

# CIVIL CONSTRUCTION

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Fred Asiri

NSF Review May 22, 1995

# OVERVIEW

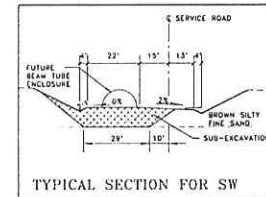
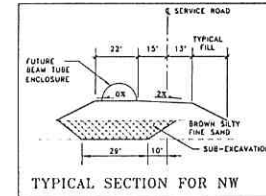
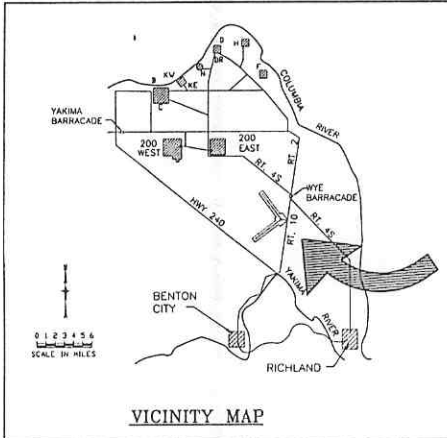
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- **ACTIVITY PROGRESS UPDATE**
  - HANFORD, WASHINGTON SITE
  - LIVINGSTON, LOUISIANA SITE
  - FACILITY AND BEAM TUBE ENCLOSURE DESIGN & CONSTRUCTION MANAGEMENT
- **BUDGET VS PERFORMANCE VS ACTUAL**
  - BEAM TUBE ENCLOSURE
  - FACILITY
- **PROJECT SCHEDULE**
  - BEAM TUBE ENCLOSURE
  - FACILITY



# LIGO SITE - HANFORD

## PROJECT AREA



**NOTES:**

ALL DISTANCES AND COORDINATES ARE SHOWN AS STATE PLANE HORIZONTAL DATUM: WASHINGTON STATE PLANE LAMBERT SOUTH ZONE NAD 83/91

PROJECT VERTICAL DATUM: NAVD 88

BENCH MARK "MCKINLEY" METERS NAVD 88 METERS HVD 29  
171.837 170.806

(AVG LAT. 46°27'25.68") GRID FACTOR 0.999917130

(AVG ELEV. 532.80) SEA LEVEL FACTOR 0.999974515

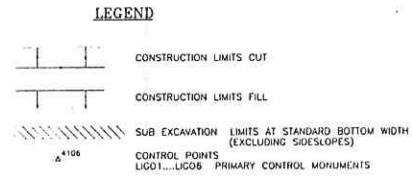
COMBINED PROJECT SCALE FACTOR = 0.999991645

STATE PLANE 999 891645' = 1000.000' MEASURED GROUND

FOR BORING TEST INFORMATION SEE DAMES AND MOORE "REPORT OF GEOTECHNICAL SURVEY LIGO PROJECT HANFORD, WASHINGTON FOR CALIFORNIA INSTITUTE OF TECHNOLOGY"

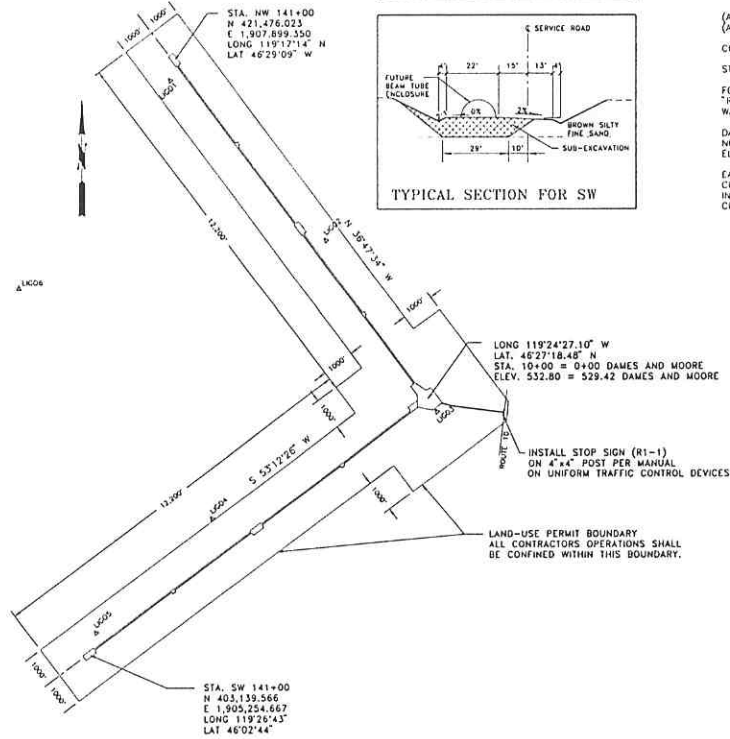
DAMES AND MOORE REPORT IS BASED ON THE VERTICAL DATUM NAVD 1929. ADD 3.38 FEET TO THE DAMES AND MOORE ELEVATIONS TO CONVERT TO PROJECT DATUM.

EARTHWORK QUANTITIES ARE BASED ON AN 85% COMPACTION FACTOR OF 1.20. QUANTITIES ARE PROVIDED FOR INFORMATION ONLY AND IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY.



**NOTE**  
THE LOCATION OF ALL EXISTING UNDERGROUND UTILITIES IS SHOWN BY AN APPROXIMATE BAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. HE AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

**CALL 48 HOURS BEFORE YOU DIG  
1-800-424-5668**



**CONTROL POINTS AS SHOWN ON PLAN**

POINT	NORTH	EAST
4000	416265.451	191545.237
4007	410449.107	1915022.944
4003	409729.950	1914005.815
4004	408670.910	1913637.021
4005	408225.783	1912800.531
4006	407920.423	1911663.060
4007	407198.728	1911546.609
4008	407031.368	1910438.202
4010	406286.850	1909450.003
4011	405186.964	1909531.270
4012	405341.443	1908203.406
4013	404518.240	1907068.256
4014	403549.004	1907209.175
4015	403781.623	1906805.329
4017	402078.915	1905071.492
4100	411810.531	1915803.899
4101	411945.186	1915020.461
4102	413009.295	1915150.441
4103	412908.311	1914308.263
4104	413866.547	1913550.146
4105	414258.279	1913440.958
4106	415308.747	1912511.804
4108	416272.219	1911281.271
4109	416775.825	1912107.242
4110	416809.184	1911250.031
4111	418040.331	1911044.984
4112	417709.687	1910713.540
4113	418871.241	1910010.331
4114	419821.205	1910012.479
4115	419871.848	1909201.890
4116	420844.053	1908201.665
4117	420974.351	1909114.030
4118	421259.613	1907837.330
4201	421113.464	1907424.030
4202	416184.285	1912528.087
4203	416647.803	1916004.284
4204	407401.131	1909613.125
4205	403900.639	1905770.659
4206	413750.547	1904062.124

**JUB**  
J-U-B ENGINEERS, INC.  
Engineers Surveyors Planners  
KENNICK, WASHINGTON

Scale: AS SHOWN  
Date: SEPTEMBER 28, 1993  
Sheet: 1 OF 13

# CIVIL CONSTRUCTION

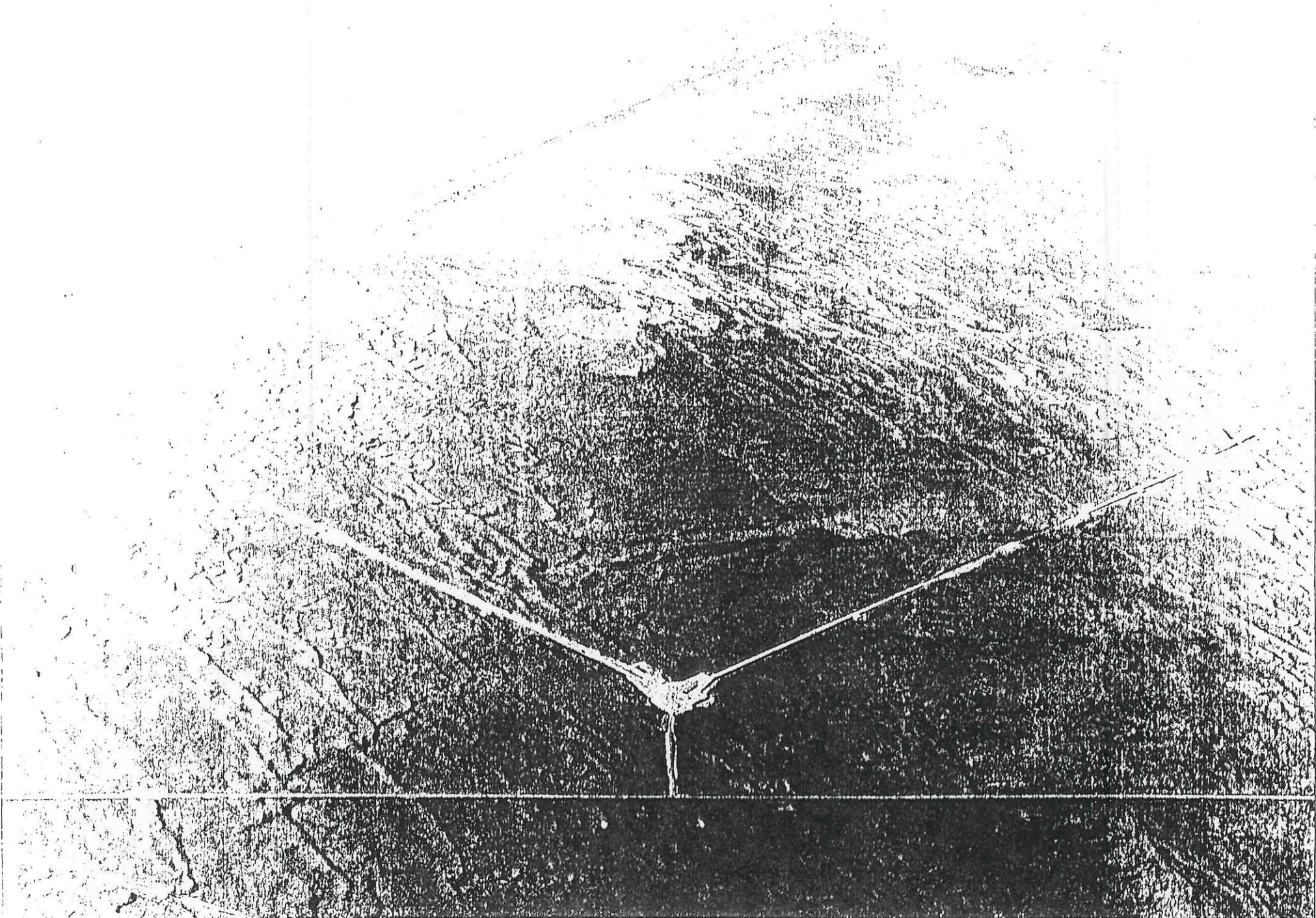
## ACTIVITY PROGRESS UPDATE

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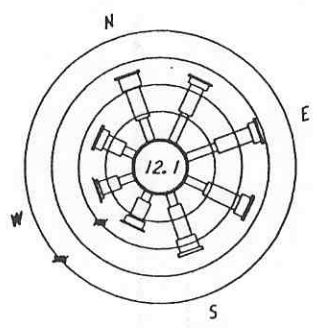
### HANFORD, WASHINGTON SITE

