UPDATE-1 MEETING
VACUUM EQUIPMENT PHASE A
HANDOUTS

LIGO-G950009-00-V

John Worden
April 28, 1995

Package Contents:

1. Viewgraphs
2. Vacuum Equipment Controls and the Phase A Contractors
   LIGO-C950416-00-V
3. Site and building drawings (6)
   (Parsons WA-SK-101,120,300,310,320,330)

AGENDA

8:30 General

Directions for developing the basis of bid.

8:45 LIGO Project controls and contracting (P. Lindquist)

Funding profile.
Buy America Act.
Taxes and Permits.
Labor agreements, Davis Bacon.

9:30 Scientific Requirements (M. Zucker)

Special Environmental Constraints - noise and vibration.

10:00 Vacuum Equipment Control System (V. Schmidt)

LIGO Vacuum controls and interfaces.

10:30 Vacuum Equipment (J. Worden)

Provisions for safety lockout.
Joint occupancy definition and schedule of building availability.
Building layout - rack locations, LN2 tank location, building access.
Bakeout temperatures for gauges, pumps.
80K pump - duty cycle requirements.
Select PDR order.

BASIS FOR BID

The contractors are reminded that:

- LIGO will be comparing the two proposals with one another and that in order to compare "apples with apples" we need to know what assumptions are used to generate the price proposal. If in doubt, please ask us.
- LIGO requests detailed costing in order to identify cost drivers and in order to price future scope changes.

JOINT OCCUPANCY

For the purposes of the Phase A design competition, JOINT OCCUPANCY is defined as follows:

- the Laser and Vacuum Equipment Area (LVEA) of the Corner Station will be turned over in a finished state with power systems and HVAC operational. Civil construction of the attached Operations and Support Building (OSB) will be ongoing. A large equipment access door is provided with a long concrete slab on grade outside. The End and Mid Stations will be turned over in a complete condition.
- occupancy will be shared with LIGO staff installing control system hardware. The VE contractor will have priority.
- Joint occupancy dates are:
  - WA Corner building - Aug 1, 1997
  - WA Mid/End buildings - Sep 1, 1997
  - LA Corner building - Mar 1, 1998
  - LA Mid/End buildings - Apr 1, 1998

BUILDING LAYOUT

- show Parson's drawings

GAUGE AND PUMP BAKEOUT

The bakeout subsystem shall:

- include a means to heat, insulate and control gauge and ion pump temperatures to 250C coordinated with the associated vacuum enclosure bakeout. Only devices directly exposed to the vacuum enclosure are to be considered. For example, annulus gauges and ion pumps are excluded from the baking requirements.
- include a means to heat, insulate and control the temperature of two main turbo pump carts up to the turbo inlet flange.

All turbo pumps shall be supplied with the factory supplied heating jackets and temperature controllers.Turbo pump bakeout need not be coordinated with a vacuum enclosure bakeout.

80K PUMP

Once stable operations are achieved LIGO requires a minimum of 90 days of liquid nitrogen storage for the 80K pumps.

- The purpose of this is to limit the interferometer downtime due to liquid nitrogen delivery trucks. Refill procedures are allowed one 8 hour shift to service the entire site.
- Assume that there are no other users of liquid nitrogen other than the Vacuum Equipment.

PDR ORDER SELECTION

Coin toss.

Project Controls and Contracting

Phil Lindquist

LIGO Project Controls Manager

Project Controls and Contracting

(Phil Lindquist - LIGO Project Controls Manager)

Contract Funding Profile

Buy American Act

Taxes and Permits

Labor Agreements

Funding Profile

- We expect that all or the majority of the funds for Phase B of the Vacuum Equipment Contract will be obligated when the contract is awarded

Buy American Act

- No more than 50 percent of the total value of the contract may be of foreign origin/fabrication
  - Proposal shall identify country of origin and value

Taxes and Permits

- For proposal purposes assume that no special permits will be required by DOE, NSF, or CIT
- All expected applicable taxes shall be included but shall be separately identified in the cost estimate

