Memorandum

July 10, 2003

To: Dave Hogg and Ted Miller

From: Richard Bradley, Alan Bridle, Bill Porter, and Dale Webb

Subject: Review of Space Requirements - Committee Report

Committee Charges

On June 26, 2003, this committee was appointed by D. Hogg to review the space requirements of the future NRAO Charlottesville facilities in order to address concerns raised by the NSF over the proposed leased space request and to consider an option not previously addressed. The Committee met on July 8 , 9, and 10, 2003 in Charlottesville to address the following charges:

a) Explore a facilities option that entails using the expanded Edgemont Road facility for as much laboratory space as possible, reconfiguring the existing Dynamics Building to support what functions it can, and then identifying what functions, if any, are not accommodated at either Edgemont Road or the Dynamics Building that will require placement at a third site for some period of time.

b) Determine where such functions are located with the goal of finding the most efficient use of space.

c) Consider what changes would be necessary at the Dynamics Building to accommodate whatever functions the committee proposes to place at the existing Ivy Road spaces as well as what changes would be required to the Edgemont Road facility.

d) Identify and quantify whatever cannot be put into these two facilities in terms of type of function, square foot requirements, and any special needs the function may require.

e) Consider the extremely important issue of timeliness ... the need to meet ALMA milestones and that a decision was required on the Dynamics Building lease by July 1, 2003. (This charge was a later addition by T. Miller.)

Executive Summary

• The Dynamics Building is a structurally unsuitable building for further expansion of NRAO activities as defined in this report. In addition, it has a number of characteristics that make it potentially unsafe for the type of work demanded of the NRAO Technology Center. We conclude that the Dynamics Building cannot play any ongoing role in meeting the requirements of this Center, and the NRAO should vacate it as soon as possible.

• In response to the charges to this Committee, an effort was made to plan for inserting as much of the Technology Center as possible into reconfigured space at the Edgemont Road building. Only two major laboratories, Correlator and Photonics, would fit into the available space. Locating both of these at Edgemont Road would lead to over crowding there within three years as the Science Center expands, and would produce an undesirable separation of the Photonics Labs from the rest of the Technology Center.

• The Edgemont Road Building can and should house the ALMA Correlator Lab once the Building expansion is completed.

• An alternate facility must be found to house all other components of the Technology Center. The NRAO should move the existing engineering staff and labs into this facility by the end of 2003. We know of only one facility in Charlottesville that can meet the technical requirements of the Technology Center on the necessary timescale. This facility is the former Institute of Textile Technology (ITT), which is capable of housing approximately 80 employees and high level technical applications.

• Time is now of the essence if the ITT facility is to be readied for NRAO occupancy in time to receive the activities that should be vacated from the Dynamics Building.

Assumptions

• We acknowledge the creation of the U.S. ALMA Science Center and the NRAO Technology Center in Charlottesville.

• We acknowledge that the Observatory-wide consolidation efforts will result in the closure of the Tucson facility and moving approximately 38 persons to the Charlottesville facilities.

• The Edgemont Road building has already been reconfigured to meet the needs of the scientific, administrative, computing services, human resources, and business components of the NRAO in Charlottesville, including the location of the new U.S. ALMA Science Center.

Discussion

A national center of excellence for science and technology in the 21st century places demands on its facilities that go far beyond providing enough physical space for its employees to work. These facilities must provide appropriate work spaces whose unique characteristics are driven by the science and technology objectives of the center. In addition, it must create an atmosphere that enhances creativity and encourages efficiency among the staff. This objective is being hampered by our current circumstances that place 147 persons in four separate buildings located in both Charlottesville and Tucson.

Over the past several years, it has become increasingly apparent that the present facilities of the Central Development Laboratory (CDL) located in the Dynamics Building on Ivy Road in Charlottesville do not meet current and future NRAO requirements. Indeed, these inadequacies provided the foundation for justifying the Edgemont Road building expansion as described in a June 17, 1998 Needs Statement written by CDL staff in preparation for the Millimeter Array construction activities. In July, 2002, the NSF gave approval to the Edgemont Road Building expansion plan based upon the NRAO Charlottesville Facilities Plan submitted to the NSF by the NRAO on March 8, 2002. However, in April, 2003, the NRAO Director decided to consolidate NRAO facilities by closing the Tucson site and creating the U.S. ALMA Science and NRAO Technology Centers in Charlottesville. A result of this decision will be the transfer of at least 38 persons from Tucson and possibly several persons from Socorro to Charlottesville. The expanded space under construction at the Edgemont Road building was quickly reconfigured from engineering laboratories to office space and the supporting infrastructure was downsized accordingly. From a financial and timetable standpoint, it is now too late to reconfigure this building again. At present, the configuration can easily accommodate about 110 persons with the focus placed clearly on scientific and administrative activities and not on engineering. This new U.S. ALMA Science Center and combined NRAO Headquarters building will be fully utilized within three years of completion as shown by Table 1 outlining space and personnel requirements previously sent to the NSF.

