LIGO
Status Report

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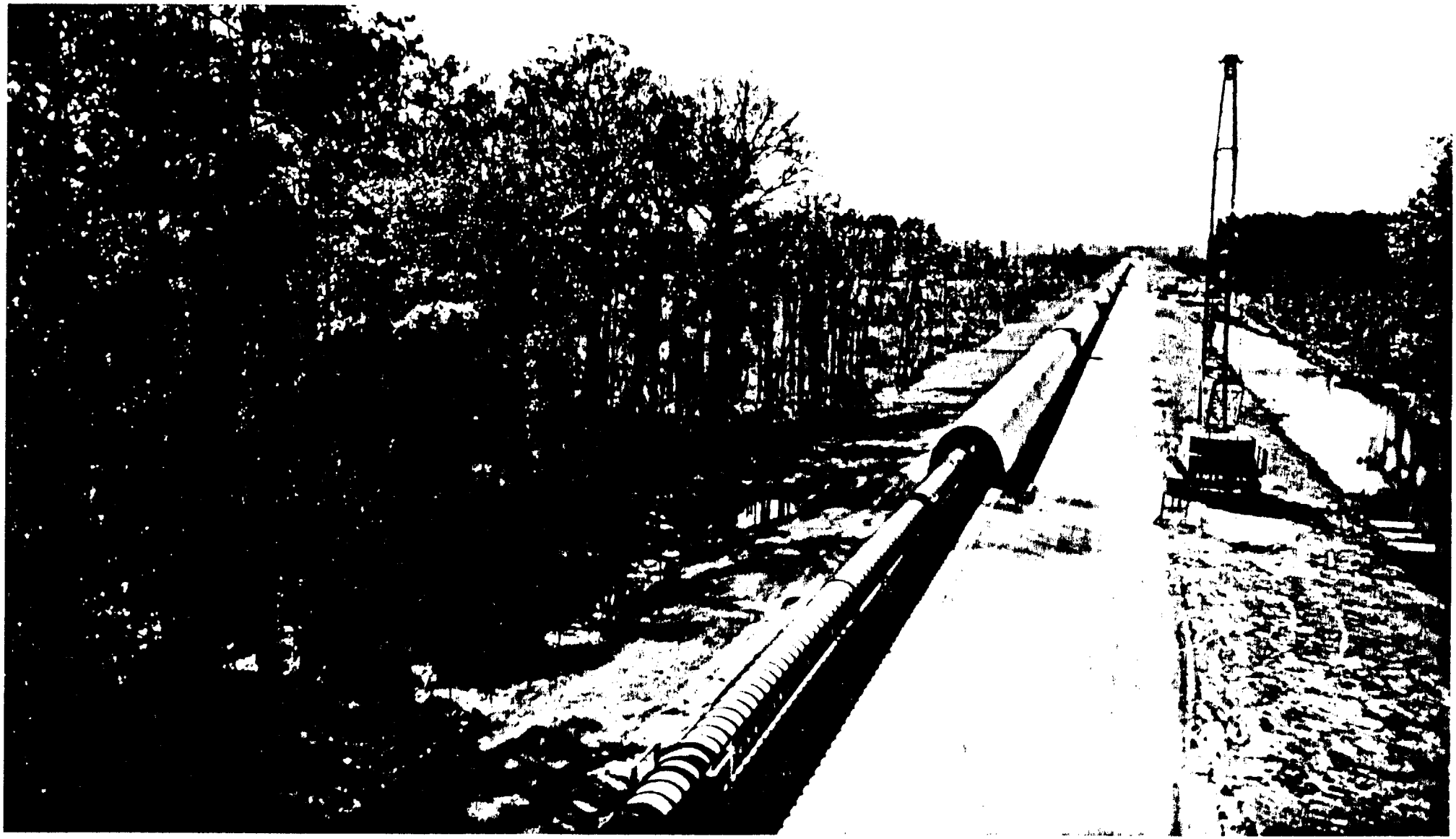
Caltech

LIGO-G980113-02-M

LIGO Schedule

main activities

1996	Construction Underway
	-mostly civil
1997	Facility Construction
	-beam pipe & enclosure
1998	Construct Detectors
	-complete vacuum systems
1999	Install Detectors
	-interferometers in vacuum
2000	Commission Detectors
	-first light; testing
2001	Engineering Tests
	-sensitivity; engineering run
2002	Initial LIGO Detector Run
	- $h \sim 10^{-21}$