Labor Agreements

- Davis-Bacon will apply for purposes of the proposal for Phase B
  - » applies to both sites
- A copy of "Stabilization Agreement" for Hanford is provided
  - » includes current wage determinations and labor agreements
  - » latest rates and agreements will apply at time of contract award
  - » revisions will be handled as change orders
- A copy of Davis-Bacon rates for Livingston will also be provided
  - » rates will be frozen at the time of contract award
- For proposal purposes assume that labor rates will remain constant for the duration of the contract
  - » no contingency to be included for possible rate changes

SPECIAL ENVIRONMENTAL CONSTRAINTS

M. Zucker
April 28, 1995

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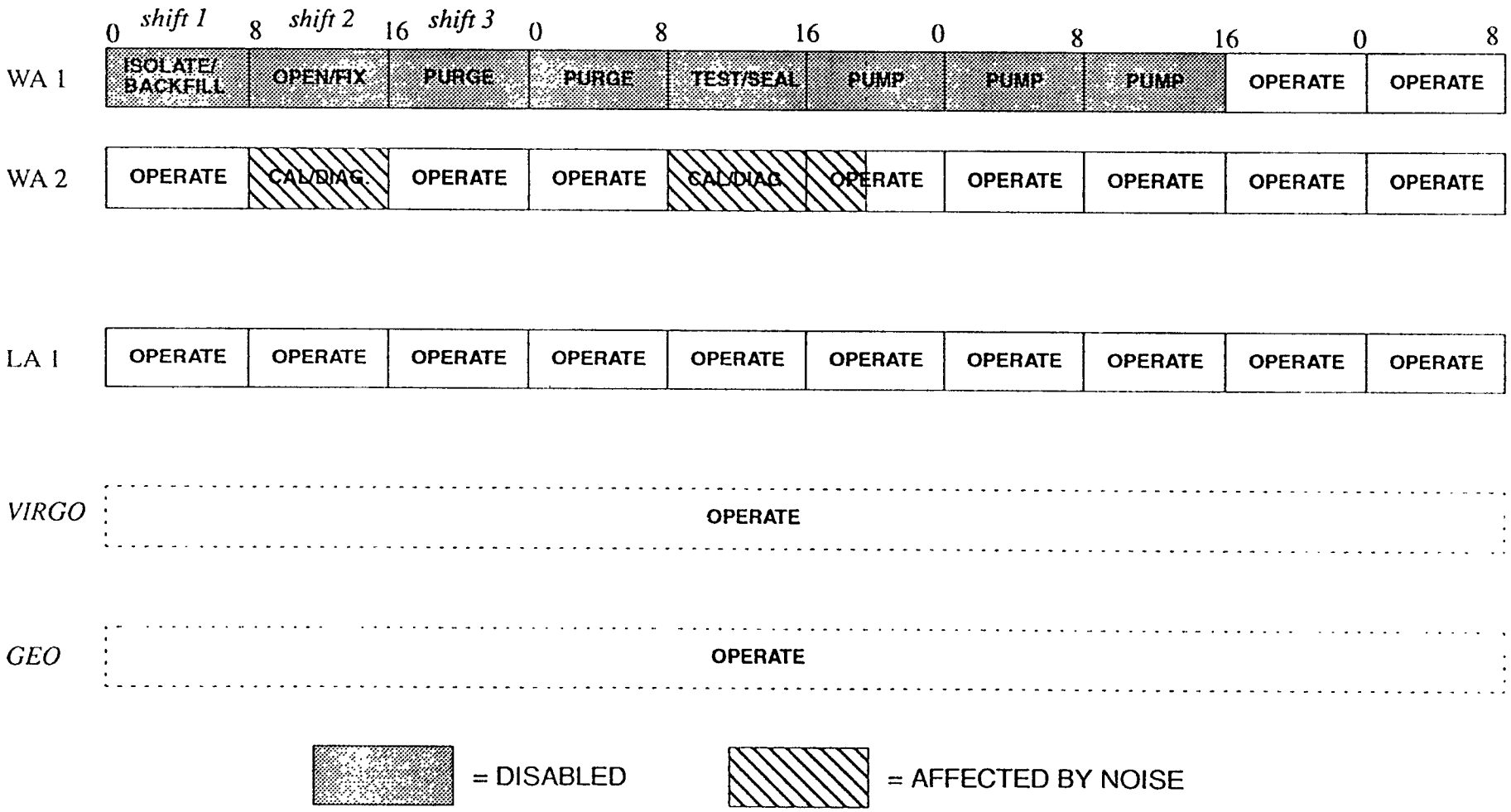
APPLICABILITY OF SPECIAL ENVIRONMENTAL CONSTRAINTS