- SITE INVESTIGATION STUDIES / REPORTS ARE COMPLETED
- AMBIENT GROUND NOISE MEASUREMENT IS COMPLETED
- CONSTRUCTION OF SITE ROUGH GRADING IS COMPLETED WITHIN THE BUDGET COST
  - CONSTRUCTION WAS DONE BY SELAND CONSTRUCTION
  - GEOTECHNICAL FIELD MONITORING WAS DONE BY DAMES & MOORE
  - CONSTRUCTION MANAGEMENT TASK WAS PERFORMED BY J-U-B ENGINEERS

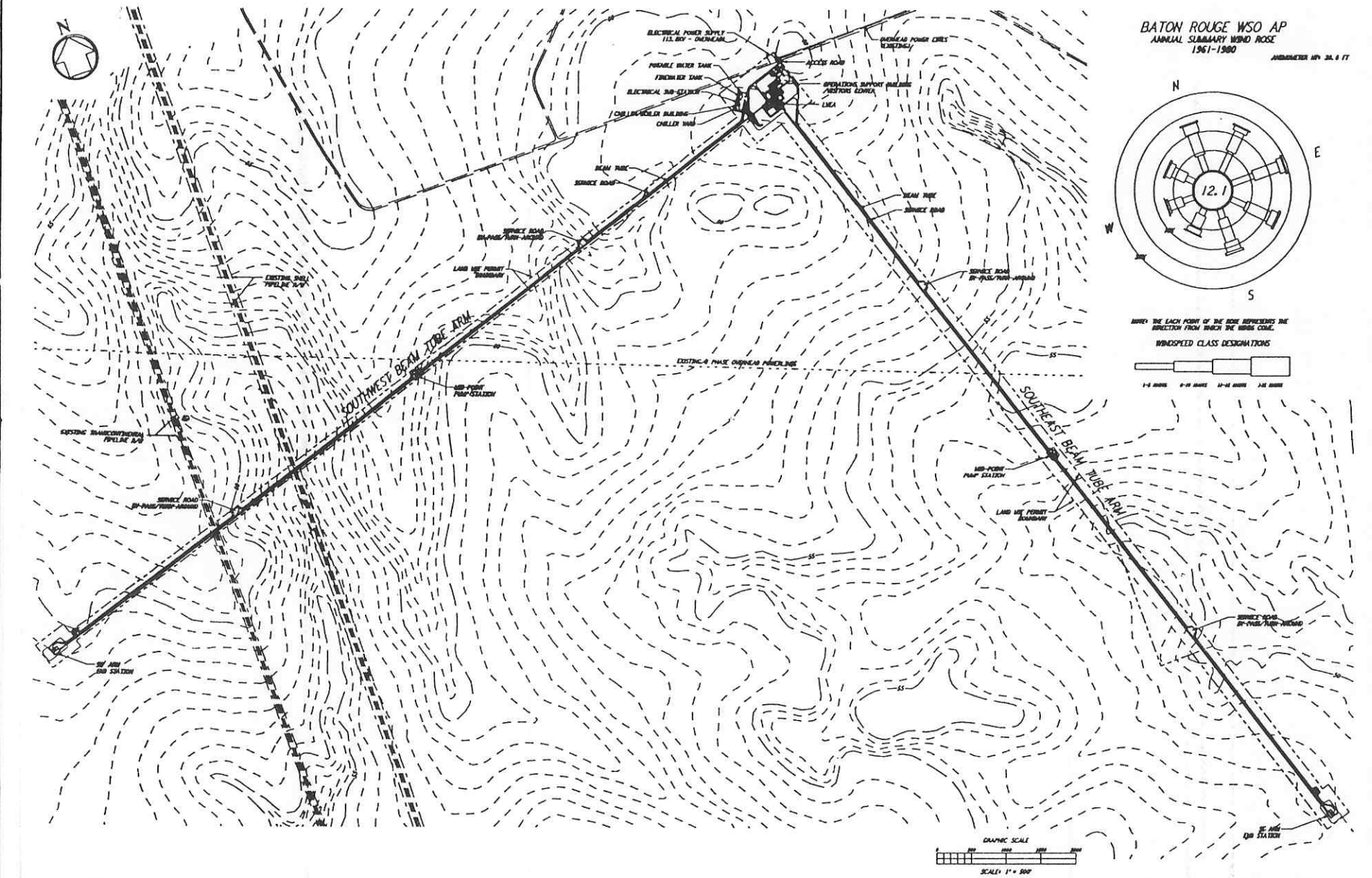
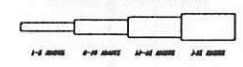




**BATON ROUGE WSO AP**  
 ANNUAL SUMMARY WIND ROSE  
 1961-1990  
 ANEMOMETER HP: 20.6 FT



AROUND EACH POINT OF THE ROSE REPRESENTS THE DIRECTION FROM WHICH THE WINDS COME.



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9				DATE	4-14-95
8				ISSUED BY	HPB
7				CHECKED	
6				DESIGN NO.	
5				PROJ. MGR.	
4				CLIENT	
3					
2					
1					
	DATE	APPROVED BY	DESCRIPTION OF REVISION		
	4-14-95		FOR CONCEPTUAL REVIEW		

9					
8					
7					
6					
5					
4					
3					
2					
1					
	DATE	APPROVED BY	DESCRIPTION OF REVISION		
	4-14-95		FOR CONCEPTUAL REVIEW		

**PARSONS**  
 100 WEST WALNUT STREET  
 PASADENA, CALIFORNIA

**LIGO**  
 CALIFORNIA INSTITUTE OF TECHNOLOGY  
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LASER INTERFEROMETER  
 GRAVITATIONAL-WAVE OBSERVATORY  
 SITE NO. 2 - LIVINGSTON, LOUISIANA

OFFICE: 1"=500' PPI150963 B094

OVERALL SITE PLAN

LA-88K-100

5

4

3

2

1

# CIVIL CONSTRUCTION

## ACTIVITY PROGRESS UPDATE (cont'd)

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### LIVINGSTON, LOUISIANA SITE

#### SITE INVESTIGATION

- WETLAND DELINEATION, SECTION 404 OF CLEAN WATER ACT (PERMIT WAS OBTAINED IN DEC. 1994)
- ENVIRONMENTAL ASSESSMENT (FINDING OF NO SIGNIFICANT IMPACT WAS SIGNED IN MARCH 1995)
- FINAL GEOTECHNICAL REPORT WAS COMPLETED IN JANUARY 1995
- FINAL HYDROLOGIC & HYDRAULIC REPORT WAS ISSUED IN MARCH 1995
- PIPELINE CROSSINGS
  - CONCEPTUAL DESIGNS FOR PIPELINE CROSSINGS WERE PREPARED BY WOODWARD-CLYDE
  - CONCEPTS WERE REVIEWED AND COMMENTED BY EAGLETON ENGINEERING COMPANY
  - DESIGN OPTIONS WERE REVIEWED AND CHOICES WERE MADE WITH SHELL PIPELINE COMPANY