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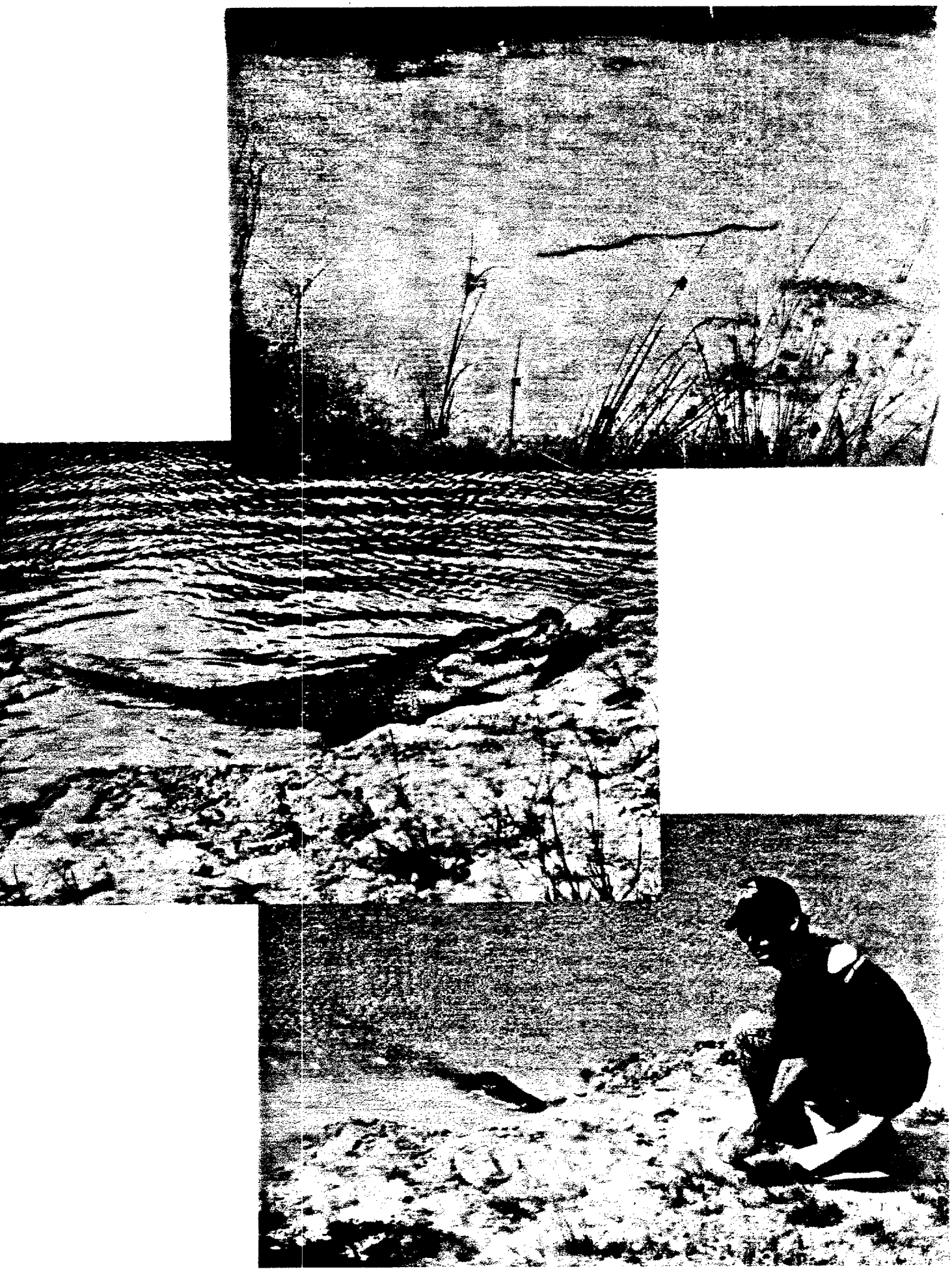