SYSTEM	4.6.1 SHOCK	4.6.2 ACOUSTIC	4.6.3 VIBRATION	4.6.5 PARTICULATE
ENCLOSURES	X	X	X	X
PUMPS:				
ROOTS	X	O	O	X
OTHER	X	X	X	X
VALVES	X	A	A	X
PURGE/VENT:				
CLEAN RM.	X	O	O	X
OTHER	X	X	X	X
BAKEOUT	X	O	O	X
CONTROLS	X	X	X	X

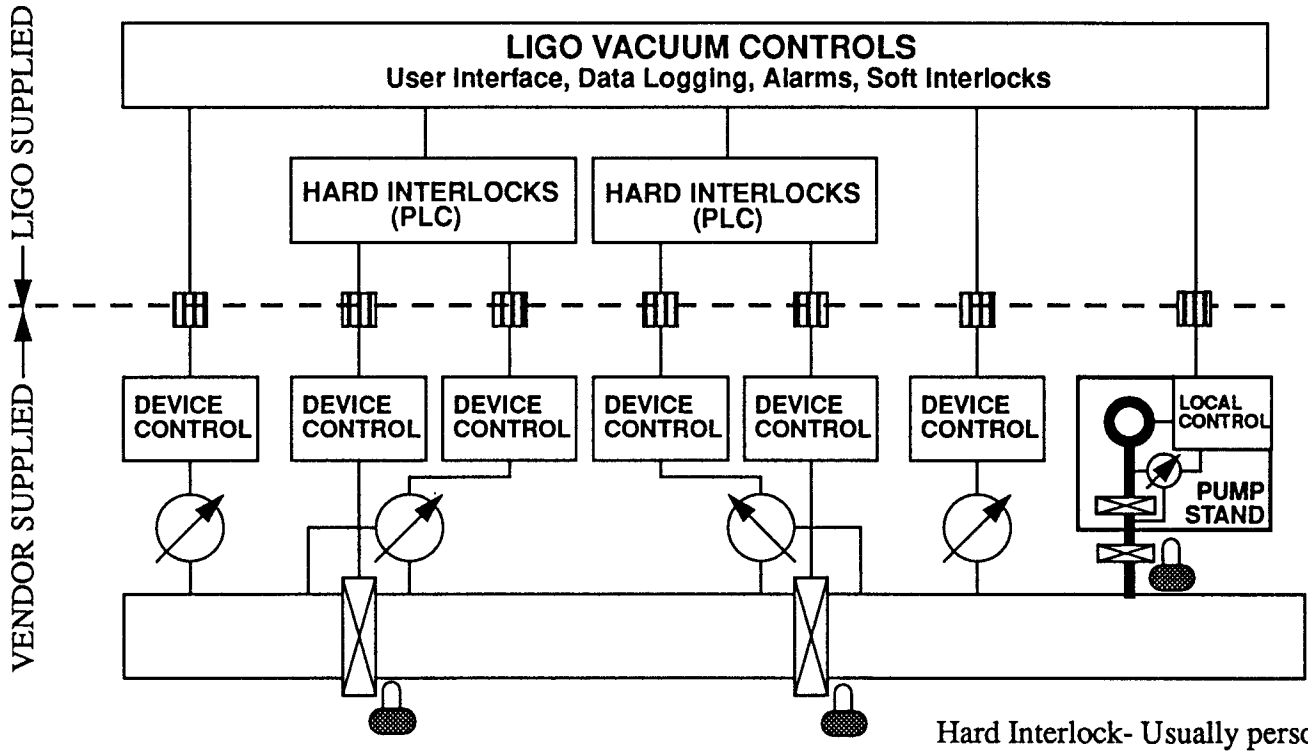
Key:
X = Applicable
O = Exempt
A = Exempt during actuation, applicable in end state (open or closed)