# CIVIL CONSTRUCTION

## ACTIVITY PROGRESS UPDATE (cont'd)

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### SITE IMPROVEMENT

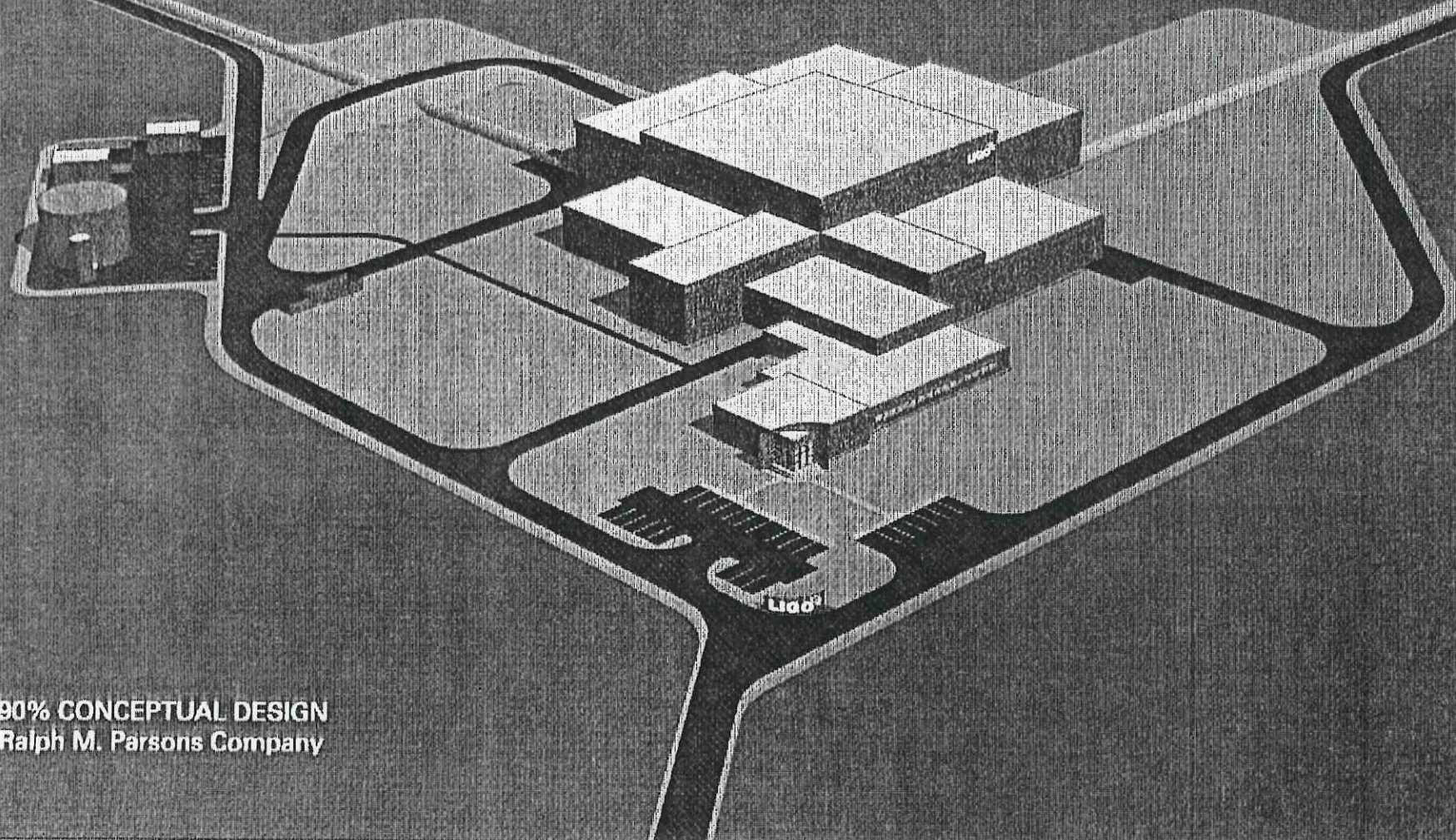
- **LAND CLEARING**

- **REQUEST FOR PROPOSAL WAS ISSUED IN FEBRUARY 1995**
- **PROPOSALS RECEIVED IN MARCH 1995**
- **REQUEST FOR BID ADJUSTMENTS WAS RELEASED ON MARCH 16, 1995**
- **ADJUSTED BIDS WERE RECEIVED IN APRIL 1995**
- **SELECTION OF CONTRACTOR WAS COMPLETED BY MAY 5, 1995**
- **CURRENTLY, CONTRACT IS OUT FOR APPROVAL BY NSF**
- **WORK IS PLANNED TO START BY JUNE 1995**





CALIFORNIA INSTITUTE OF TECHNOLOGY  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
**LASER INTERFEROMETER  
GRAVITATIONAL-WAVE OBSERVATORY**



90% CONCEPTUAL DESIGN  
Ralph M. Parsons Company

# ACTIVITY PROGRESS UPDATE

## FACILITY DESIGN & CONSTRUCTION MANAGEMENT

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- PROPOSALS WERE RECEIVED ON SEPT. 23, 1994
- SELECTION OF THE ARCHITECT-ENGINEER (AE) FIRM WAS COMPLETED ON NOV. 8, 1994
- NSF APPROVED SELECTION OF THE RALPH M. PARSONS COMPANY AS THE AE ON FIRST WEEK OF JAN. 1995
- ADVANCED NOTICE TO PROCEED WAS ISSUED TO THE RALPH M. PARSONS ON DEC. 6, 1994
- PROJECT KICK-OFF MEETING TOOK PLACE ON JAN. 10, 1995
- THE CONCEPT DESIGN PHASE (PHASE A) FOR FACILITY AND BEAM TUBE ENCLOSURE BEGAN ON JAN. 10, 1995 AND SCHEDULED FOR COMPLETION ON JUNE 30, 1995
- PRELIMINARY DESIGN FOR ROUGH GRADING AND DRAINAGE SYSTEM FOR LIVINGSTON SITE HAS BEEN INITIATED



# SUMMARY OF MILESTONES AND EVENTS FOR THE FACILITY CONCEPT DESIGN PHASE FOR PERIOD ENDING MAY 22, 1995

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MILESTONE / EVENTS	COMPLETED	REMARKS
<b>Design Configuration Control Document (DCCD) Submittal</b>	<b>2/10/95</b>	<b>Requirement Definition</b>
<b>DCCD Review by LIGO</b>	<b>2/27/95</b>	<b>Intense LIGO Participation</b>
<b>60% Concept Presentation</b>	<b>3/17/95</b>	
<b>90% Concept Design Submittal</b>	<b>4/14/95</b>	<b>Estimate Submitted on 4/21</b>
<b>90% Concept Design Review by LIGO</b>	<b>4/25/95</b>	
<b>Directive for Facility Trade Studies</b>	<b>4/28/95</b>	
<b>Concept Design Trade Studies Report</b>	<b>(Due 5/26/95)</b>	



# SUMMARY OF MILESTONES AND EVENTS FOR THE BEAM TUBE ENCLOSURE CONCEPT DESIGN PHASE FOR PERIOD ENDING MAY 22, 1995

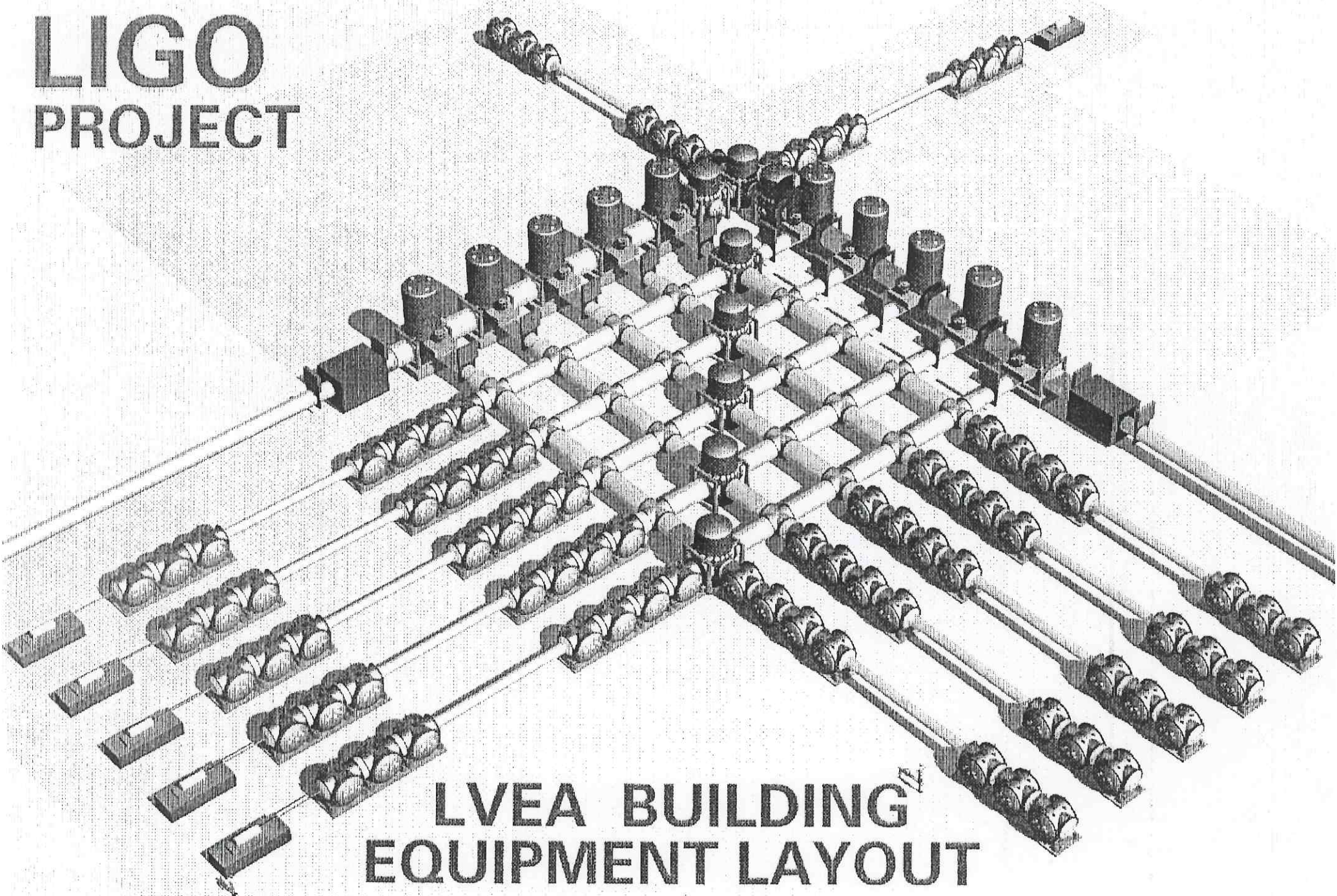
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MILESTONE / EVENTS	COMPLETED	REMARKS
Concept Design for Beam Tube Enclosure (BTE)	2/24/95	
BTE Concept Design Review by LIGO	3/9/95	
Trade Study Recommendation for BTE	3/24/95	Study Four Alternates
Directive for BTE Trade Study	3/31/95	
BTE Trade Study Report	4/30/95	
Trade Study Evaluation and Disposition	5/8/95	
Directive on Trade Study Issued	5/9/95	



