BEAM TUBE BAKEOUT

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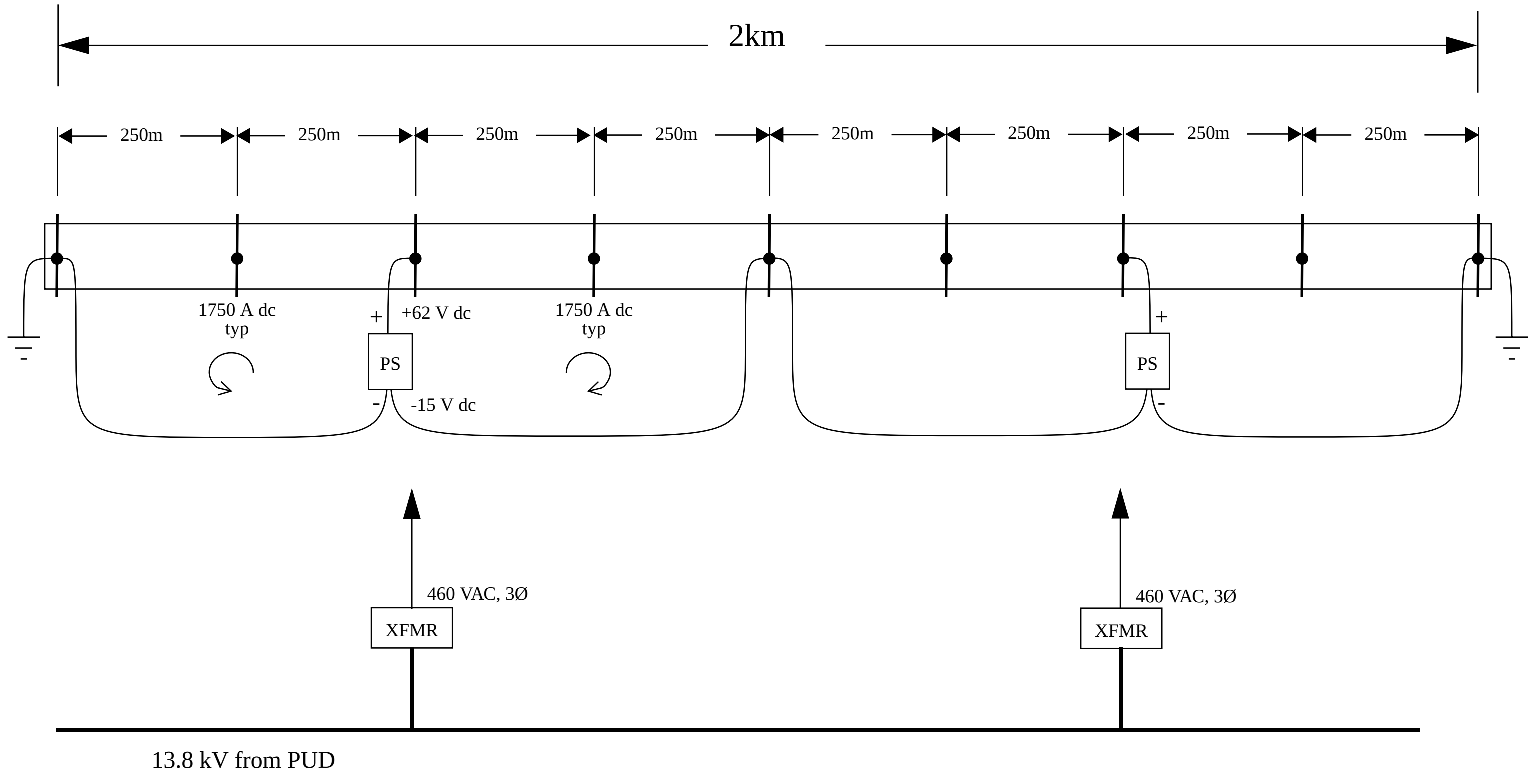
BEAM TUBE BAKEOUT REQUIREMENTS & OBJECTIVES

- LIGO Science Requirement Document
  - Sets the GOAL for residual gas pressure "... at a level or below an equivalent strain noise of 2×10^{-25} $Hz^{-1/2}$"
  - GOAL level supports future advanced interferometers (additional pumping may be used if needed)
  - Initial interferometer requirement is much more relaxed