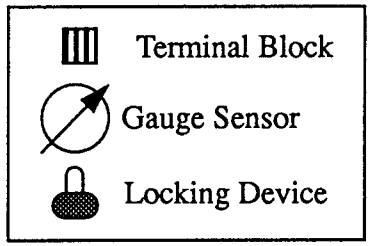
OBJECTIVE: OPTIMIZE COINCIDENT OPERATION

EXAMPLE SCENARIO: "ELECTRICAL FAULT IN WA HAM #4"



LIGO Vacuum Controls
Interface Between Vendor and LIGO Supplied Equipment





Hard Interlock- Usually personnel safety or critical device protection related.

Soft Interlock- Not related to personnel safety or critical device protection. Implemented in software by CDS.

Fig. 1: LIGO Vacuum Controls Concept

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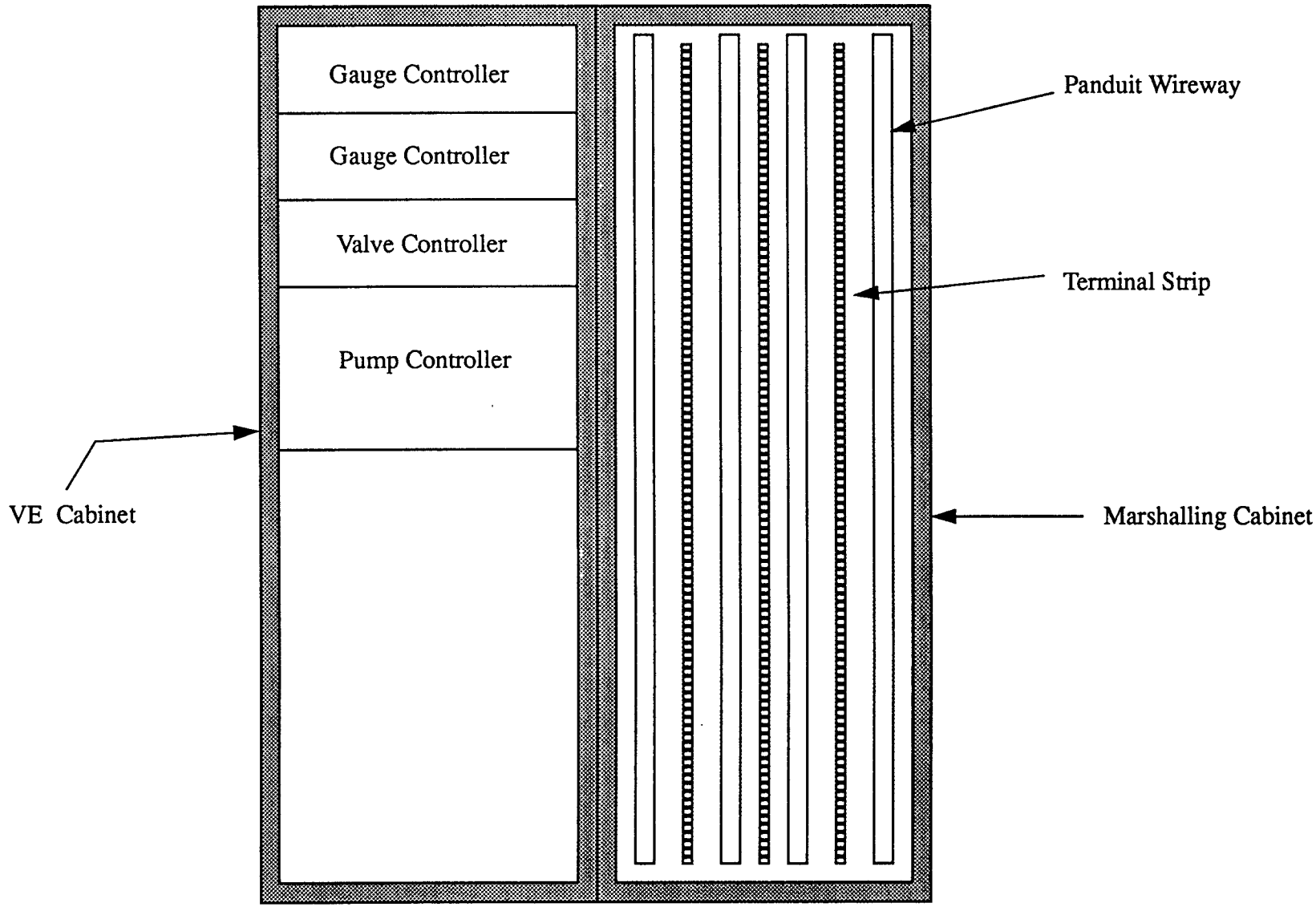
LIGO Vacuum Controls
Interface Between Vendor and LIGO Supplied Equipment