The search for adequate space to support the new NRAO Charlottesville Technology Center began in May, 2003 with a re-examination of the Dynamics Building. The most fundamental problem is that this building was originally designed as general office space and therefore lacks the basic characteristics required for a modern high technology electronics laboratory. For example, the building consists of several floors that are supported only by the outside walls via a cantilevered truss resulting in a structure that is prone to sizable mechanical vibrations during normal use. Severe weight restrictions are also imposed. These limitations have forced the NRAO to perform tolerance sensitive activities such as microassembly, micromachining, and wire bonding on the (only) 2,500 sq. ft. concrete slab floor space that is available on the first floor. This restriction has resulted in an overcrowded machine shop and in splitting other laboratory functions between floors to make use of this precious solid floor space. In addition, difficulty of access to the machine shop has limited the physical dimensions of the machines that can be installed. Additional problems with the use of the Dynamics Building

include the lack of a freight elevator, low ceiling heights, severe dust contamination, inadequate AC power circuits, inadequate temperature and humidity stability, and a limitation on the amount of noise that can be generated by the cryogenic compressors and fume hood exhaust systems without disturbing the occupants of adjacent commercial property. There are now and have been for many years major safety concerns at this facility. They include: 1) limited size and thus over-crowded machine shop with no safe places to weld (and thus no welding capability) , 2) chemistry laboratory used in a building not designed for, or properly adapted to, handling, storage, and use of hazardous chemicals, 3) inadequate lifting facilities for heavy equipment and no structure to support or room to install proper equipment, 4) noise pollution from loud cryogenic systems with no place to mount these systems properly, 5) generally inadequate ventilation systems in the machine shop which allows oily mists to adversely affect the operation of sensitive and precision equipment located nearby. The requirements on the space for the critical ALMA Front-End Integration and Support Facility such as a large (3,200 sq. ft.) open area with high ceilings and a concrete slab floor cannot be satisfied at the existing Dynamics Building.

These are all serious and potentially expensive problems with this building. **We conclude that the Dynamics Building cannot play any ongoing role in meeting the requirements of the Technology Center, and the NRAO should vacate it as soon as possible.** The engineering staff should be focused on solving important technical problems in radio astronomy instrumentation, rather than spending time searching for ways to work around building inadequacies.

As an aside, the present owner has indicated his desire for a single tenant to occupy the building after NRAO's current lease expires in December, 2003. A decision by the NRAO to occupy the entire building should have been conveyed to the owner by July 1, 2003 (the NRAO's one month extension request for this decision has been rejected by the owner). We strongly recommend that the NRAO not renew this lease, but instead move all of the existing Charlottesville engineering staff to an alternate site by December 2003.

Our response to charges (a), (b) and (d) is therefore summarized in Table 2, which lists the space requirements and special needs of all functions to be carried out in the NRAO Technology Center, and identifies those functions which can possibly be done at Edgemont Road. The Committee understands that the technical activities conducted within our various laboratories are tightly coupled through the need to share equipment, utilize machine shop facilities, exchange ideas and procedures, etc. Splitting a center between several locations will lead to inefficiencies and loss of productivity. While this Committee agrees that the ALMA Correlator Group (1,200 sq. ft. lab plus 9 offices), the ALMA Photonics Group (1,500 sq. ft. plus 4 offices), the technical library, and the drafting offices could, in principle, be located at Edgemont Road as shown in Table 2, we do not recommend this plan. Rather, we recommend that only the Correlator Group be located at Edgemont Road after completion of the addition. This recommendation is based on three points: 1) the Correlator Group is a good fit to the space and infrastructure available on the First Floor of the Edgemont Road building, 2) its

instrumentation is a strong source of radio frequency interference (RFI) and the Edgemont Road facility is RFI tolerant, and 3) the Correlator Group may not suffer greatly due to the separation from the NRAO Technology Center and may benefit from proximity to the end users at the U.S. ALMA Science Center.