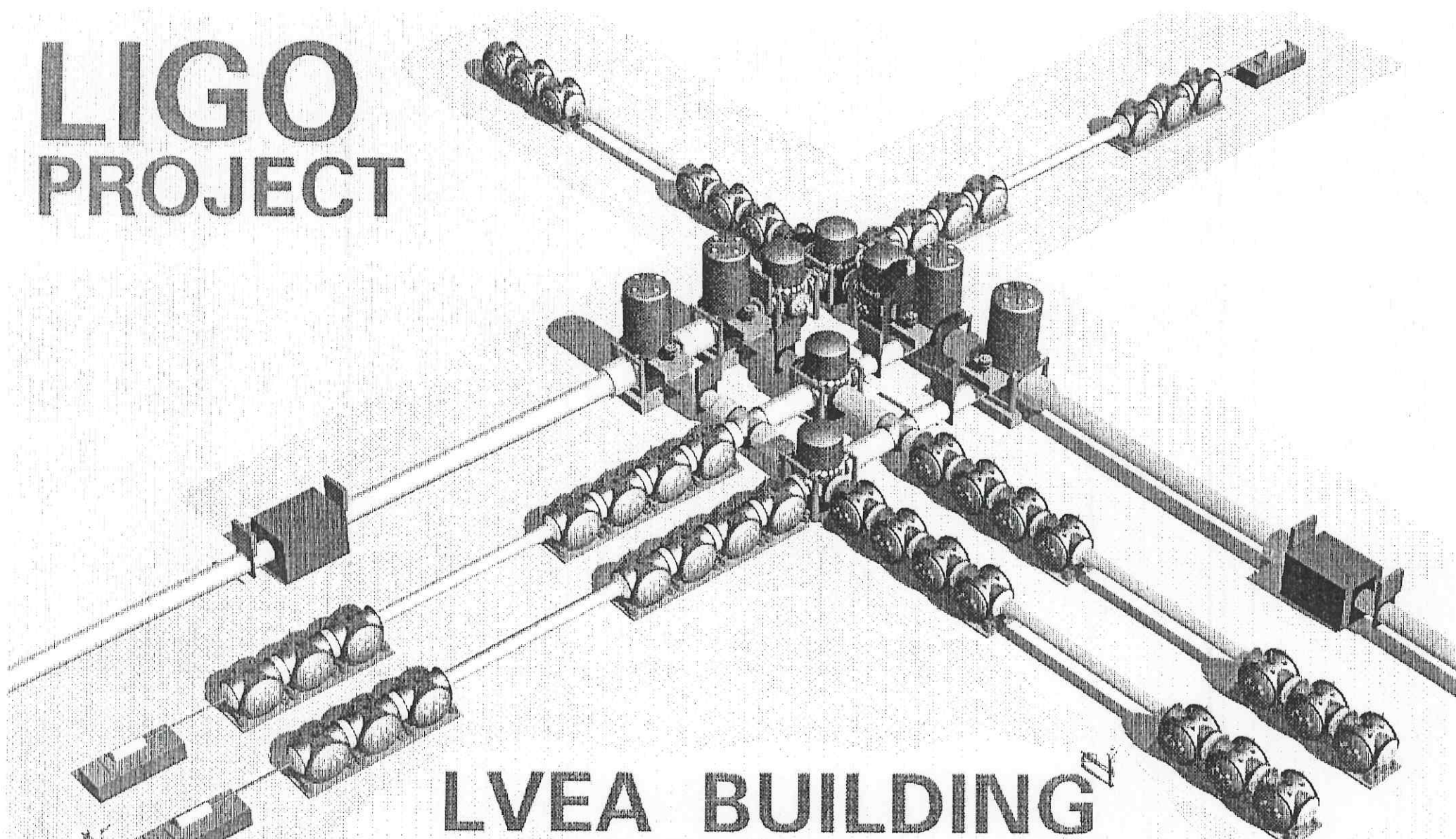


# LIGO PROJECT

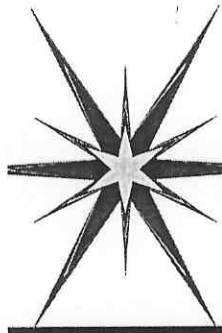


## LVEA BUILDING EQUIPMENT LAYOUT

# LIGO PROJECT

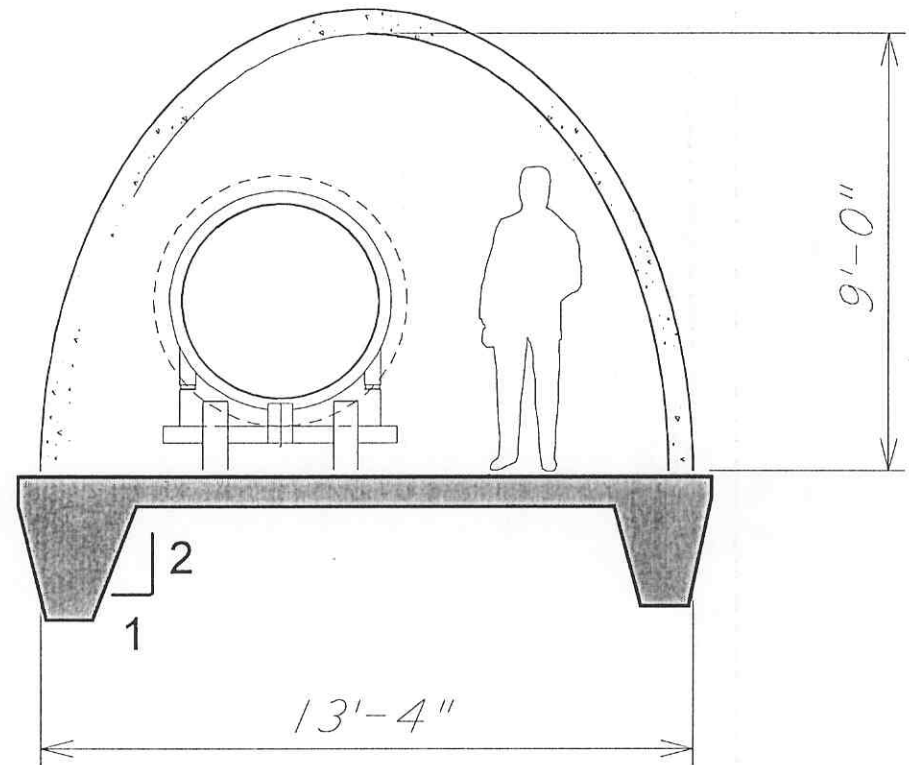


## LVEA BUILDING EQUIPMENT LAYOUT



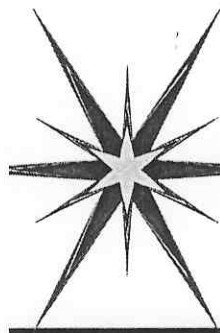
# Beam Tube Enclosure Alternates

- ▶ Continuous Concrete Slab (w/ expansion Jt.)
- ▶ Best RAM Rating
- ▶ \$7.1 Million (Direct)
- ▶ Beam Tube is 100% Accessible
- ▶ Low Life-Cycle Cost



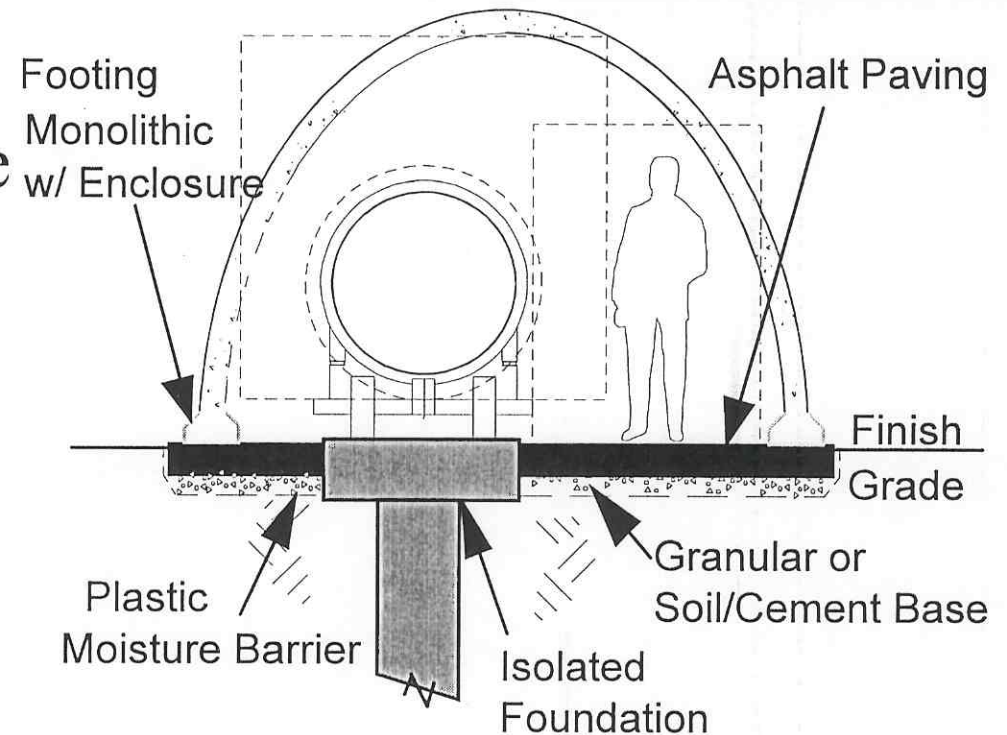
Alternate 1



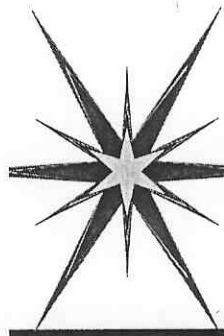


# Beam Tube Enclosure Alternates

- Isolated Foundation Support of Beam Tube
- Asphalt Paving Floor and Support of Enclosure Segments
- \$6.8 Million (Direct)

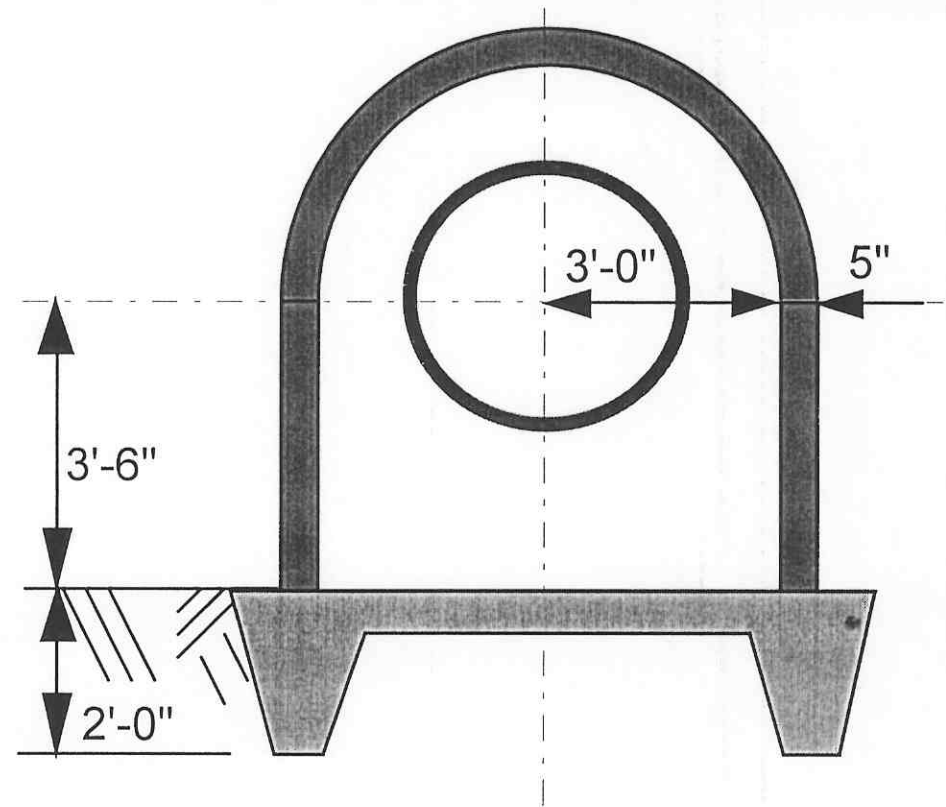


Alternate 2

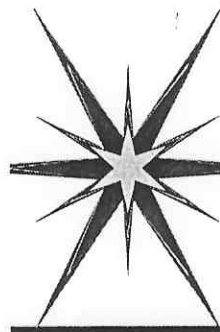


# Beam Tube Enclosure Alternates

- Continuous Concrete Slab
- Beam Tube is Accessible at Vacuum Ports Only (Removal Required for Other Areas)
- \$5.2 Million (Direct)
- High Life-Cycle Cost and Risk to BT