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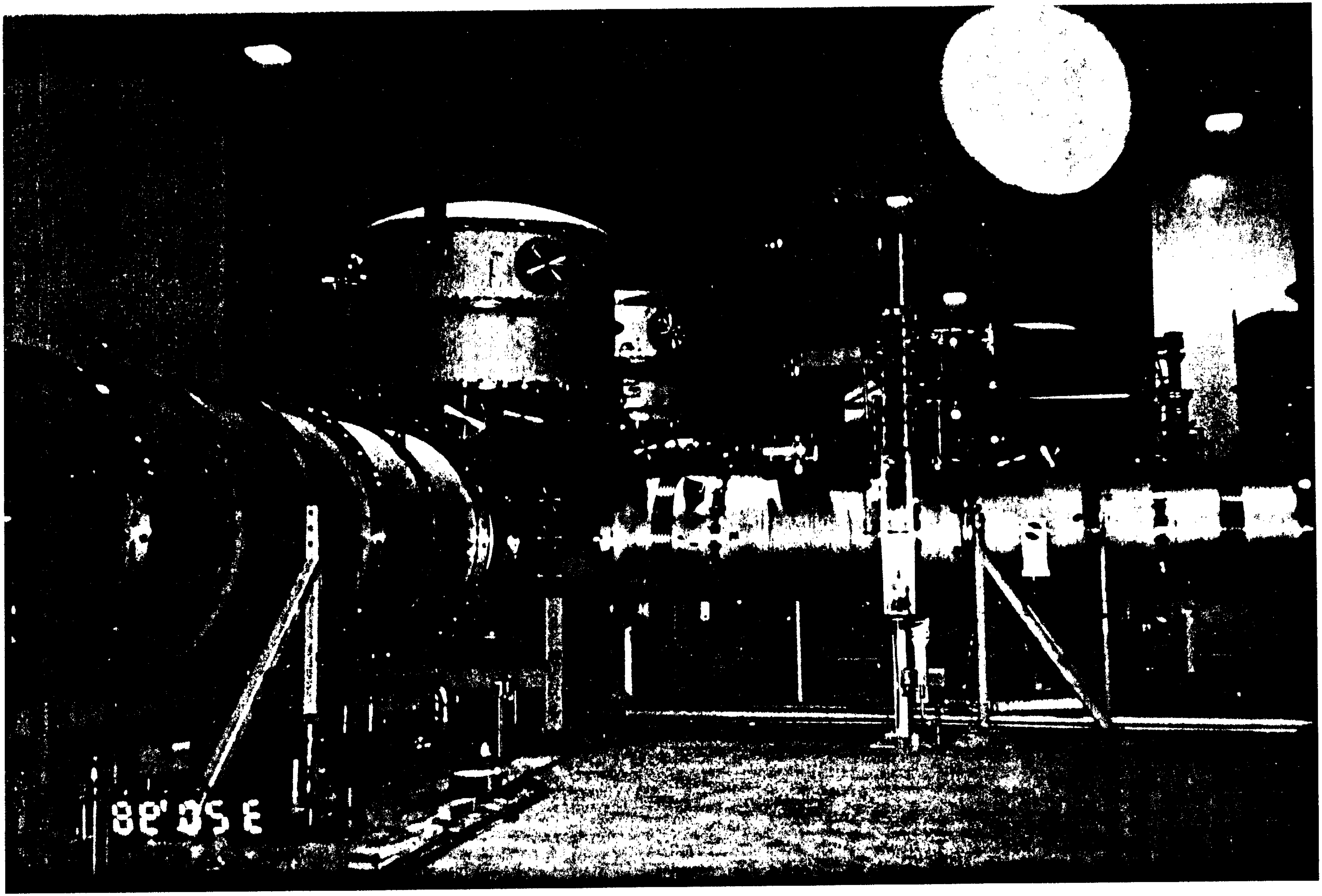