- The interface between the vacuum equipment and LIGO Controls will be at the terminal blocks provided by LIGO.
    - Vacuum equipment vendor will be responsible for cabling and connections from vacuum equipment to terminal blocks.
    - LIGO will be responsible for cabling and connections from terminal blocks to controls equipment.
- The terminal blocks will be located in a marshalling rack (LIGO provided) adjacent to or less than 10 meters from each vacuum equipment rack.
- The terminal blocks will be standard DIN rail mounted terminal blocks available from vendors such as Phoenix Contact, Wago and Weidmueller.
- LIGO will provide rack layout drawings and specifications to vacuum equipment contractor 2 months prior to VE FDR.

LIGO Vacuum Controls
Interface Between Vendor and LIGO Supplied Equipment

- Vacuum equipment contractor will provide LIGO with complete wiring drawings and signal lists at the VE FDR. Preliminary signal lists will be provided by the vacuum equipment contractor as part of the ICD at the VE PDR.
- Vacuum equipment contractor will, at the VE FDR, provide LIGO with sequences and interlocks which are required for commissioning and are to be implemented by LIGO Controls.

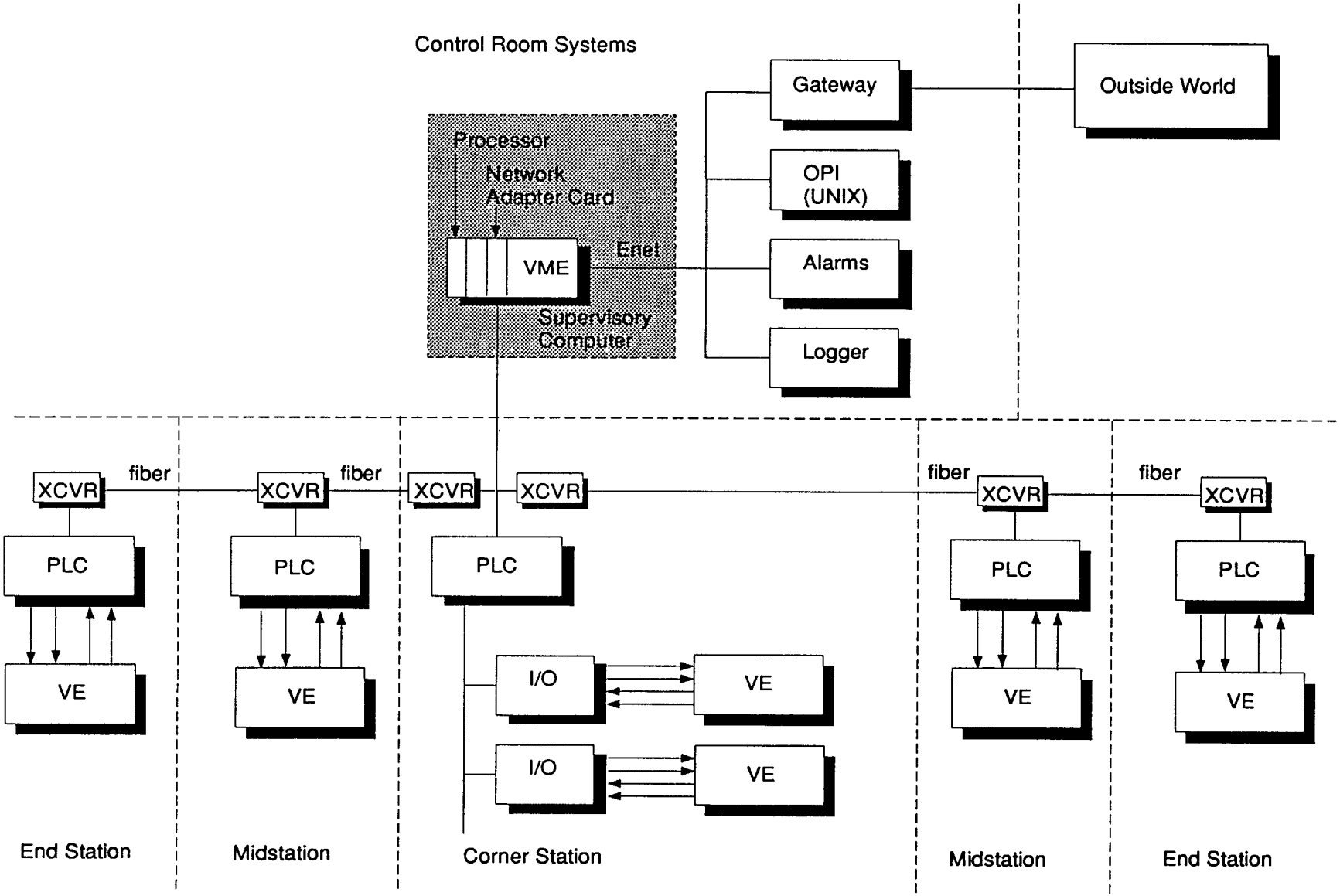
LIGO Vacuum Controls
Typical LIGO Marshalling Cabinet and Terminal Blocks