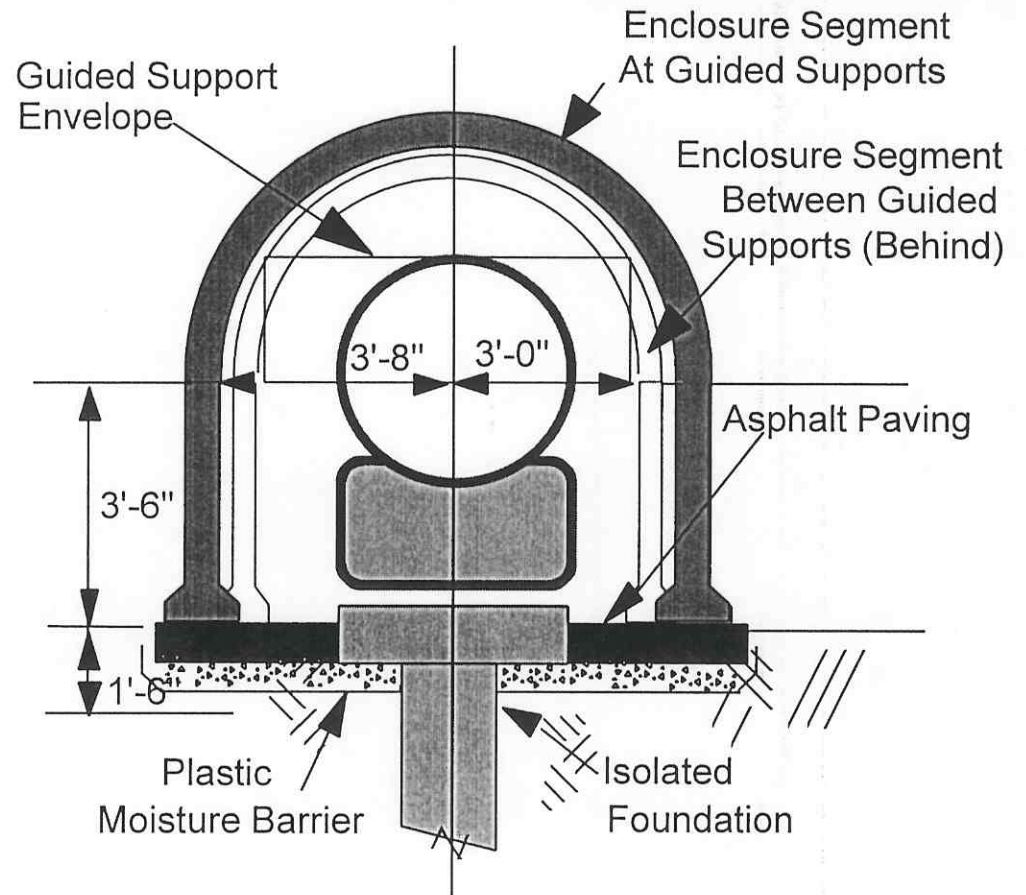


Alternate 3



# Beam Tube Enclosure Alternates

- Isolated Foundation for Beam Tube
- Asphalt Paving Floor and Support of Enclosure Segments
- \$5 Million (Direct)
- Low RAM Rating
- High Life-Cycle Cost & Risk to Beam Tube



Alternate 4

# SUMMARY

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- **HANFORD SITE**

- **SITE CHARACTERIZATION IS COMPLETED**
- **CONSTRUCTION OF ROUGH GRADING IS COMPLETED**

- **LIVINGSTON SITE**

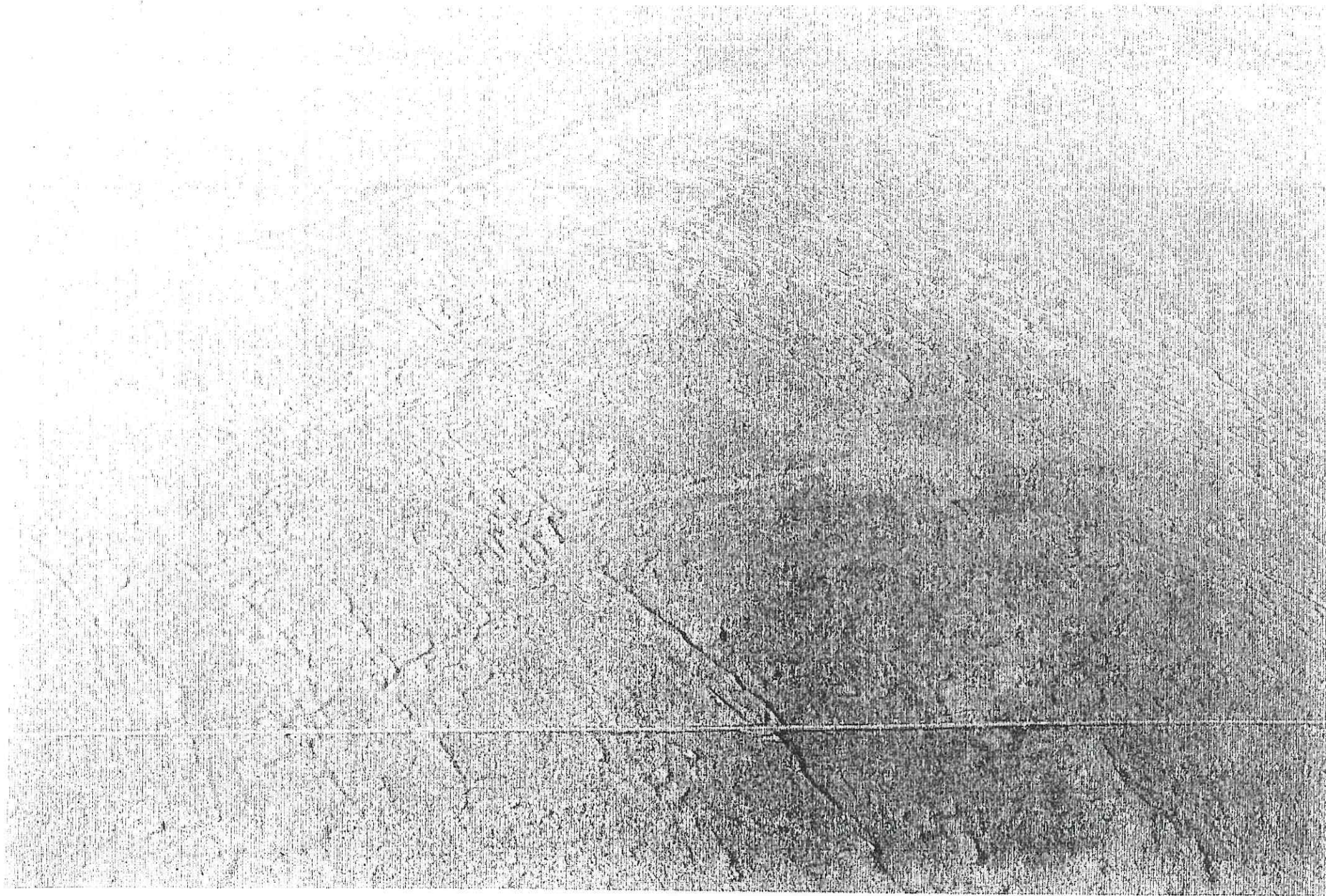
- **SITE CHARACTERIZATION IS COMPLETED**
- **PERMIT FOR SECTION 494 OF CLEAN WATER ACT HAS BEEN OBTAINED**
- **FINDING OF NO SIGNIFICANT IMPACT HAS BEEN SIGNED**
- **PIPELINE CROSSING OPTIONS HAVE BEEN FINALIZED WITH 2 OF 3 PIPELINE COMPANIES**
- **PRELIMINARY DESIGN OF ROUGH GRADING AND DRAINAGE SYSTEM HAS BEEN INITIATED**
- **“CLEARING AND GRUBBING” CONTRACTOR IS SELECTED**