- Bakeout Objectives
  - Reduce H_2O, CH_4, CO, CO_2, etc. outgassing to achieve partial pressures less than LIGO goal level (10^{-10} torr for H_2O, corresponds to strain noise of 2×10^{-25} $Hz^{-1/2}$)
  - Reduce outgassing of contaminating hydrocarbons to minimize risk to interferometer optics

BEAM TUBE BAKEOUT
ELECTRICAL HEATING POWER



NEED FOR TUBE HEAT[1] -

2 x 400 kVA = 800 kVA (summer days)
2 x 460 kVA = 920 kVA (summer nights)
2 x 505 kVA = 1010 kVA (winter nights)
2 x 550 kVA = 1100 kVA (coldest winter nights)

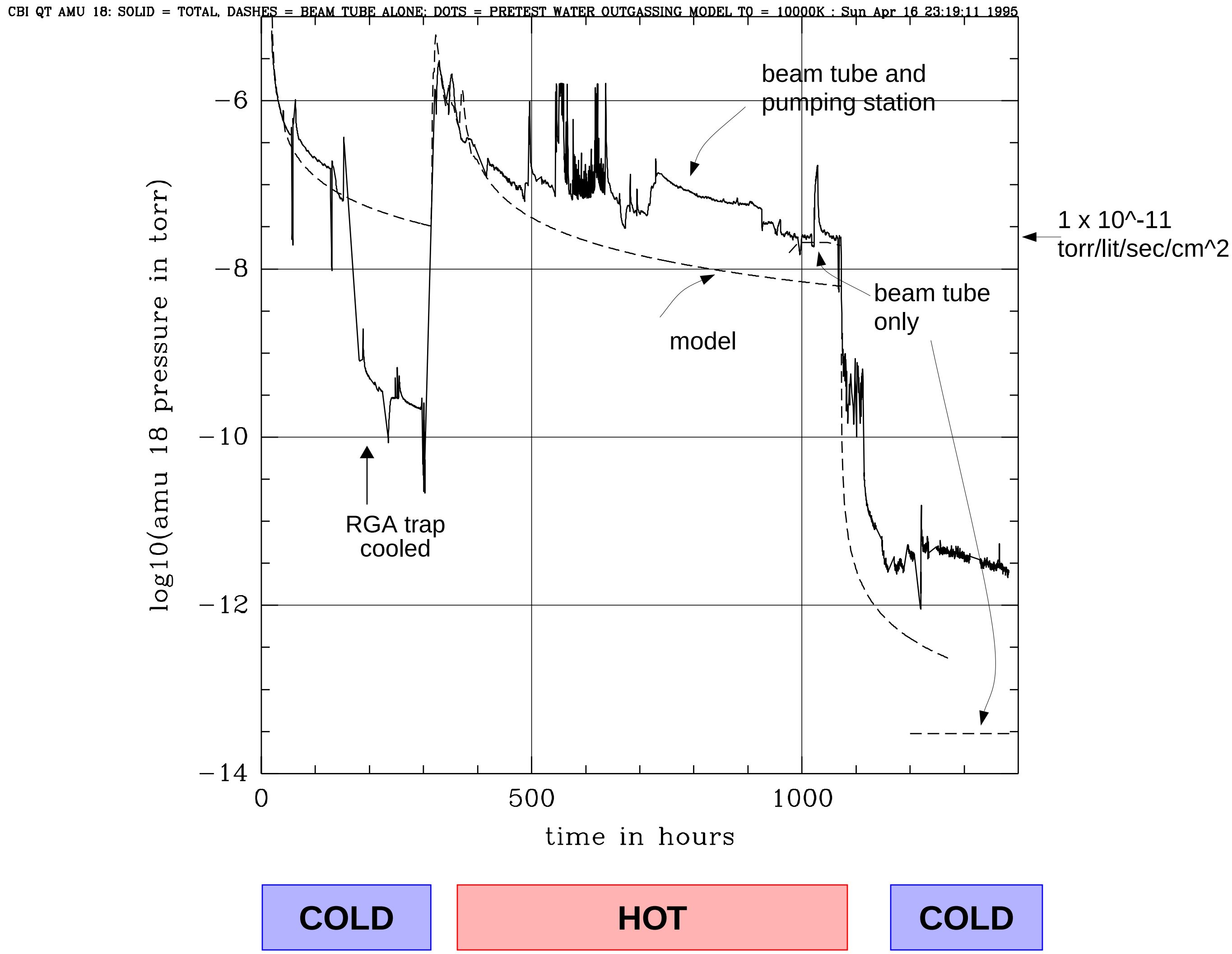
[1]Additional power required for pumps, instrumentation, auxiliary heating