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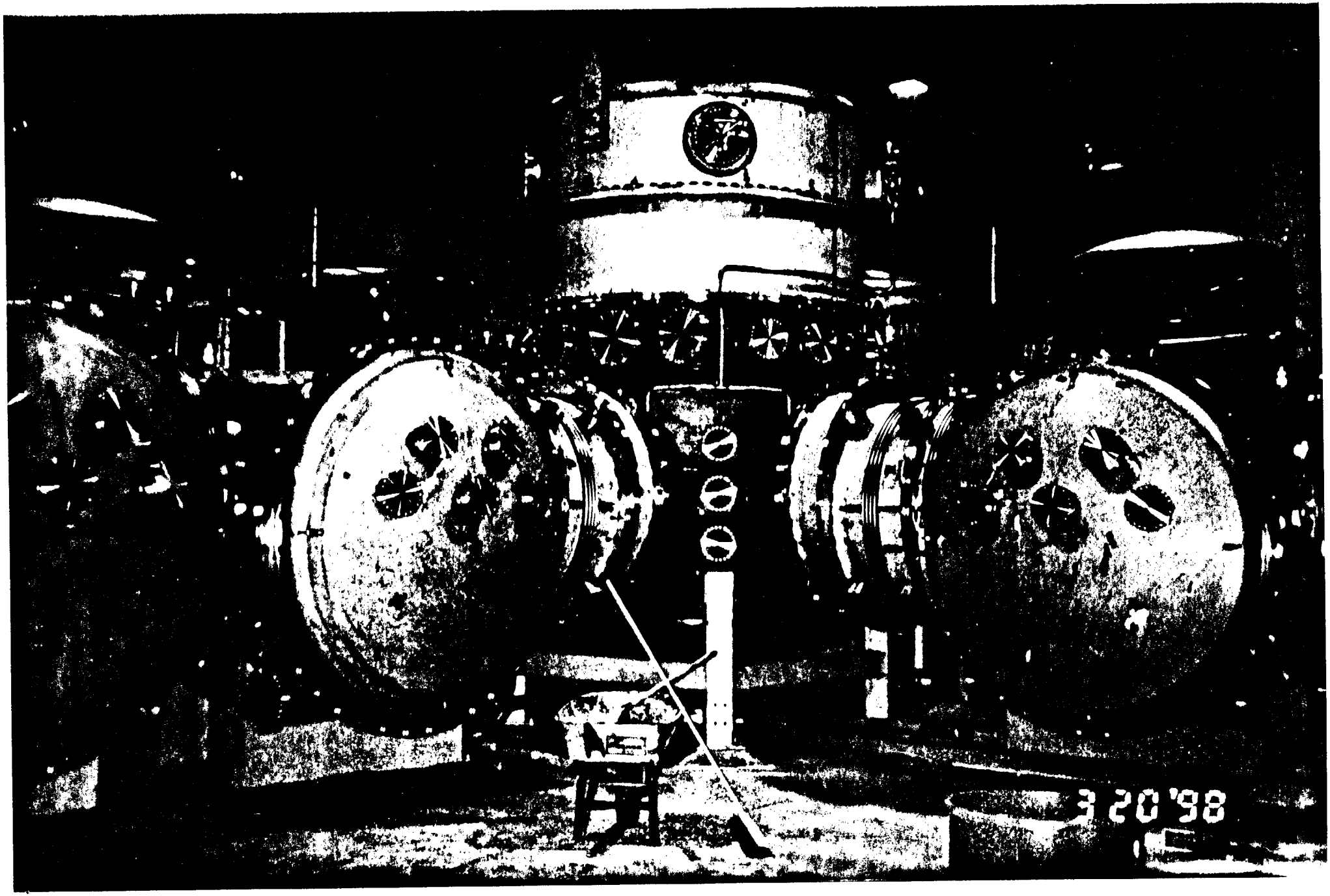


