Operating the Observatories

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Motivation for presentation

Costs to operate the LIGO sites increase in 2002 and beyond.

One might think the costs should decrease, since installation work will have concluded

I will describe factors contributing to anticipated *increased costs* for observatory operation

Roadmap for presentation

1. Brief overview of FY2001 operations budget.
   - "Fixed" costs.
   - "Variable" costs related to activity.
   - FY2001 budget is based on experience with site operations since FY97. We have developed a fairly mature understanding of fixed costs needed to sustain the sites.
2. Comparison of budget requirements for round-the-clock operation in FY02 with installation and commissioning requirements in FY01.

FY2001 Operations Budget Fixed Costs

- Approximately 50% of budget is resident staff labor
  - 7 scientific staff (including LDAS scientist installing/commissioning system)
  - 6 engineering support – 2 software, 1 ea: vacuum, optics, electronics, facilities (maintain installed infrastructure)
  - 9 operations/tech support (specialists in network support, electronics, vacuum, optics, etc.) transition to become operators
- Approximately 20% of budget is for building and site maintenance, utilities, etc. (more at LLO where utility costs are higher)
- Approximately 5% of budget is for vacuum system operation at each site (more at LHO where system is larger – includes LN purchases)
- Approximately 4% of budget supports computer and network operations at sites – (includes maintenance contracts and supplies)
- Approximately 3% of budget is for phones, administrative supplies, incidental electronics and optics supplies.
- Approximately 3% other miscellaneous expenses (repairs, travel by site staff, etc.)

Fixed Costs total approximately 85% of FY01 Operations Budget

FY2001 "Variable" Costs

- Approximately 15% of budget at each site needed to complete installation/commissioning (more in percentage and absolute values at LHO since 2 IFO's)
  - Approximately 7-10% of budget supports travel to sites (again more at LHO where there are two IFO's)

FY2001 Operations Budget

- One might expect operating budget to decrease by about 5-8% at conclusion of commissioning
  - Elimination of installation costs for tooling, supplies, services, contract labor related to installation
  - Travel should remain about the same level to support campus participation in data taking

But there are also budget increases that occur

Major Contributing Factors to Proposed Budget Increase

Costs stated relative to FY01 site operations budget:

- +15% (~$1380 annually)
  - Replacement of control and data acquisition electronics on 4 year cycle
  - *recommended by NSF review panel*
- +6% (~$540K annually)
  - Networked data distribution via OC3
  - *recommended by NSF review panel*
- +6% (~$515K annually)
  - Maintenance and replacement of control room computer eqpt, custom electronics, and embedded controllers.
  - Represents about 10% of total value of control room computers and 5% of total value of custom electronics and VME controllers

Major Contributors to Proposed Budget Increase (ctd)

Costs stated relative to FY01 site operations budget:

- +11.5% (~$1062K annually) Labor:
  - +6% - Operations personnel to staff continuous running of the interferometer and to support around the clock analysis and management of data on-site
  - +3% - Additional resident scientific staff at each site to provide effective liaison to utilize LSC visitors. To effectively utilize LSC visitors so they can be productive requires some investment of time by site staff to work with them, coordinate visit, etc. A small investment by LIGO to get leverage a big payoff from LSC
  - +2.5% - An explicitly dedicated outreach budget with material and labor support

Detail - Staffing Increment to Support Full Time Operation

- Operating philosophy: 2 operations specialists per 8 hour shift, plus scientific staff
  - Level of scientific staff coverage to be dictated by experience – most likely *at least one* scientist per shift for initial operation (requires visitors from campuses to sustain this), and hopefully reduced coverage if/when operations become routine.
  - Role of scientist is to be the “eyes and ears” of the scientific community that will analyze the data – identify what are unique features of interferometer, environment, configuration, etc. That should be known by those looking at the data. Important to maintain travel budget from campuses to sites to fully support this role
- Around the clock operation requires 9.7 operations specialists vs 9 budgeted during commissioning phase – assuming normal operation, no training courses, flu epidemics, etc.
  - Additional operating staff needed to make operation robust; handle exceptional conditions

Staffing Increment Detail (ctd)

- +2 FTEs each site to staff control room operations and other repairs, calibrations, LSC liaison
- +1 FTE each site: Full time systems administration for general computing (now being done part time by operators)
- +1 FTE each site: Staff to support 24 hour LDAS operation
  - Present budget has one scientist dedicated to installation and commissioning of system
  - Additional tech support required for system support and maintenance and for data management, “data librarian” to manage data distribution
- +1 FTE each site: LSC liaison scientist.
- +1 FTE each site: Outreach staff

Budget Summary

- FY02 budget deltas for recurring operations:
  - -8% elimination of installation costs
  - +21% replacement of computing and electronic hardware
  - +6% network distribution of data
  - +11% labor to support 24x7 operation and outreach

NET INCREASE: ~30% recurring

- Additional $506K (non-recurring) for engineering of active seismic isolation system for LIGO upgrade (2 years only)