculation

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
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
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
Book 13, NAL Targets

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

- Hydrogen Safety in the Beam Transport Enclosure, NAL, (draft), 1971
- Lynn Stevenson's Proportional Counters in 15-Foot Bubble Chamber Main Vacuum, Hernandez, August 1971
These are a random selection of topics going through the 1 1/2-inch thick book from back to front.

Monthly Reports

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

Trip Reports

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

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

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

- Bubble Chamber Safety Review Committee, Fifth Meeting, October 29, 1982 (10th meeting in old series)
- Bubble Chamber Safety Review Committee, Sixth Meeting, December 8-9, 1983 (11th meeting in old series)
These are a random selection of topics going through the 1 3/4-inch thick book from back to front.

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

DEPARTMENT/DIVISION

BL ENGINEERING DIVISION

PROJECT GROUP

MECHANICAL ENGINEERING DEPARTMENT

PERSON TO CONTACT

PAUL HERNANDEZ

DEPARTMENT HEAD/ENGINEER (Signature Required)

TOD KOSIN

RECORDS MANAGEMENT USE ONLY

FILE UNIT CODE

AM FILE UNIT CODE

AM 2148

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EXT.

LOT SCHEDULE REF

CURRIC FLEET

DATE

20 JUL 1987

FILE LOCATION/INCLUSIVE SHELF SPACES

TRANSFERRED TO

DATE

RECEIPT PERIOD

REVIEW YEAR

TITLE OF RECORDS OR FILE UNIT

FERMILAB 15-FOOT LIQUID HYDROGEN BUDDLE CHAMBER - BOX 5

INCLUSIVE DATES

AUG 1970 TO JULY 1987

CLASSIFICATION

☑ UNCL. ☐ CLASS.

CHRONOLOGICAL SUBJECT

ARRANGEMENT RECORDS

BRIEF DESCRIPTION OF RECORDS

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

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<td>CHICAGO BRIDGE &amp; IRON ORES</td>
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<td>NA 5 DRAWINGS &amp; PV-170 DRAWINGS</td>
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<td>MAIN VACUUM TANK</td>
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<td>OPTICAL SYSTEM DRAWINGS &amp; SPECS</td>
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<td>HYDROGEN REFRIGERATOR</td>
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<td>HIGH PRESSURE GAS STORAGE FAC</td>
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<td>FIRE PROTECTION SYSTEM</td>
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<td>39</td>
<td>CONTROL ROOM DRAWINGS &amp; PAGES</td>
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<tr>
<td>40</td>
<td>SITE LAYOUT &amp; BUILDING ARRANGEMENTS &amp;</td>
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ALSO INCLUDED IN BOX 5 ARE DRAWINGS AND REPORTS I COLLECTED DURING
THE 1950'S AND 1960'S WHEN I WAS PROJECT ENGINEER FOR ALVAREZ.

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<td>BRITISH BUDDLE CHAMBER NOTES</td>
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<td>42</td>
<td>CERN 2.5 BUDDLE CHAMBER DRAWINGS &amp; REPORTS</td>
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<td>43</td>
<td>A FEW NOTES</td>
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<td>FRENCH BUDDLE CHAMBER</td>
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<td>RUSSIAN 1-5 BUDDLE CHAMBER REPORT &amp; DRAWINGS</td>
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</tbody>
</table>
Russian Bubble Chambers

Box 5

Jacket 44, Russian report and drawings

Russian Chamber drawings of an LBL look-a-like

- 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.
  - Chamber assembly section
  - "side and end elevation
  - Expansion Piston cross section
  - Chamber assembly end section

Nikitin's 25 cm Hydrogen Bubble Chamber

- Liquid Hydrogen Bubble Chamber with a diameter of 25 cm.

4-inch (approximate) Chamber

- 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.
French Bubble Chambers

Box 5

Jacket 43. French Bubble Chamber a few notes

- Saclay 81 cm hydrogen bubble chamber report, possibly Cern Courier
- Etude sur les possibilites de construction et l'interet d'une chambre mixte a haut tauz de repetition. 1 September 1965, DESY, CEA, CERN
- 2 letters to Hernandez from Saclay/
- Chambre a bulles de 35 cm corps, section, 18 Mar 1958 801
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 DC 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
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
Magnet specification for Helium Bubble Chamber Refrigerator

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.
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 Booklet
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)
Fermilab 15 - ft Bubble Chamber
Box 5

15 ft Bubble Chamber Drawings

**Jacket 40 = Building Arrangement and Site Layout**

<table>
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<th>Document Title</th>
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<tr>
<td>Bubble Chamber General Assembly, Illustration</td>
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<td>Neutrino Beam Line</td>
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<td>Site Plan</td>
<td>2625 ME 25027</td>
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<tr>
<td>Neutrino Beam Line Berms &amp; Structures</td>
<td>2961 ME 30368</td>
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<td>Neutrino II Fence Site Plan</td>
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<td>Neutrino Lab - Phase V Area Plan</td>
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<td>&quot; &quot; &quot; &quot; Compressor Bldg Plan</td>
<td>PA - 4</td>
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<td>Neutrino Labs &quot;A&quot; &amp; &quot;B&quot; Plan View</td>
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<td>Lab &quot;B&quot; Site Plan</td>
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<td>Bubble Chamber Building Cross Section</td>
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<td>Bubble Chamber Works Area</td>
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<td>Barry Controls Isolation Element Report</td>
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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 1 of the Neutrino Laboratory, October 18, 1972
Compressor M  
NAL Specifications for the Hydrogen Refrigerator  
Cold Box 'H':