Technical Status
facilities

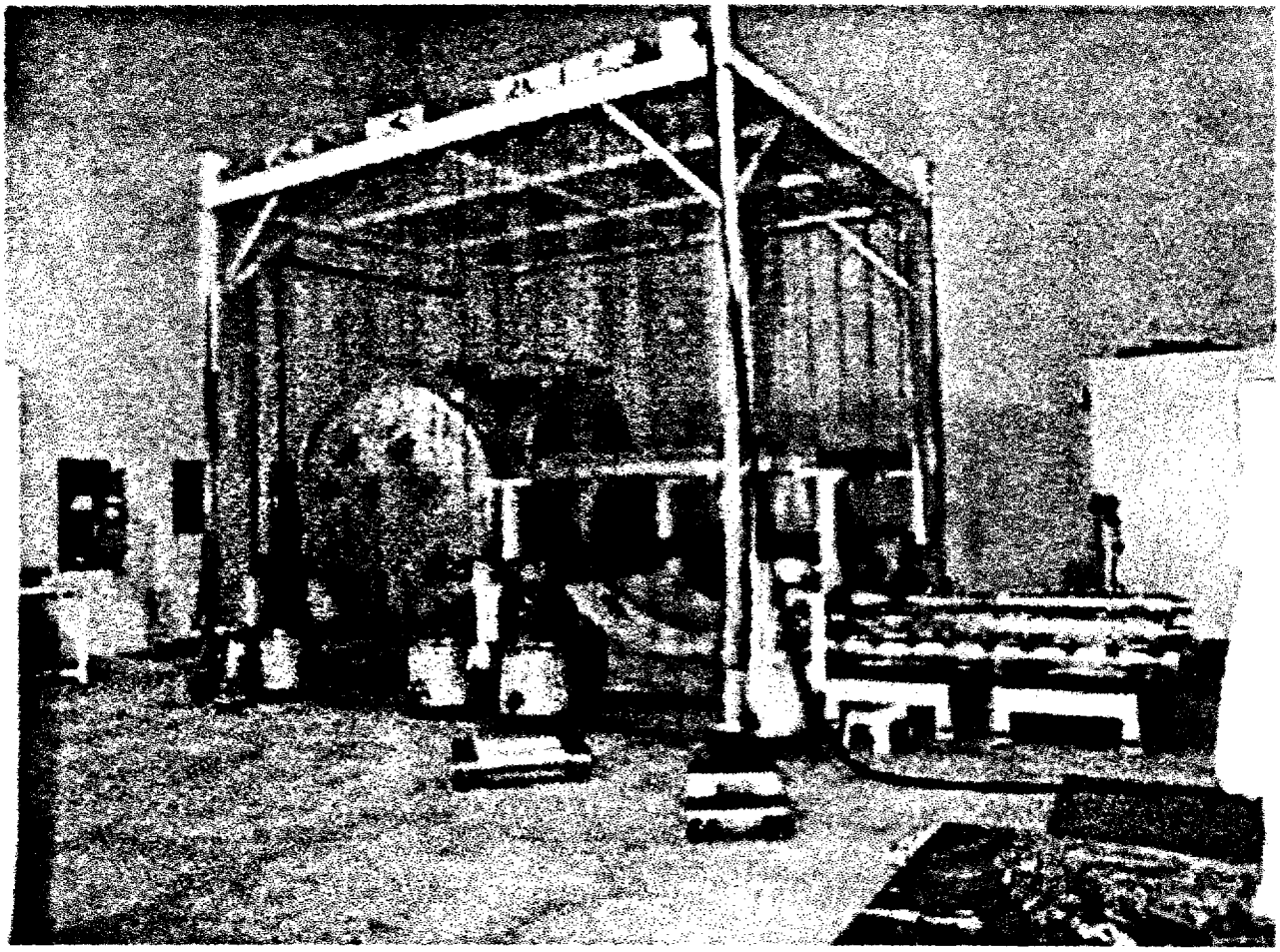
- Hanford Construction
  - » building complete
  - » beam tube under vacuum (pre-bake ~2 10^{-7} torr)
  - » near term activities -
    - – beam tube bakeout
    - – HAM vacuum chamber first article test
    - – prestabilized laser
    - – input optics (soon)