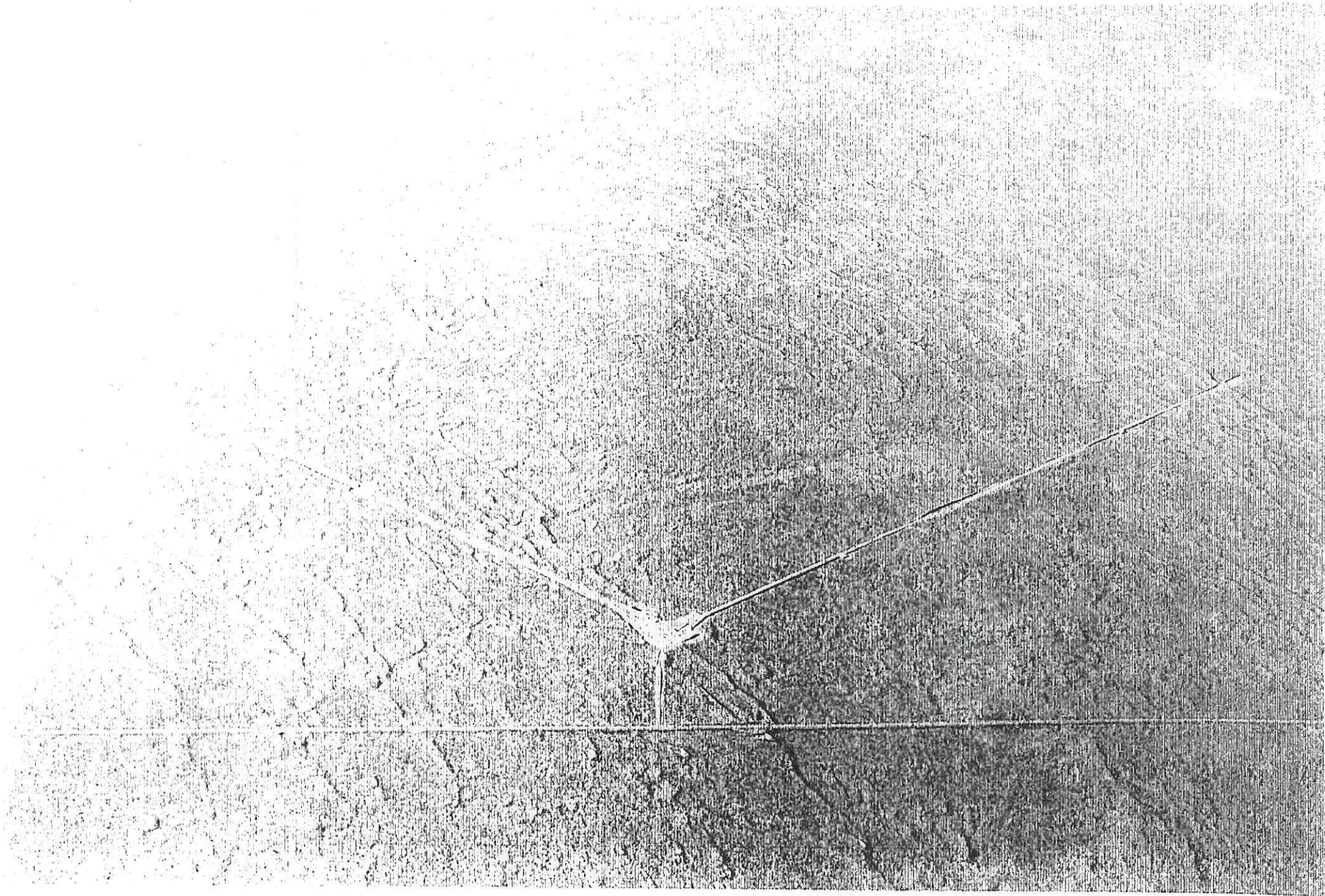


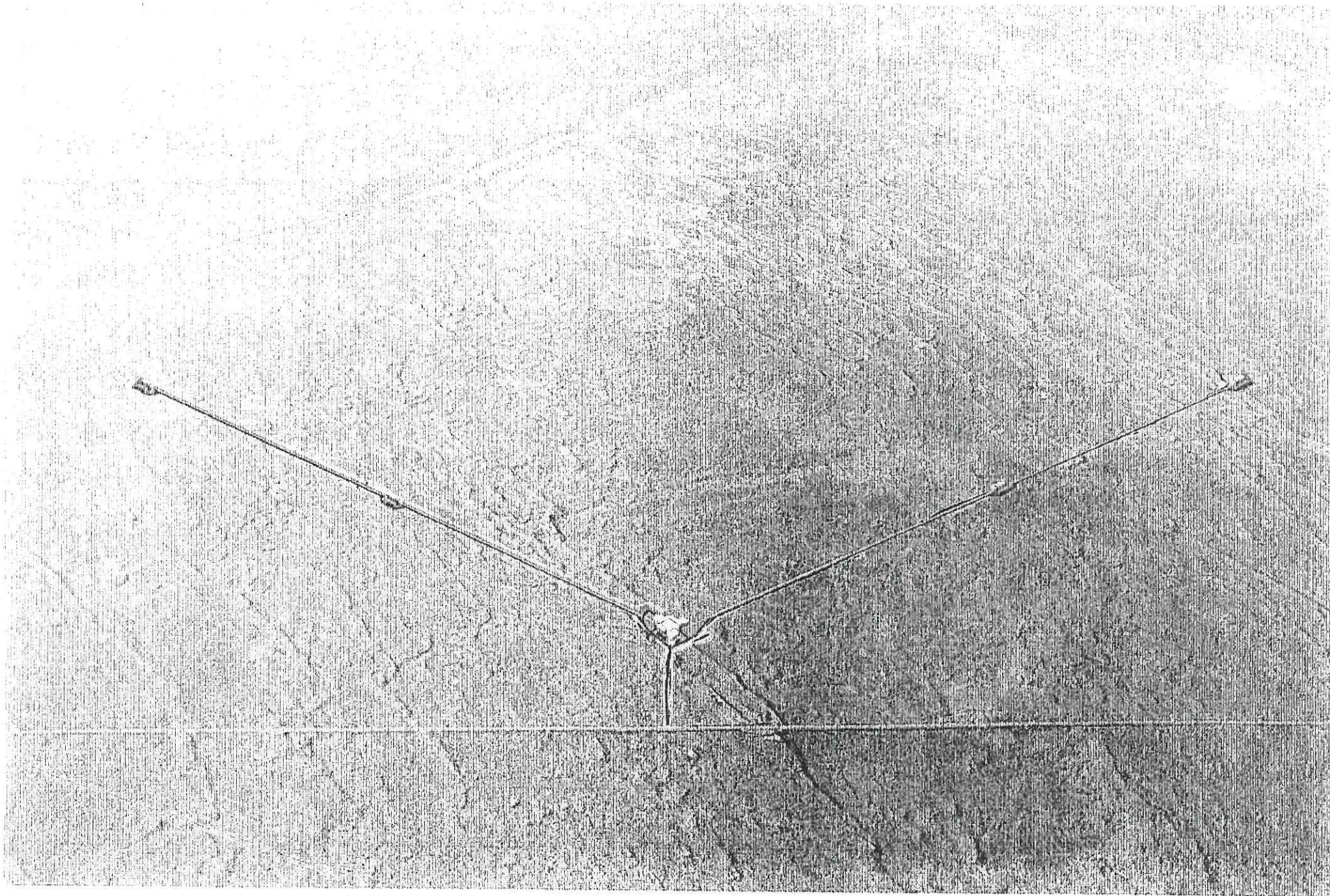
# SUMMARY (cont'd)

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- **DESIGN AND CONSTRUCTION MANAGEMENT**
  - **ARCHITECT ENGINEER FOR DESIGN & CONSTRUCTION MANAGEMENT HAS BEEN RETAINED**
  - **CONCEPT DESIGN PHASE IS IN PROGRESS WITHIN BUDGET AND ON SCHEDULE**
- **WORK AROUND PLANS TO MEET LEVEL ONE MILSTONES HAVE BEEN IDENTIFIED IN THE BASELINE SCHEDULE**







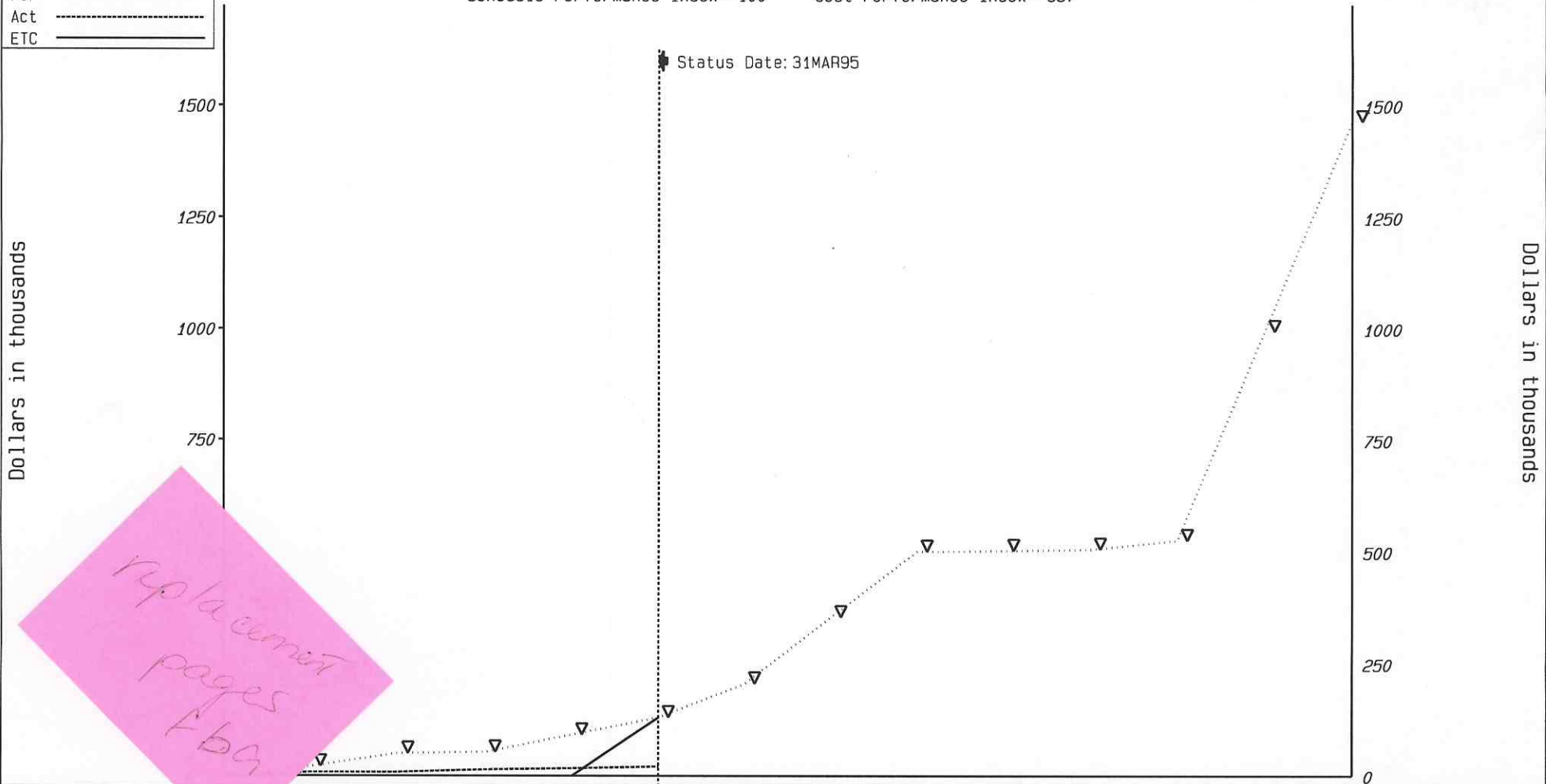


LIGO PROJECT  
1.1.3 Beam Tube Enclosures (BTE)  
Budget vs Performance vs Actual