LIGO Vacuum Controls
Acceptable Signal Types To and From Vacuum Equipment

- The interface between LIGO controls and vacuum equipment will consist of discrete digital and analog signals. Acceptable signal types are:
  - Analog Input to Controls- 0 to 10 VDC, input impedance < 1 Kohm
  - Analog Input to Controls- 4 to 20 mA, input impedance 600 ohms nominal
  - Analog Output from Controls- 0 to 10 VDC, output current drive 10 mA max.
  - Analog Output from Controls- 4 to 20 mA, voltage compliance 15 VDC max.
  - Discrete Input to Controls- 24 VDC, input impedance greater than 1 Kohm, or contact closure with contacts rated at 24 VDC, 500 mA
  - Discrete Output from Controls- 24 VDC, 100 mA max.
  - Discrete Contact Output from Controls- 24 VDC, 1 A max.
  - RTD Temperature Measurement- ISO 385 curve platinum RTDs, 100 or 1 Kohm
  - Thermocouple Measurement- Types B, R, S, E, T, J, K
- Other signals types may be possible and will be considered on a case by case basis.

LIGO Vacuum Controls
Possible PLC Configuration



LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

- LIGO -

CALIFORNIA INSTITUTE OF TECHNOLOGY

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LIGO-C950416-00 -V 4/24/95

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LIGO Vacuum Equipment

Vacuum Equipment Controls and the Phase A Contractors

Title

J. Worden, M. Zucker

Author(s)

Vacuum Equipment Controls: Clarifications to Scope of Work in Phase B

For the purposes of the Phase A Design Competition, the proposers shall assume that the selected Phase B vendor will be responsible for the following scope of work related to controls equipment and software.

The vendors may assume that all LIGO-provided interlock and control equipment necessary for commissioning and acceptance testing of the Vacuum Equipment will be available when required. Tasks which depend upon availability of LIGO-provided equipment, and descriptions of such equipment, should be clearly identified in the Phase B proposals.