- Louisiana Construction
  - » buildings occupied
  - » beam tube complete
  - » near term activities -
    - – completion of beam tubes under vacuum
    - – vacuum equipment being installed

- Problems
  - » gate valves; power in Livingston; lightning

Seismic Isolation System

first article test



- Horizontal Access Module (HAM)
  - » First article test being done in the Hanford LVEA
  - » performance tests getting underway
- SMC test at Hytec, Inc.
- Installation will begin soon

Seismic System

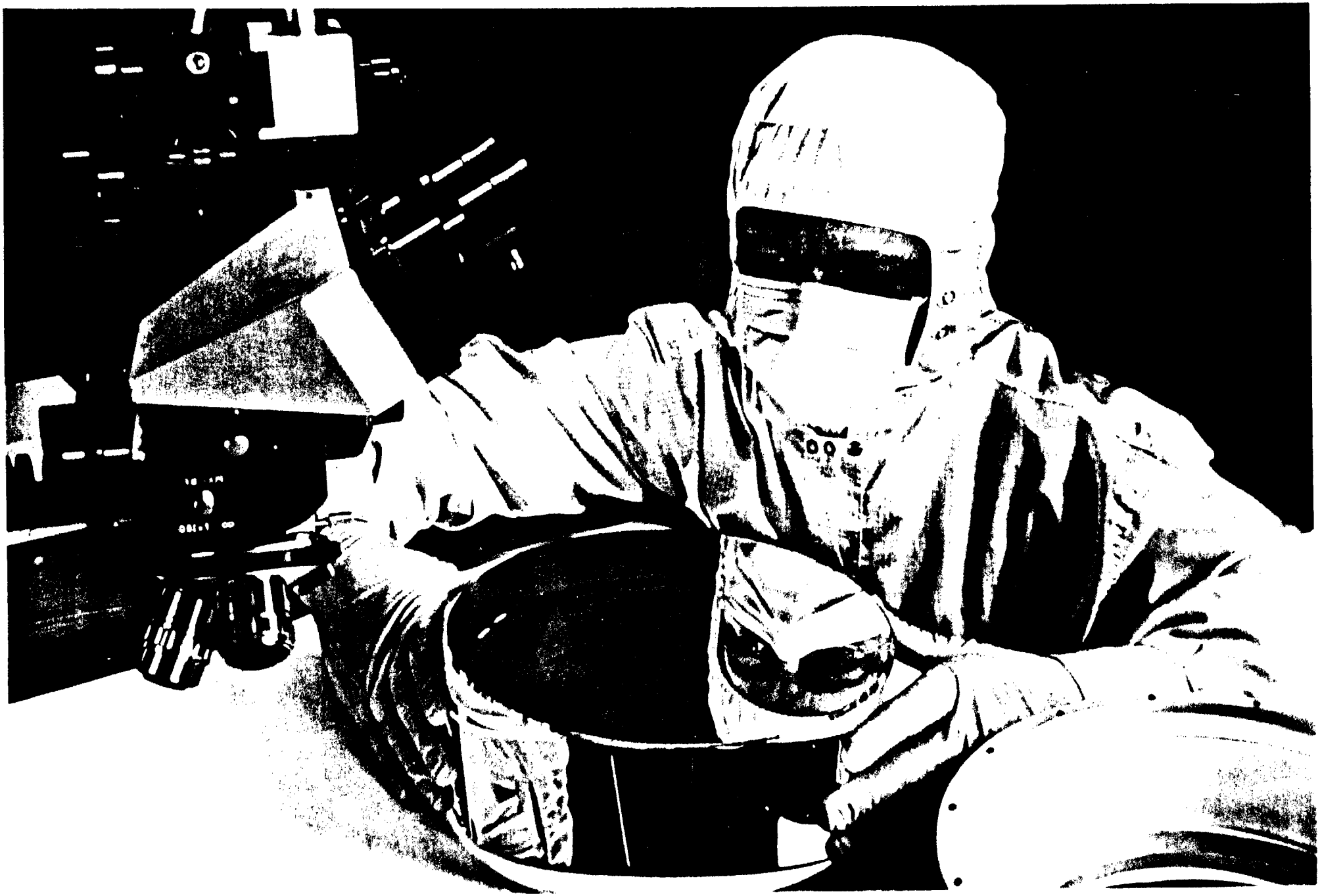
damped springs

- Constrained Layer Damped spring
  - » damped layer between outer phoshor-bronze tube and an inner segmented aluminum tube
  - » production springs from Pegasus

Technical Status

detector and r&d

- Initial detector
  - » Most subsytems are in final design or under construction
- Detector focus
  - » Laser developed and constructed at Lightwave; prestablization at Caltech, delivered to Hanford)
  - » Input Optics - Florida (Hanford fall 98)
  - » Core Optics - (under construction)
  - » Seismic Isolation - procurements; first article tests
  - » Data Acquisition/Data Analysis - (construction)
  - » Length and Alignment Sensing - (final design)
- R&D
  - » R & D in support of Initial LIGO
    - – Phase Noise Interferometer - (complete)
    - – 40 meter Interferometer - (recycling studies)
  - » LIGO Lab advanced R&D program - (starting)



LIGO
schedule

- Construction Project (1995-1999)
  - » Facilities and Initial Detector
    - – **presently 85% complete !**
    - – facilities construction nearing completion on schedule
    - – detector is about 3 months behind schedule
- Detector Installation (1999)
  - » Operations activity
    - – beginning now (PSL, input optics, etc)
    - – main activity during 1999
- Commissioning (2000-2001)
  - » Subsystems begin this year
  - » Initial detectors implementation
    - – $h \sim 10^{-20}$ - Coincidence (Hanford/Livingston)
      - Engineering run (end of 2000)
    - – $h \sim 10^{-21}$ - Initial Design Sensitivity (end 2001)

LIGO

construction costs

- tracking construction costs
  - » construction funds $292.1M
  - » costed as of July $221.2M
  - » committed $267.1M
  - » remaining contingency $ 14.4M

- emphasis in *'end game'* is on:
  - » analysis of cost to complete
  - » running contingency analysis

task	percent complete	actual costs(M$)	estimate to complete	estimated percent contingency
facilities	94%	150.3	16	15%
detector	55%	24.6	30.6	34%
R & D	99%	20.7	2.8	0%
project mgt	77%	25.6	8.7	23%
total	**85%**	**221.2**	**58.1**	**26%**

Technical Status
site operations

- Site operations provide resident infrastructure to support facilities operations and detector integration, commissioning and operations

- Hanford and Livingston are being staffed up to ~20 technical staff each

- Both sites are already operational
  - » operating conventional facilities
  - » supporting the bake
  - » supporting integration of detector
  - » hosting meetings (LSC, GWIC, NSF review, etc)
  - » laboratories and technical infrastructure being developed

- **The action is now at the sites !!!**

Technical Status
data and computing

- Detector Diagnostics
  - » concepts and design
- End to End Simulations
  - » development and 40 m validations
- Data Analysis System (DAS)
  - » data formats - frames (VIRGO)
  - » architecture and design
  - » 40 m data to test DAQ/DAS systems

These activities will interface with new LSC development groups

LIGO Funding

by task and by year

- Construction Project
  - » R & D in support of initial detector
  - » deliver operational facilities
  - » deliver constructed detector
- Operations
  - » physical detector integration
  - » commission detector
    - – coincidences end of 2000 $h = 10^{-20}$
    - – design sensitivity end of 2001 $h = 10^{-21}$
- Advanced R&D funding
  - » develop enhanced detector subsystems
  - » new interferometer configurations