LEGEND

Bud	.....▽.....▽.....▽.....▽
Per	—————
Act	-----
ETC	—————

Schedule Performance Index= 100      Cost Performance Index= 637



Replacement  
pages  
fba

	DEC94	JAN95	FEB95	MAR95	APR95	MAY95	JUN95	JUL95	AUG95	SEP95	OCT95	NOV95	SCALE
Budget	21	50	92	131	206	353	500	502	505	525	994	1,464	K\$
Performance	0	0	0	131									K\$
Actual/Forecast	8	8	14	20									K\$
Schedule Variance	-21	-50	-92	0									K\$
Cost Variance	-8	-8	-17	111									K\$

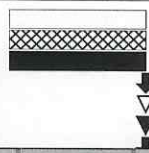
Schedule Variance = Perf-Budg      Cost Variance = Perf-Actual      Schedule Performance Index= Perf/Budg      Cost Performance Index= Perf/Actual





Start: 04/01/95  
 Finish: 04/01/95  
 Time Now: 04/01/95  
 Project: SPECIAL  
 Run: 05/18/95  
 Page: 1 of 1

Planned  
 Critical  
 Actual Dates  
 Milestone-Baseline  
 Milestone-Planned  
 Milestone-Completed  
 Baseline Dates



Caltech



FACILITY CONSTRUCTION

Open Plan Professional by Welcom Software

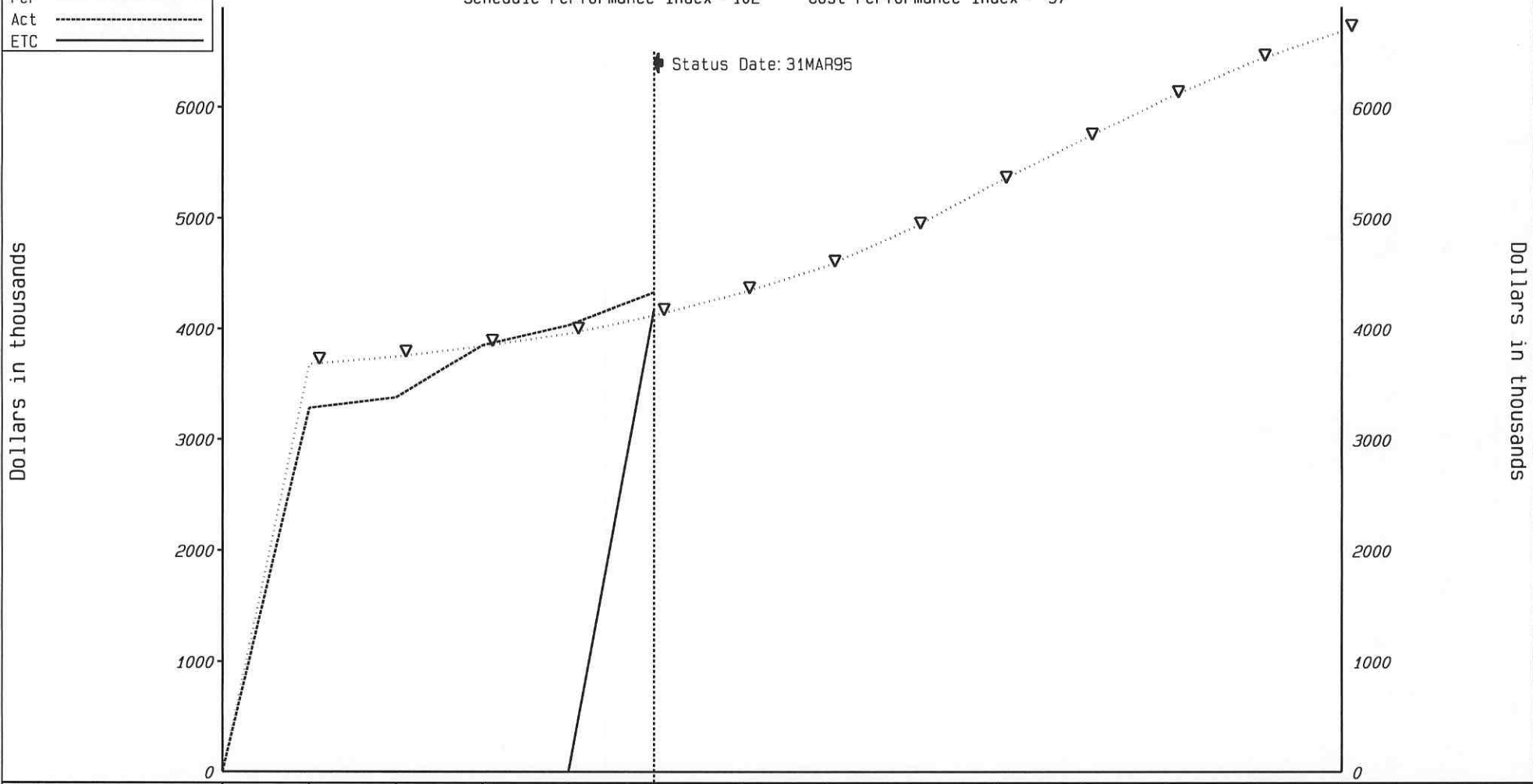
Activity Desc.	EStart	EFinish	1994				1995				1996				1997				1998				1999				2000			
			Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	O
SELECT WA CONTRACTOR	02/16/96	05/23/96	Stated: 04/01																											
NSF REVIEW - WA	05/24/96	06/21/96																												
INITIATE BUILDING CONSTRUCTION - WA	06/21/96	06/21/96																												
CONSTRUCTION PHASE - WA	06/24/96	08/04/97																												
JOINT OCCUPANCY - WA	08/04/97	08/04/97																												
ACCEPTANCE PHASE - WA	08/05/97	11/25/97																												
INITIATE FACILITY SHAKEDOWN - WA	02/26/98	02/26/98																												
ROUGH GRADING DESIGN - LA	06/13/95	09/07/95																												
SELECT ROUGH GRADING CONTRACTOR - LA	09/08/95	11/02/95																												
NSF REVIEW - LA	11/03/95	12/04/95																												
ROUGH GRADING - LA	12/05/95	06/10/96																												
GROUND SETTLEMENT - LA	06/11/96	02/14/97																												
SELECT LA CONTRACTOR	04/12/96	07/23/96																												
NSF REVIEW - LA	07/24/96	08/20/96																												
INITIATE BUILDING CONSTRUCTION - LA	02/14/97	02/14/97																												
CONSTRUCTION PHASE - LA	02/17/97	05/08/98																												
JOINT OCCUPANCY - LA	05/08/98	05/08/98																												
ACCEPTANCE PHASE - LA	05/11/98	09/01/98																												
INITIATE FACILITY SHAKEDOWN - LA	11/13/98	11/13/98																												

LIGO PROJECT  
1.1.4 Facility Design & Construction  
Budget vs Performance vs Actual

LEGEND

Bud	.....▽.....▽.....▽.....▽
Per	—————
Act	-----
ETC	—————

Schedule Performance Index= 102    Cost Performance Index= 97



	FY94	DEC94	JAN95	FEB95	MAR95	APR95	MAY95	JUN95	JUL95	AUG95	SEP95	OCT95	NOV95	SCALE
Budget	3,680	3,747	3,844	3,956	4,121	4,319	4,560	4,905	5,320	5,710	6,087	6,415	6,682	K\$
Performance	0	0	0	0	4,185									K\$
Actual/Forecast	3,284	3,379	3,853	4,035	4,327									K\$
Schedule Variance	-3,680	-3,747	-3,844	-3,956	64									K\$
Cost Variance	-3,284	-3,379	-3,853	-4,035	-142									K\$

Schedule Variance = Perf-Budg    Cost Variance = Perf-Actual    Schedule Performance Index= Perf/Budg    Cost Performance Index= Perf/Actual  
\*\*\* Prepared by LIGO Project Controls Group \*\*\*

Start: 04/01/95  
 Finish: 04/01/95  
 Time Now: 04/01/95  
 Project: SPECIAL  
 Run: 05/16/95  
 Page: 1 of 1

Planned  
 Critical  
 Actual Dates  
 Milestone-Baseline  
 Milestone-Planned  
 Milestone-Completed  
 Baseline Dates

Caltech



BEAM TUBE ENCLOSURE DESIGN & CONSTRUCTION

Open Plan Professional by Welcom Software

Activity Desc.	EStart	EFinish	1993			1994			1995			1996			1997			1998			1999				
			Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct
SELECT SLAB DESIGN CONTRACTOR	06/01/94	06/01/94																							
INITIAL TUBE SLAB DESIGN	06/01/94	01/23/95																							
COMPLETE INITIAL SLAB/COVER DESIGN	01/23/95	01/23/95																							
TUBE ENCLOSURE COMMON CONCEPTUAL DES	01/24/95	03/24/95																							
TE DESIGN COMMON TRADE STUDIES	04/03/95	05/12/95																							
TUBE ENCLOSURE COMMON DESIGN	05/15/95	06/26/95																							
TE DESIGN REVIEW	06/26/95	06/26/95																							
SELECT TUBE SLAB CONTRACTOR - WA	06/27/95	09/07/95																							
NSF REVIEW - WA	09/08/95	10/05/95																							
INITIATE SLAB CONSTRUCTION - WA	10/05/95	10/05/95																							
CONSTRUCT SLAB - WA	10/06/95	02/02/96																							
COMPLETE SLAB - WA	02/02/96	02/02/96																							
CONSTRUCT & INSTALL ARM 1 TUBE ENCLOSU	05/03/96	10/09/96																							
CONSTRUCT & INSTALL ARM 2 TUBE ENCLOSU	10/10/96	03/06/97																							
SELECT TUBE SLAB CONTRACTOR - LA	06/27/95	09/21/95																							
NSF REVIEW - LA	09/22/95	10/19/95																							
INITIATE SLAB CONSTRUCTION - LA	02/17/97	02/17/97																							
CONSTRUCT SLAB - LA	02/17/97	06/09/97																							
COMPLETE SLAB - LA	06/09/97	06/09/97																							
CONSTRUCT & INSTALL ARM 3 TUBE ENCLOSU	06/10/97	10/29/97																							
CONSTRUCT & INSTALL ARM 4 TUBE ENCLOSU	10/30/97	03/27/98																							