The boundary between LIGO and Phase B Vendor deliverables is depicted schematically in Figure 1, *LIGO Vacuum Controls Concept.*

1. Device Level Controllers, Power Supplies, and Safety Devices

The vendor shall provide control and power modules for all gauges, ion pumps, getter pumps, and power-assisted valves. Modules shall accept commands and report status information in compatible formats as outlined in paragraph 5.6 (Monitor and Control Subsystem) of the LIGO Vacuum Equipment Specification, LIGO-E9400002-01-V.

The vendor shall equip all equipment deemed capable of hazardous or disruptive accidental operation with physical lockout devices. LIGO will incorporate use of these devices in procedures for issuing personnel work permits. Types and locations of equipment requiring lockout devices shall be determined on the basis of Failure Modes and Effects and/or Hazards analyses, subject to LIGO approval. As an initial starting basis, LIGO suggests that all valves with apertures exceeding 8 inches be key-locked, and that removable handles be used on smaller hand valves capable of accidentally venting the envelope.

2. Envelope Interlocks and Valve Controls

Interlocking and user control interface for power-assisted valves on each vacuum envelope section (and for isolation valves between sections) will be provided by LIGO.

The vendor will specify operating sequences for normal operation of all equipment, and will recommend interlock functions and logic based upon these sequences and on FMEA and Hazard analyses. The vendor will also provide adequate sensors (redundant if necessary) to reliably derive all necessary pressure/status information for each volume. Interlocking and control requirements for Pumps, Bakeout and Vent/Purge subsystems are described separately below.

3. Pump Interlocks and Controls

3.1 Main Roughing, Turbomolecular and Annulus Pump Stations

Each movable pump stand shall be provided with valves, sensors, interlocks and controls adequate to assure safe and convenient operation as a standalone unit.

Summary status information outputs and top-level command inputs shall be accessible to LIGO Controls. Signals inputs/outputs shall conform to guidelines outlined in paragraph 5.6 of LIGO-E9400002-01-V. Where Programmable Logic Controllers or other microprocessor-based controls are used, networking, hardware and software/programming environment choices are subject to LIGO approval for interoperability with LIGO control standards.

3.2 80 K Pumps

Each 80K pump system (including any associated reservoirs, plumbing and circulation mechanisms) shall be provided with temperature and flow sensors, interlocks, and controls adequate for safe and efficient operation. Interlocking and control of boundary valves for the internal and insulating vacuum spaces will be provided by LIGO as described under "Envelope Interlocks and Valve Controls," above.

Summary status information outputs and top-level command inputs shall be accessible to LIGO Controls. Signal inputs/outputs shall conform to guidelines outlined in paragraph 5.6 of LIGO-E9400002-01-V. Where Programmable Logic Controllers or other microprocessor-based controls are used, networking, hardware and software/programming environment choices are subject to approval for interoperability with LIGO control standards.

3.3 Ion and Getter Pump Controls

Ion and getter pump controllers and supplies shall be provided by the vendor (see "Device Level Controllers..." above).

Summary status information outputs and top-level command inputs shall be accessible to LIGO Controls. Signal inputs/outputs shall conform to guidelines outlined in paragraph 5.6 of LIGO-E9400002-01-V. Where Programmable Logic Controllers or other microprocessor-based controls are used, networking, hardware and software/programming environment choices are subject to approval for interoperability with LIGO control standards.

4. Bakeout and Vent/Purge Interlocks and Controls

The bakeout system shall be provided with adequate sensors, controls and interlocks for safe, uniform bakeout of any isolatable vacuum section. It shall not depend upon LIGO controls for operation or safety.

The Vent/Purge system, including portable Softwall Cleanrooms, shall also be capable of standalone operation. Interlocking and control of vacuum boundary valves will be provided by LIGO as described under "Envelope Interlocks and Valve Controls," above.

Summary status information outputs and top-level command inputs for both systems shall be accessible to LIGO Controls. Signal inputs/outputs shall conform to guidelines outlined in paragraph 5.6 of LIGO-E9400002-01-V. Where Programmable Logic Controllers or other microprocessor-based controls are used, networking, hardware and software/programming environment choices are subject to approval for interoperability with LIGO control standards.