Legends:

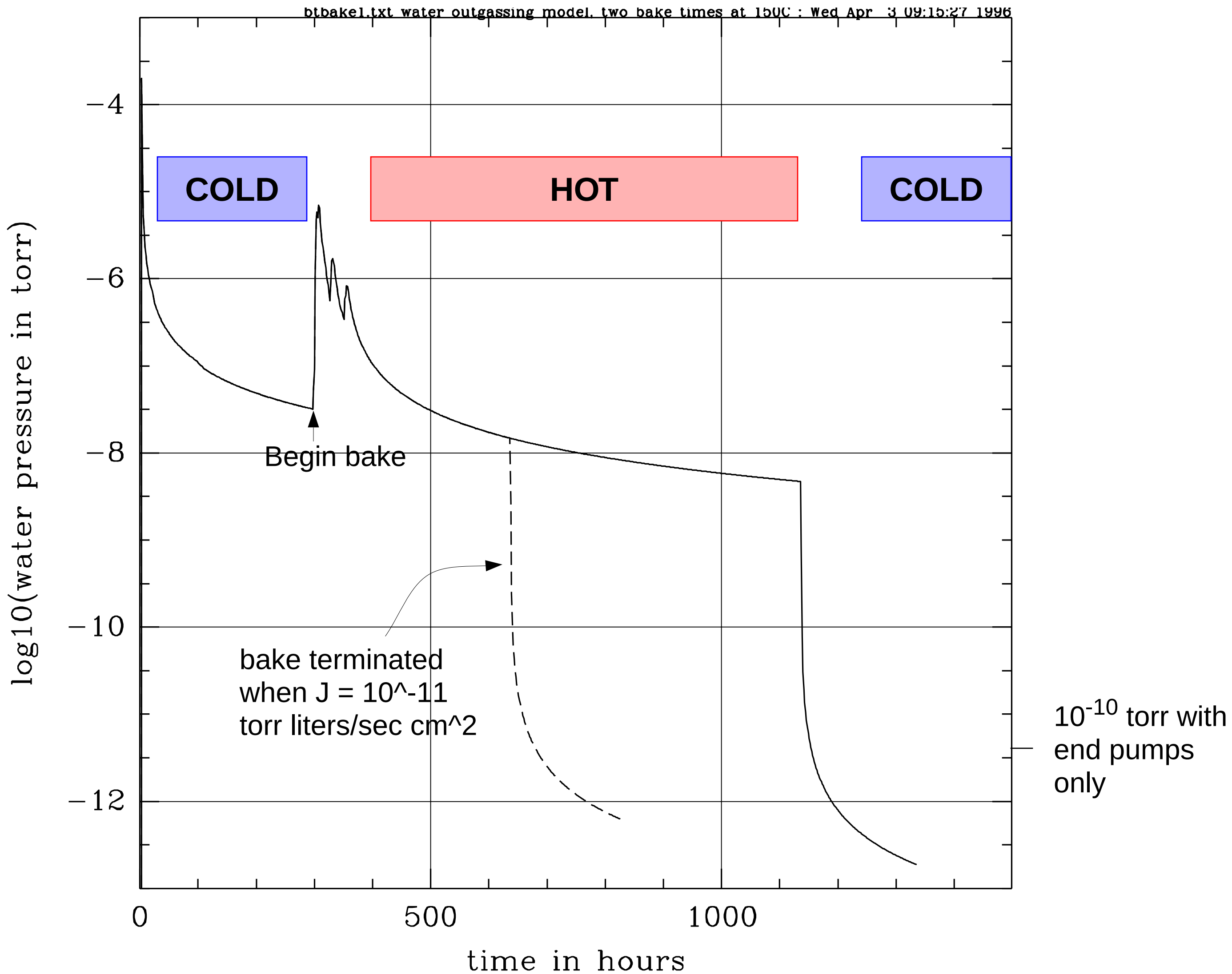
PS — Low voltage, high current DC power supply

