

MEMO:phaseapout.tex  
 FROM: PS,RW (December 7, 1988)  
 TO: W.Althouse and F.Raab  
 CONCERNING: Outline of Draft on Phase A Operations

### ASSUMPTIONS BEING MADE

#### 1) LIGO schedule:

Design freeze of initial interferometer 4/91

Facilities at first site complete 1/94

Facilities at second site complete 1/95

#### 2) People estimated by 1/93:

LIGO engineering staff 6

Scientists on the project 12

Design, technical and construction support on the project 6

Graduate students on the project 8

Facilities specific people (programmer,site manager,vacuum technician,  
 facility operator,maintenance) 5/site

#### 3) Responsibilities of this group:

##### a) Receivers

Design, construction, qualification, pretesting and installation of the receivers into the facilities some help from industry where it is possible and cost effective.

##### b) Facilities

Monitor and guide design and construction of the facilities. Initial shakedown; manage and guide the vacuum system installation and testing; design, test and program the facility data acquisition system; design install and debug environmental monitoring and control system; design, qualify and test facility/receiver interfaces

##### c) Diagnostic studies of receiver performance

d) Configure data analysis hardware, develop algorithms,write and debug data analysis software, develop data logging pipeline.

### Estimates of time required in man years

#### Receivers:

1) Isolation systems

2) Pointing systems

3) Laser stabilization and power enhancement

4) Mirror testing and qualification

5) Optical components testing and qualification

- 6) sensor development and construction (industrial contract?)
- 7) electronics design, fabrication, testing and qualification

Facilities:

- 1) Vacuum system test and qualification
- 2) Receiver/facility interface debug and qualification
- 3) Data acquisition and storage system qualification and test
- 4) Facility and environmental monitoring instrumentation system installation, debugging and qualification
- 5) Laser cooling system test and qualification
- 6) Data analysis and communications computer system installation, qualification and debugging
- 7) Data acquisition software development and debugging

Operations:

- 1) Receiver installation and debugging
- 2) Receiver signal diagnostic studies in correlation with environmental and other monitoring signal
- 3) Development of quicklook software
- 4) Development of data analysis software
- 5) The data analysis for gravitational waves

(Need to have an idea of the people and the tasks and times involved to think about a realistic initial operations scenario)

#### Issues to Address in Developing an Initial Operations Strategy

- 1) The home facilities
  - a) Expectations for the home facilities, type of capability and equipment
  - b) Testing that can be done on the initial receiver at home facilities
- 2) The Initial search receiver(s)
  - a) The degree of reliability - the amount of effort expended to pretest and qualify, the evaluation of pretest in longer facilities (for example, Huntsville) to anticipate the extrapolation from the prototypes,
  - b) The sensitivity requirement and band choice - based on absolute standards or relative to the state of the art at the time
  - c) The value of full and fractional length interferometers in the initial search .
  - d) The effort put into diagnostic studies before changes in the search receiver are made or a new receiver is begun

- e) "Engineered" versus developmental receiver- mechanism for declaring a receiver design sufficiently tested to be promoted to full-time search.
- f) The role of the receiver(s) at the second site initially

3) Mechanism for sensitivity improvement in phase A

- a) Criterion to decide on improvement of search receiver vs development of new receiver
- b) The strategies to avoid interference in the search by development receiver research

4) Strategy for the development of receivers at the second site

- a) Simultaneous or staggered receiver build - should one wait so as to incorporate the experiences at the first site, and if so, how long?
- b) Are both sites to be used for both search and development?

5) Consequences of operations scenario

- a) Typical number of people on site during facility shakedown, receiver installation and shakedown, data collection and debugging, Mark II development-office space, lab space, living accommodations? Do we need housing for a site manager or any other resident staff?
- b) Is tank space (especially footprint) adequate for first receiver scenario? Corner chamber presumably for first installation of anything new? Is access sufficient in current design, or do we need to be able to completely lift tank clear of internals? Do both full- and half-length interferometers fit in corner chamber? Do we need special rigs for working in LIGO tanks-scaffolding, clean fork lifts, portable "clean rooms", or the like? Are all tanks big enough to hold realistic receiver designs? What is minimum number of tanks required?
- c) How will skill mix change in engineering staff change over time? Eventually, civil engineering over. When do we have on-staff engineer to help in the process of "engineering" a validated receiver design for residence in vertical-access tanks? Are there other special engineering skills we will need to add as project matures?
- d) Communications links between sites and to home institutions- what sort, what bandwidth, what information available? Real-time cross-correlation between sites? "Remote observing" from home institutions? Will control panel be computerized as in modern factory, making it accessible over remote link?