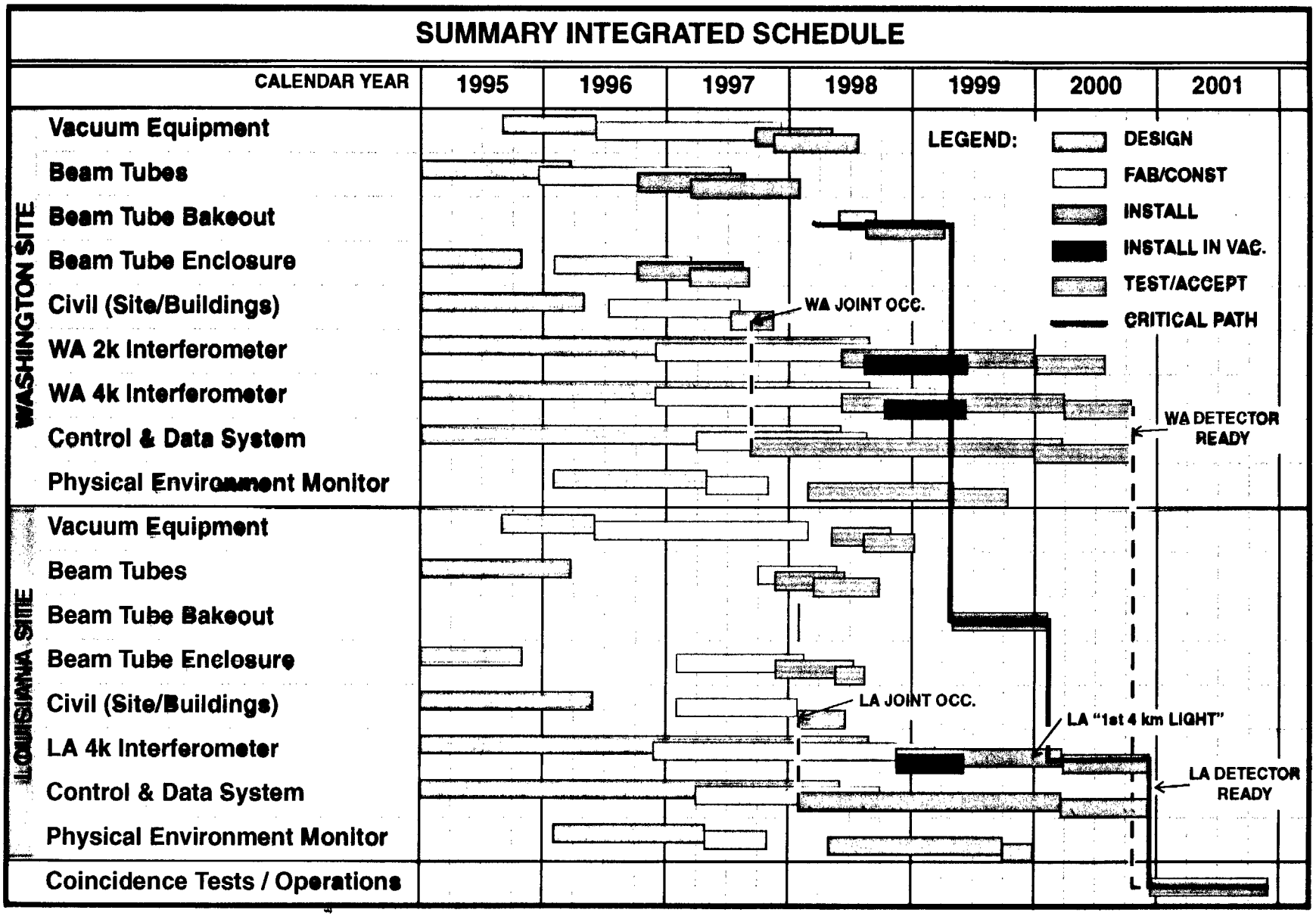
fiscal yr	construction	R & D	operations	advanced R&D
thru 1994	35.9	11.2		
1995	85	4		
1996	70	2.4		
1997	55	1.6	0.3	0,8
1998	26.2	0.9	7.3	2,7
1999			20.9	2.8
2000			21.1	2.9
2001			19.1	2.9
total	**272.1**	**20**	**68.7**	**12.1**

LIGO Commissioning

resources and schedule

- Major activities
  - » detector installation 1999-2000
  - » commission interferometers 2000-2001
  - » improved sensitivities 2001-2002
- Goals
  - » coincidences @ h ~ 10^{-20} < Jan 2001
  - » sensitivity h ~ 10^{-21} < Jan 2002
- Resources - Operations of LIGO Lab
  - » 1998 $7.3M
  - » 1999 $20.9M (plan)
- Possible ~$1M shortfall in 1999
  - » Reduction of $1M would be ~25% reduction in personnel for **Detector Support and Engineering Support Groups**
    - – similar percentage reduction in detector installation and commissioning effort
    - – unclear how much this will involve layoffs or put us into hiring-firing spiral