Statused:04/01





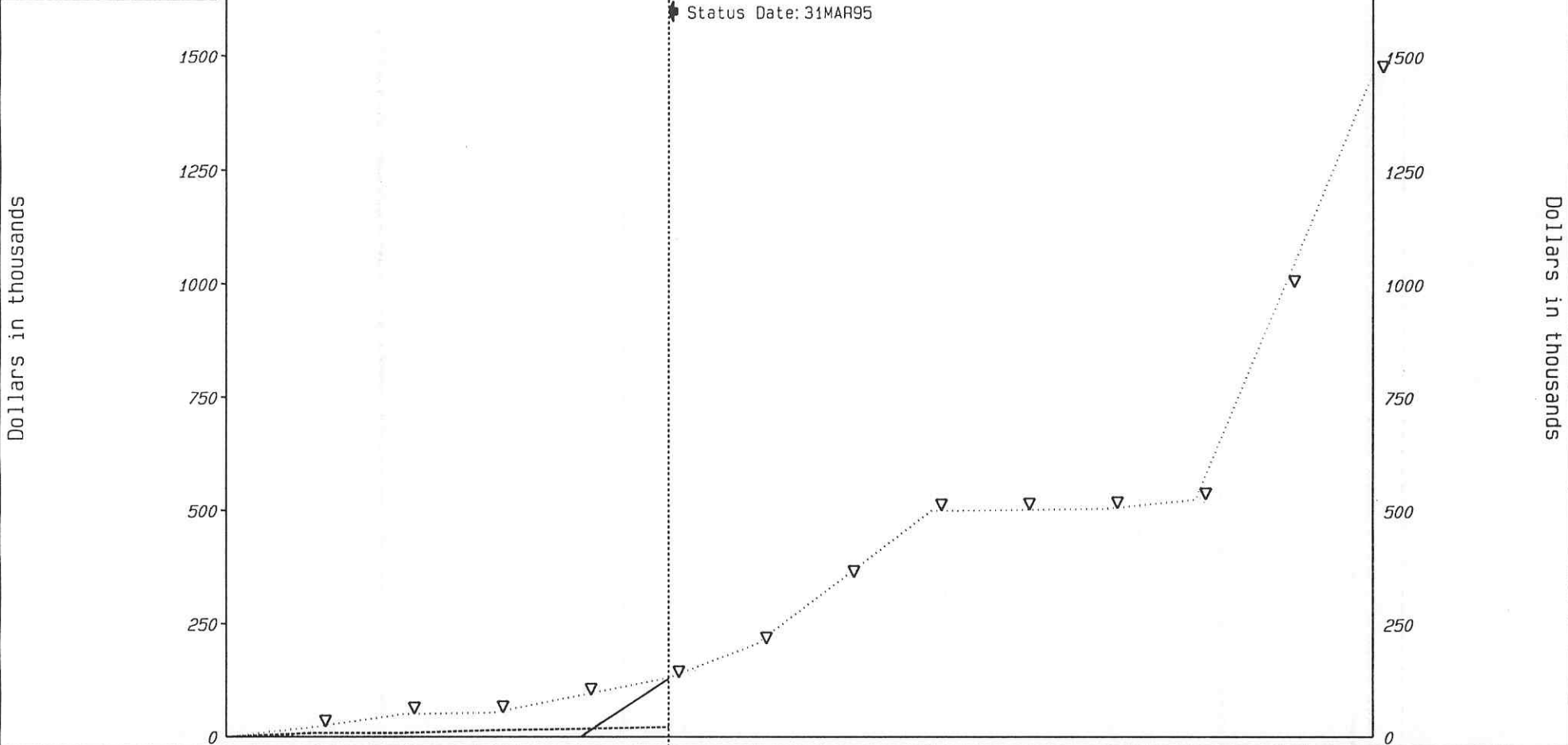


LIGO PROJECT  
1.1.3 Beam Tube Enclosures (BTE)  
Budget vs Performance vs Actual

LEGEND

Bud	.....▽.....▽.....▽.....▽
Per	—————
Act	—————
ETC	—————

Schedule Performance Index= 98    Cost Performance Index= 626



	FY94	DEC94	JAN95	FEB95	MAR95	APR95	MAY95	JUN95	JUL95	AUG95	SEP95	OCT95	NOV95	SCALE
Budget	21	50	53	92	131	206	353	500	502	505	525	994	1,464	K\$
Performance	0	0	0	0	129									K\$
Actual/Forecast	8	8	14	17	20									K\$
Schedule Variance	-21	-50	-53	-92	-2									K\$
Cost Variance	-8	-8	-14	-17	109									K\$

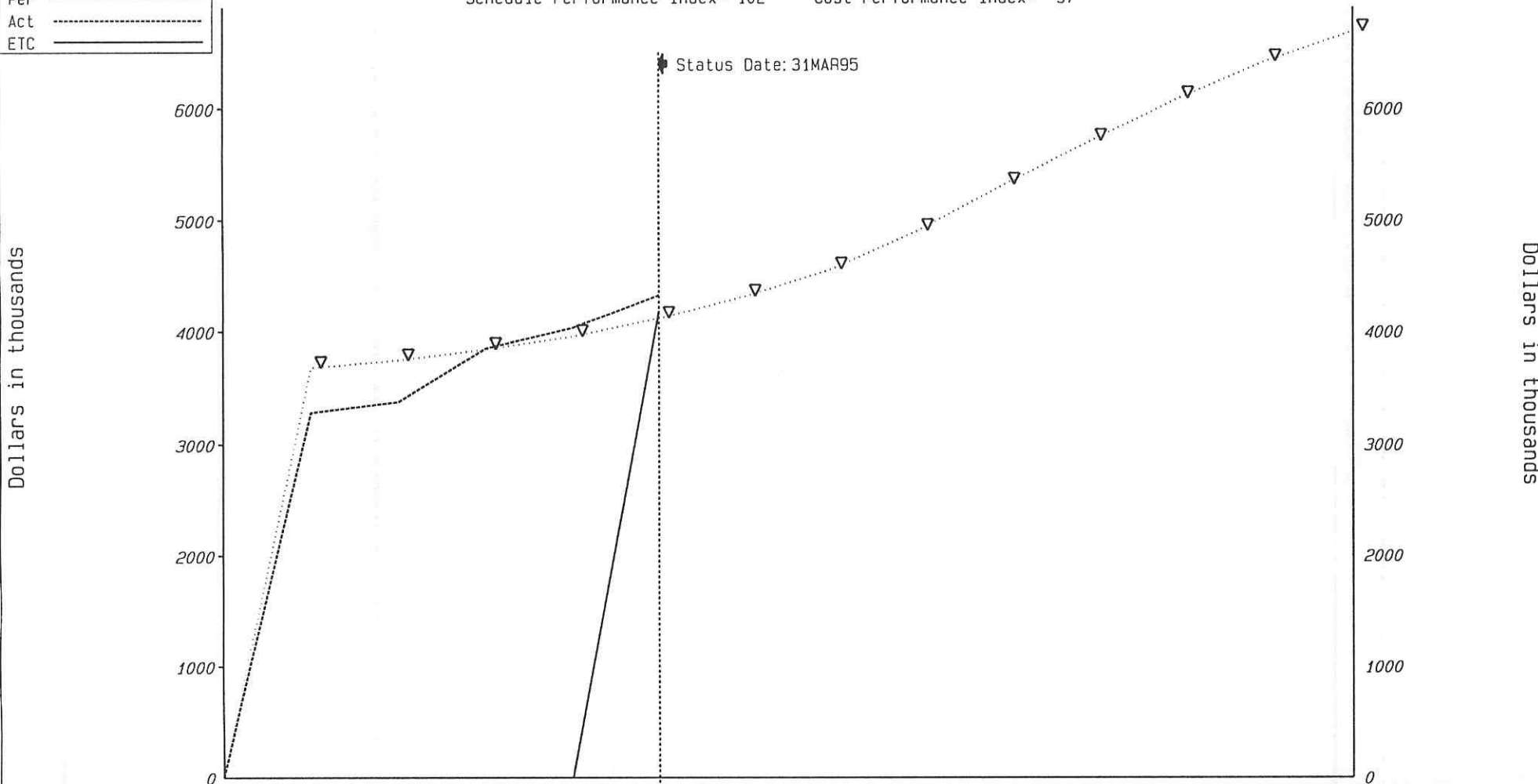
Schedule Variance = Perf-Budg    Cost Variance = Perf-Actual    Schedule Performance Index= Perf/Budg    Cost Performance Index= Perf/Actual  
\*\*\* Prepared by LIGO Project Controls Group \*\*\*

LIGO PROJECT  
1.1.4 Facility Design & Construction  
Budget vs Performance vs Actual

LEGEND

Bud	.....▽.....▽.....▽
Per	—————
Act	.....
ETC	—————

Schedule Performance Index= 102      Cost Performance Index= 97



	FY94	DEC94	JAN95	FEB95	MAR95	APR95	MAY95	JUN95	JUL95	AUG95	SEP95	OCT95	NOV95	SCALE
Budget	3,680	3,747	3,844	3,956	4,121	4,319	4,560	4,905	5,320	5,710	6,087	6,415	6,682	K\$
Performance	0	0	0	0	4,189									K\$
Actual/Forecast	3,284	3,379	3,853	4,035	4,327									K\$
Schedule Variance	-3,680	-3,747	-3,844	-3,956	68									K\$
Cost Variance	-3,284	-3,379	-3,853	-4,035	-138									K\$

Schedule Variance = Perf-Budg    Cost Variance = Perf-Actual    Schedule Performance Index= Perf/Budg    Cost Performance Index= Perf/Actual  
\*\*\* Prepared by LIGO Project Controls Group \*\*\*