Given our conclusion about the Dynamics Building, our response to charge (c) is moot, so we proceed directly to (d) and (e). All activities that cannot be located at Edgemont Road as shown in Table 2 must be located at a third facility in Charlottesville. **This facility should be as close as possible to Edgemont Road to promote interaction between the staff in the two buildings, and must be available for full occupancy by the technical staff who are now in Charlottesville by the time the existing lease of the Dynamics Building expires, i.e. by December 31, 2003.**

Although not asked for in its charge, this Committee wishes to comment on the location that best fits these requirements. We know of only one laboratory site in Charlottesville that meets all of these needs ... the former Institute of Textile Technology (ITT) site at 2551 Ivy Road. These buildings were originally designed as laboratory space and provide the solid concrete slab floors, high ceilings, a large freight elevator, suitable AC power, a working chemistry laboratory, etc. that can be reconfigured to our specifications. The ALMA groups (photonics, local oscillator, and correlator), the ALMA Front-End Integration and Support Facility, and the research and development groups (low noise amplifier, low noise SIS mixer, and cm-wave electronics) together with the machine shop, chemistry lab, drafting, technical library, engineering administration, and office support (conference rooms, canteen, communal space, shipping/receiving, storage, etc.) all fit nicely into the space that is available at this location. This site is clearly an excellent fit to our requirements for structure, ability to meet special needs and safety requirements, reasonable proximity to Edgemont Road, and availability for occupancy by the end of 2003. We conclude that the only known and best possibility for obtaining appropriate space for the new NRAO Technology Center is the immediate rental of the ITT buildings. This allows for closure of 20,000 sq. ft. of labs and offices in Tucson and closure of 16,457 sq. ft. of inadequate labs in Charlottesville, and combines those efforts in the ITT, 38,500 sq. ft. facility.

We have noted that the combination of the Edgemont Road and ITT could exceed our immediate space requirement by as much as six percent. This is a potential benefit to the NRAO, because it will permit locating the Correlator Group at ITT before the Edgemont Road addition is finished, allowing the digital group to meet required ALMA milestones, and will allow for additional technical programs that are in early stages of planning, such as FASR, or for permanent location of the Correlator Group at ITT and use of the ground floor at Edgemont Road for other NRAO activities still under discussion.

Table 1. NRAO Charlottesville and Tucson Staffing Projections

Calendar Year	Tucson		Charlottesville							
			Edgemont Road Stone Hall		2051 Ivy Road Dynamics Builiding		2496 Old Ivy Road Old Ivy Commons		2551 Ivy Road ITT	
	People	Gross Sq ft	People	Gross Sq ft	People	Gross Sq ft	People	Gross Sq ft	People	Gross Sq ft
2002	36	20,000	61	24,423	45	15,487	-	-	-	-
2003	39	20,000	53	24,423	39	17,387	16	5,184	-	-
2004	31	20,000	53	24,423	-	-	16	8,014	48	38,500
2005	23	20,000	75	60,261	-	-	-	8,014	61	38,500
2006	-	20,000	93	60,261	-	-	-	-	79	38,500
2007	-	-	101	60,261	-	-	-	-	79	38,500
2008	-	-	108	60,261	-	-	-	-	79	38,500
2009	-	-	115	60,261	-	-	-	-	79	38,500
2010	-	-	121	60,261	-	-	-	-	79	38,500
2011	-	-	121	60,261	-	-	-	-	79	38,500
2012	-	-	121	60,261	-	-	-	-	79	38,500

Table 2. NRAO Charlottesville Technology Center Requirements

Function	Number of Staff	Assignable Sq.Ft.*	Special Needs	Special Issues	Edgemont Road?
ALMA Photonics	11	1,500	Slab, clean, HVAC, optical bench	LASER safety	Poss
ALMA LO	6	800	Clean, anti-static, cryo		No
ALMA Correlator	6	1,200	Heavy duty HVAC, power, anti-static	RFI source	Poss
Correlator Programmers	4	1,025	Proximity to correlator		Poss
ALMA Front-End Integration and Support	22	3,200	> 11 ft. clearance, cryo		No
Chemistry	1	800	Special ventilation, HAZMAT storage and containment, emergency power cutoff, showers, alarm	HAZMAT, fumes	No
R&D - Amplifiers	7	1,700	Slab, temp+humidity control, low RFI, clean, cryo		No
R&D - SIS Mixers	4	2,200	Slab, temp+humidity control, low RFI, clean, cryo, shielded room		No
R&D - cm-wave systems	3	1,200	Low RFI, cryo, anechoic chamber		No
Machine Shop	5	2,400	Slab, wide access, temp+humid control, ventilation/mist control, welding capability, high floor load		No
Cryo Compressors	N/A	500	Adequate ventilation, power, high floor load, proximity to cryo dewars	Noise, vibration source	No
Drafting	3	500	Flat file space		Poss
Technical Library	N/A	1,200	High floor load, low humidity, low sun light		Poss
Shipping and Receiving	1	500	Loading dock, access to and from labs by freight elevator		No
Staff Offices	Included with labs	3,600	Proximity to labs		No
Lab Management	5	1,200	Proximity to staff		No
Canteen/Break	N/A	600	Proximity to staff		No
Conference	N/A	1,000	Proximity to staff		No
Comm/Networking	1	250	Central within lab facility		No
Storage	N/A	1,000	Floor load, proximity to labs		No

* *gross* square footage is roughly 1.5 times assignable.