5. Physical Interfaces for Control Components

Electronic equipment cabinets for vendor-supplied devices and LIGO equipment will be provided against the walls nearest the beam manifolds in each building. In each corner station there are two such locations. Terminal blocks for connection of vendor equipment to LIGO controls will be provided within 10 meters of these cabinets. Cable trays linking the vacuum chamber areas with equipment cabinets will be provided by LIGO. The contractors' preliminary designs will be employed to determine the specific equipment space and layout requirements.

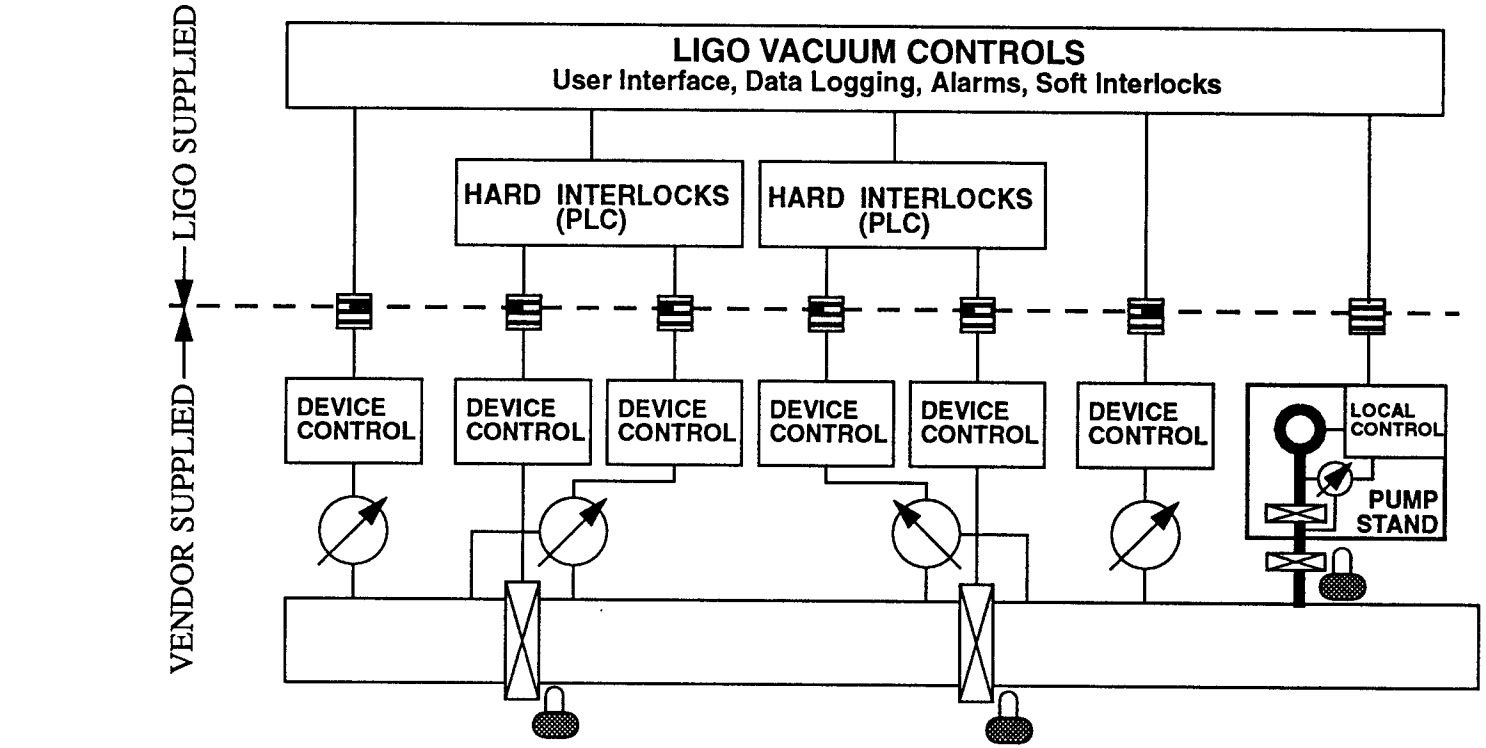

Fig. 1: LIGO Vacuum Controls Concept

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