XFMR — Power Transformer

H_2O PRESSURE - QT BAKEOUT



H_2O PRESSURE REDUCTION MODEL



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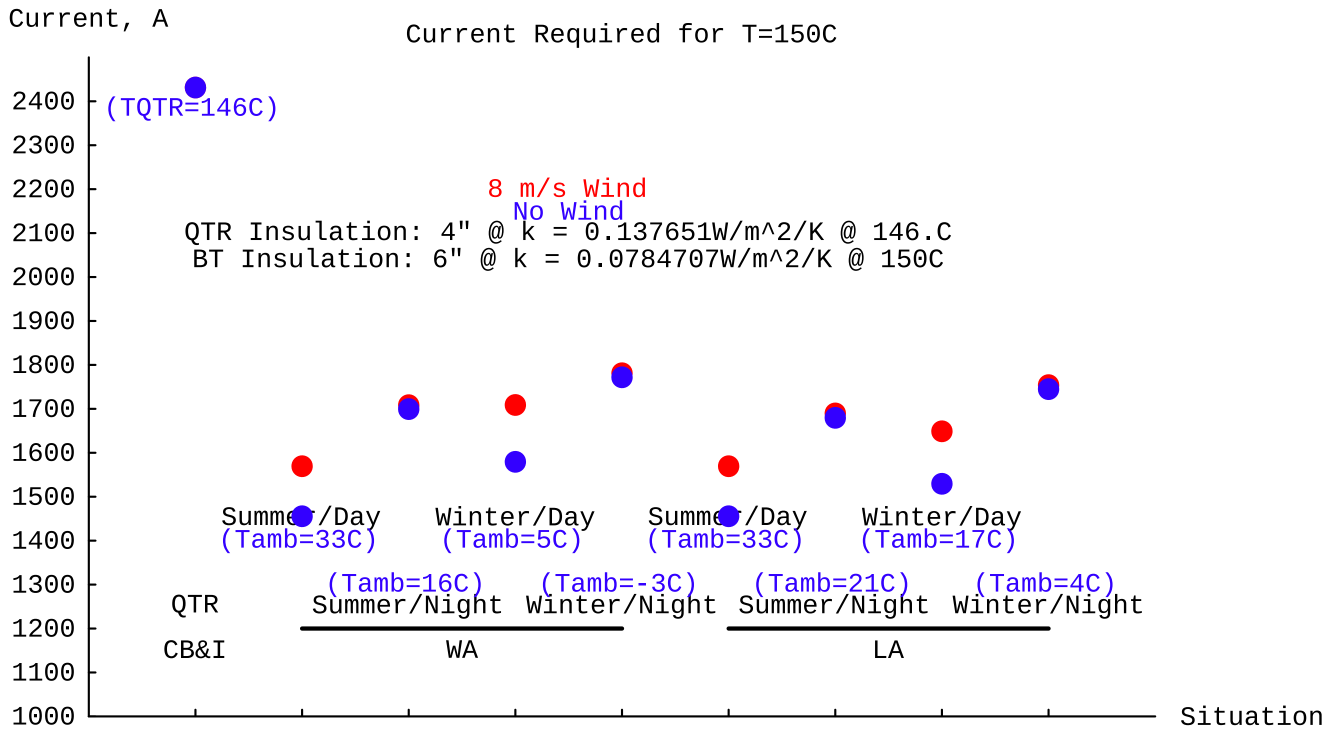
BAKEOUT POWER MODEL



BAKEOUT PLAN

- Conduct bakeout without interference with CBI and PSI installation activities
- Schedule bakeouts so that on-site LIGO staff can handle setup and execution
- Conduct first 2 km module bakeout to:
  - Validate insulation, heating and pumping designs
  - Evaluate beam tube mechanical behavior during bake
  - Shakedown the setup, bakeout and post-bake procedures (and maybe the post-bake leak localization and repair procedures)
- Iterate procedures and designs as needed
- Bake 3 remaining modules at Hanford, ship equipment to Louisiana, and bake 4 modules