APRIL 1998


SUMMARY INTEGRATED SCHEDULE
CALENDAR YEAR
1995
1996
1997
1998
1999
2000
2001
WASHINGTON SITE
Vacuum Equipment
Beam Tubes
Beam Tube Bakeout
Beam Tube Enclosure
Civil (Site/Buildings)
WA 2k Interferometer
WA 4k Interferometer
Control & Data System
Physical Environment Monitor
LOUISIANA SITE
Vacuum Equipment
Beam Tubes
Beam Tube Bakeout
Beam Tube Enclosure
Civil (Site/Buildings)
LA 4k Interferometer
Control & Data System
Physical Environment Monitor
Coincidence Tests / Operations
LEGEND:
DESIGN
FAB/CONST
INSTALL
INSTALL IN VAC.
TEST/ACCEPT
CRITICAL PATH
WA JOINT OCC.
WA DETECTOR READY
LA JOINT OCC.
LA "1st 4 km LIGHT"
LA DETECTOR READY

LIGO Commissioning

resources and schedules

- Revised installation plan (preliminary)
  - » minimal change to WA(2K) & LA(4K) schedules with overall goals -
    - – to optimize involvement and training of site staff
    - – maximize time to find and fix problems learned on first interferometer
  - » defer work on WA(4K)
    - – approximate 6-8 month delay in installation

- Impact on NSF milestones
  - » delay of 6-8 months in coincidence milestone
    - – scheduled milestone Dec 2000
  - » hopefully smaller delay in LIGO I initiation
    - – scheduled run to begin Jan 2002

LIGO Operations

physics/enhancements

- First Physics Run (~2002-2004)
  - » **LIGO I** Development Group
  - » Initial LIGO design sensitivity h ~ 10^{-21}
  - » one year integrated data (~ 2 year run)
  - » data reserved for LIGO I group for two years from collection
- Enhancements/Data Taking (~2007 ?)
  - » Advanced R&D to reach h ~ 10^{-22}
  - » implemented from 2004, mixed with data taking
  - » incremental improvements towards **LIGO II**
- Advanced Detector Configurations
  - » development work begins now
  - » implementation in about 10 years ?

LIGO Laboratory
formation

- Mission and Responsibility
  - » operate Hanford and Livingston
  - » assure scientific vitality of these facilities
  - » provide for acquisition of data, and systems for modeling and data analysis
  - » operate research and test facilities at sites and at MIT and Caltech
  - » support engineering design and fabrication of detector upgrades of new detector systems
  - » carry out R&D toward future LIGO program
  - » support LSC in exploitation of scientific goals
  - » review and coordinate new LIGO research initiatives
- Laboratory Charter
  - » approved by Caltech/MIT; final wording being determined with NSF
  - » Directorate, plus functional operational units for Hanford and Livingston Sites; Detector support, Data Analysis and Computing; Advanced R&D; Research Facilities; Technical and Engineering Support and Administration

LSC
MOUs and Attachments

- LIGO Laboratory and each LSC Collaborating Group work defined through an MOU, plus attachments for each activity (updated every 6 months)
  - » the attachments describe the program of the group, the collaborating persons and FTE equivalents; and the requests and responsibilities of the laboratory

- Initial MOUs and Attachments are ALL ready to sign for each institution to be charter members of LSC
  - » 201 collaborators (159 FTEs,)
  - » 19 collaborating groups (including LIGO Labs)
  - » 41 members on collaboration council

- All information is on LSC button on LIGO Web page

LIGO

LSC membership

- LSC membership as March '98
  - » to be updated from Aug '98 attachments
- new proposed collaborating group
  - » Louisiana Tech and Russian groups

name	# members	#FTE	#council
ACIGA	4	1.9	1
CaRT	7	3.4	1
CEGG	2	1.6	1
Florida	12	10.15	3
Geo	26	13.45	3
JILA	7	4.05	1
LSU	5	2.35	1
Michigan	2	2	1
Moscow	10	9	2
Northwestern	4	4	1
Oregon	6	3.1	1
Penn State	1	1	1
Stanford	19	13.05	3
Syracuse	4	4	1
UW-Milwaukee	4	2.75	1
Caltech	56	52.85	11
MIT	19	17.75	4
Hanford	6	6	2
Livingston	7	7	2
TOTAL	**201**	**159.4**	**41**

LSC

goals for this meeting

- Technical
  - » Progress and work of development sub-groups
    - – Stochastic Forces - Isolation Systems and Suspensions (Shoemaker)
    - – Sensing Noise - Lasers and Optics (E.Gustafson)
    - – Interferometer Configurations (K. Strain)
    - – Astrophysical Signatures (Allen/Prince)
    - – Detector Characterization (Hamilton/Sigg)
    - – Validation/Detection Confidence (Finn/Lazzarini)
- Organizational
  - » Six month reports of collaborating groups
  - » Updated attachments for Aug 98 to March 99
  - » Consideration of new collaborators
- Funding
  - » New funding proposals due October at NSF
- Participation in LIGO I
  - » General discussion
  - » Each group needs to work with LIGO Laboratory and LSC spokesman to develop a program with complementarity.

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