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

<table>
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<tr>
<td>Ring Flange</td>
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<tr>
<td>Tank Locking Ring</td>
<td>2- 3600</td>
</tr>
<tr>
<td>Tank Support Ring</td>
<td>2- 3605</td>
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<tr>
<td>Tank Anchor Ring</td>
<td>2- 3616</td>
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<tr>
<td>Floating End Support</td>
<td>4- 1741</td>
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<td>Cross Section Helium Gas Tank Car, U.S. Navy</td>
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<td>Vogt Flange #2709 for type #2 Helium Valve</td>
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<td>Helium Tank Gasket</td>
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<td>Flange Stud</td>
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<td>Steel Plug for Tank Car Cylinder, U.S. Bur of Mines (unnumbered)</td>
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Related Papers

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


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


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, 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
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
Fermilab 15-ft Bubble Chamber

Box 5

15-ft Bubble Chamber Drawings

Jacket 35 Optical System Drawings
Leak Detecting Specifications
Check Valve Assembly
Optic Window Assembly (2 copies)
Optical Fish - Eye Assembly ("Section")
  
  "  "  "  "  ,#2 Window Flange Section
  "  "  "  "  "  "  Plan
  "  "  "  "  "  "  Machine
Optical Fish - Eye Port
Optics Vac System - Monitor & Control Schematic
Camera Installation Layout (received 28 June 1971)
Optics Vacuum System Schematic
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 revision 3.

National Accelerator Laboratory Drawings

Main Vacuum System Schematic 2627 MD 25197
Vacuum Chamber - Lower Half 2627 ME 25002
Cylinder and Rod Guide Blank Cover, Upper 2621 ME 26202
Bottom Vacuum Cover Final Detail 2627 ME 25224
Assembly for Vacuum & 150 psi Pressure Test 2627 ME 25230
Cylinder & Rod Guide Blank Cover - Lower 2621 MC 26258
Manway Window Assembly 2621 MC 26312
Optical Fish - Eye Port Plug 2628 ME 25421
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

<table>
<thead>
<tr>
<th>Description</th>
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Helium System,

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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

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<tbody>
<tr>
<td>General Arrangement, Inter-Connecting Piping, H2 Pump</td>
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<tr>
<td>Chamber Area-el 730'-0&quot;, Piping Plan View</td>
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<tr>
<td>Engineering Flow Diagram, Helium System</td>
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<td>Subb-Assy #5 and Plug &amp; tip assy, B C Valve PV-189</td>
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<td>Bubble chamber Valve Assembly, PV-189</td>
<td>2625 MD 33401A</td>
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<tr>
<td>Vacuum Sphere, 12&quot; Vent Stack &amp; 18&quot; Manway</td>
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<td>Control Schematic for Helium Operated Chamber Valves</td>
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<td>30K liter BC, Vent System, Flow Diagram</td>
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<td>Main Chamber Relief (PV-190), Flow Diagram</td>
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<td>Bubble Condenser &amp; Chamber Valve PV-190</td>
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<td>Sub-assembly #3, Bubble Condenser &amp; PV-190</td>
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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

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<thead>
<tr>
<th>Drawing</th>
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<tr>
<td>1</td>
<td>General Plate</td>
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<td>Detail of Shell</td>
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<td>2A</td>
<td>Shell Plate Detail</td>
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<td>2B</td>
<td>Reinforcing Cone</td>
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<td>3</td>
<td>Expansion Cylinder Flange</td>
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<td>5</td>
<td>Dome and Knuckle Detail</td>
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<tr>
<td>LQ8</td>
<td>Proposed Cone to Skirt Joint</td>
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<tr>
<td>7</td>
<td>Camera Mounts 2 &amp; 3</td>
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<td>10</td>
<td>Condenser Port</td>
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<td>4</td>
<td>Beam Window Flange</td>
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<tr>
<td>HS</td>
<td>Main Sphere, Heat, Slab, Radiograph</td>
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<tr>
<td>AB 1</td>
<td>As Built Drawing</td>
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<td>S4D</td>
<td>Fabrication Instructions, Outer cone</td>
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<td>&quot; Sphere Assembly</td>
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<td>S4M</td>
<td>&quot; Camera Nozzle</td>
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<td>S4N</td>
<td>&quot; Beanie Fabrication</td>
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<td>S4P, R</td>
<td>&quot; Nozzles to Head</td>
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<td>S6</td>
<td>&quot; Cleaning Instructions</td>
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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 Hydrogen B.C. Beam Window Assembly 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 Engr Note 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
Fermilab 15-ft Bubble Chamber
Box 5

15-Ft Bubble Chamber Drawings

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<td>Jacket 31 Nal Vessel Drawings</td>
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<tr>
<td>Cyl and Rod Guide Spacer Ring</td>
<td>2621 MC 25248</td>
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<tr>
<td>Lip Seal Section</td>
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<tr>
<td>Chamber Bubble Condenser Port Detail</td>
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<td>Window Cooling Loop</td>
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<td>Pump Loop Heat Exchanger</td>
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<tr>
<td>Bubble Condenser &amp; Valve, PV-190</td>
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<td>Lower Piston Ring Cooling Loop</td>
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<td>Upper</td>
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<td>Support Skirt Exchanger</td>
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<td>Main &amp; Window Heat Exchanger Mounting Details</td>
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<td>Bubble Chamber Head</td>
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<td>Stainless Steel Chamber Weldment</td>
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<td>Chamber Support Assembly</td>
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Paul Hernandez
7 July 1987