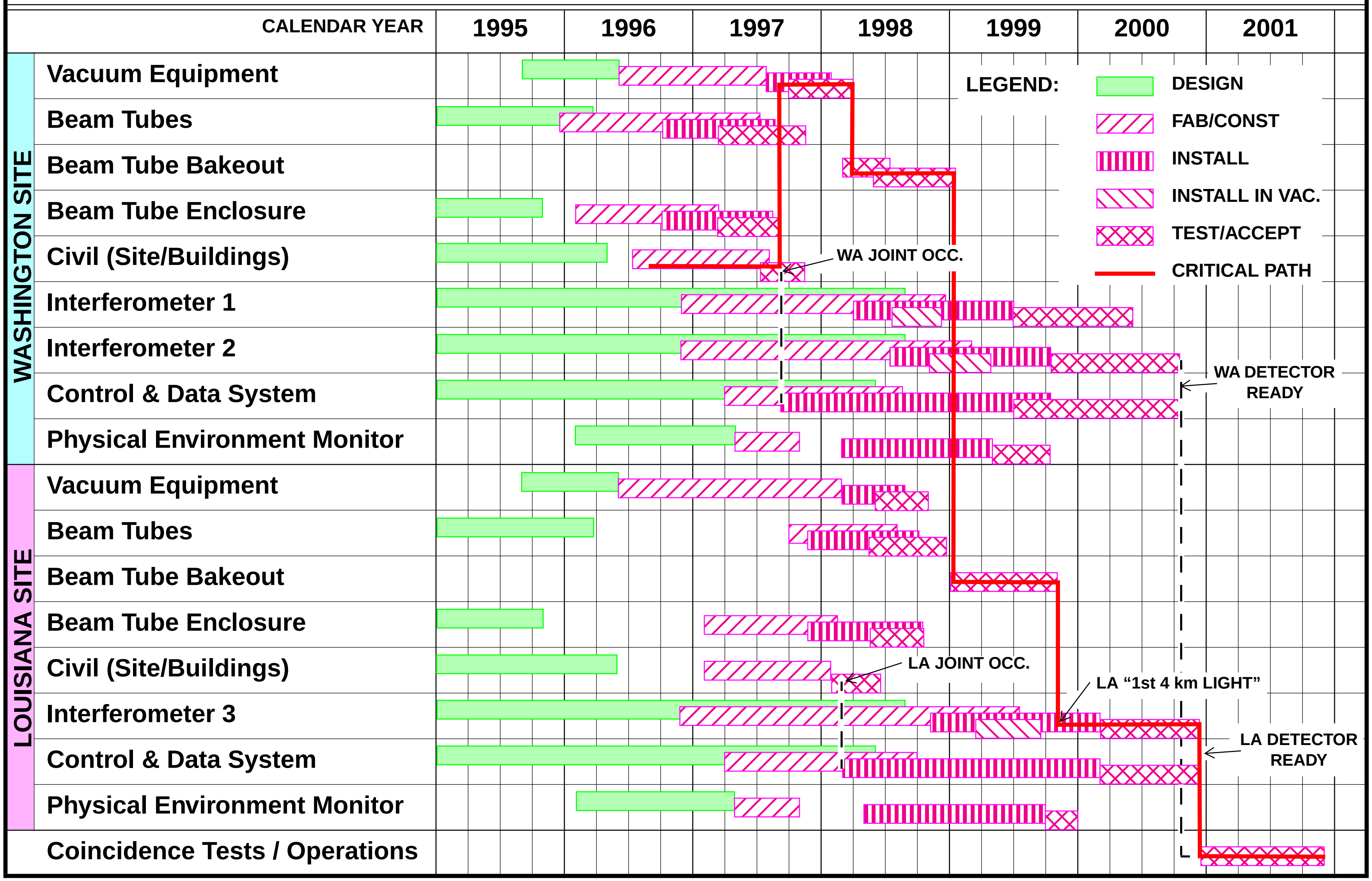
STAFFING & SUBCONTRACTS

- On-site staffing requirements:
  - Site scientist/engineer to supervise setup, bakeout, data evaluation
  - 2 site technicians (2 m-yr. per site) for equipment installation, checkout and removal
  - 4 site or temp. technicians, 1.5 m-yr. per site for 1-person-24 hr. bake monitoring
- Subcontracts:
  - Insulation contractor: purchase, prepare and install beam tube insulation
  - Power company: furnish, install and connect temporary transformers for primary AC power
  - Electrical contractor: install and connect DC power source and auxiliary AC power for pumps, instrumentation and controls

IN-HOUSE VS. SUBCONTRACTED BAKEOUT

- Advantages to carrying out the bakeout with on-site staff
  - First module bakeout conducted like a scientific experiment - our “only” beam tube is at risk
  - Appropriate scientific and engineering expertise already “mobilized” on site
  - Experiences of on-site technical support staff during bakeout will remain with and benefit LIGO
  - Reduced possibility of interference with other on-site activities
- Found no advantage to subcontracting the bakeout
  - Not a standard subcontracting item/activity
  - Insulation/equipment costs same (equipment will be recycled into LIGO operations activities)
  - Labor costs higher per m-hr (contractor overhead and profit) and experience disappears after completion

SUMMARY INTEGRATED SCHEDULE



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