

# EVLA Memo No. 55

## EVLA Transition Operations

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### Abstract

This memo assesses the incremental operations cost for the EVLA during the transition from the VLA to the completion of the New Mexico Array. For annual steady-state operations, the baseline is taken to be that defined in EVLA Memo #52, "Operations Plan for the Expanded Very Large Array," as modified here by updating some costs. It is assumed that the first antenna station of the New Mexico Array is available for NRAO outfitting in mid-2008, while the last is available near the end of 2011. Given these assumptions, the additional operations cost for EVLA Phase 2 is predicted to rise gradually from about \$0.2M in 2008 to a steady state of approximately \$1.9M in 2012. In addition, the increment to the operations cost for Phase 1 of the EVLA will be another \$0.2M, with most of that addition occurring when the correlator comes on line in 2009.

## 1 Introduction

The Expanded Very Large Array (EVLA) Project has been divided into two phases. In the first phase, new fiber optics, correlator, and electronics will be developed and installed in order to increase the sensitivity and spectral capabilities of the VLA. The second phase will include construction of the New Mexico Array, with eight new antenna stations as well as two existing antennas of the Very Long Baseline Array. Less costly, but still important parts of Phase 2 are the completion of a compact **E** configuration and the installation of a low-frequency capability on all 38 antennas of the EVLA (28 current VLA antennas plus 10 New Mexico Array antennas).

During Phase 2 of the EVLA, 10 additional antenna stations (including 8 new stations) will be added over a significant portion of New Mexico. EVLA Memo #52, "Operations Plan for the Expanded Very Large Array," assesses the increment to the annual operational cost that is expected after the completion of the EVLA. This memo describes the gradual increase of the operational costs from the current baseline to the final cost, during the implementation of Phase 2. The description below follows the basic division of tasks in EVLA Memo #52, item by item, in order to identify the additional costs during the transition period. Some costs are updated based on more recent or more accurate information than was included in EVLA Memo #52. At the end of this memo, the cost breakdowns for EVLA Phase 2 are summarized in Table 1.

Since the number of antennas and the local operational requirements will remain essentially unchanged during Phase 1, it is expected that the additional operational costs for the original 28 (retrofitted) antennas generally will be negligible. An assessment shows that the primary additional cost for Phase 1 will be an additional \$200K per year in electricity costs for the new correlator and the additional cryogenic refrigerator on each antenna. Other expected costs are at the \$5K–\$10K level and are ignored here. For completeness, the extra Phase 1 operations costs are shown in Table 2.

## 2 Itemized Phase 2 Costs

### 2.1 Field Group Costs

**1. Depreciation of Field Group Vehicles.** The field groups for the EVLA stations are assumed to have four vehicles for operations, with a cost of \$30K each depreciated over 7 years. We assume here that two vehicles are purchased at the beginning of 2008, and one each in 2009 and 2010. The annual depreciation cost thus rises from \$8K in 2008 to \$13K in 2009 and the full \$17K in 2010.

**2. Yearly Fuel Costs.** The annual cost at steady state is \$11K. It will rise with the number of vehicles, from \$5.5K in 2008 to \$11K in 2010.

**3. Vehicle Maintenance.** This rises in step with the fuel costs, to a steady state of \$5K.

**4. Vehicle Insurance.** This rises to a steady state of \$10K by 2010.

**5. Facilities for Southern Field Group.** The first antennas to be serviced by this group will be turned over to NRAO in 2008, so the total cost of \$12K is assumed to begin in 2008.

**6. Electricity & Phones.** The total cost for eight sites is projected to be \$104K. We assume one site is active in 2008, five in 2009, and all eight new sites in 2010.

**7. Water.** The total cost of \$2K is incremented by the number of stations, similarly to the electricity and phones.

**8. Fiber Rental.** The first year of fiber rental for each station is assumed to be paid out of the construction budget, as stations are brought on line. The next year, the stations' fiber costs will transition to the operations budget. EVLA Memo #52 uses a total cost of \$750K with no breakdown into components. The construction cost in the detailed Work Breakdown to be used in the EVLA-2 proposal sums to \$633K, but does not include any cost of renting the current fiber link to Pie Town. Here, we use the schedule to be provided in the EVLA-2 proposal. In 2008, we start with the Dusty and Rincon fibers, at a cost of \$38.7K. In addition, we include an annual cost of \$65K for the fiber to Pie Town, beginning in 2008. In 2009, we add the costs of Spurgeon, West U.S. 60, and Mangas. In 2010, Cuchillo, Torrance, and Elk transition to the operations budget. Finally, the fiber lease along NM 113 becomes part of operations in 2011. Incremental costs are shown in Table 1.

**9. Annual Road Grading.** The total cost of \$4K rises with the initial antenna installations at each site.

## 2.2 Maintenance

**10. Per Diem.** Three annual major maintenance visits are assumed per year, with per diem costs of \$38 per day for five people for five days. The first major maintenance visit is expected to occur in 2011, for one antenna, with visits to three antennas in 2012. Earlier visits will be accomplished as part of construction.

**11. Mileage.** Vehicle mileage for the maintenance visits is expected to occur on the same schedule as the per diem costs.

**12. Fuel Costs.** These increment as for the mileage and per diem.

**13. Overnight Accommodations.** The overnight accommodations for the maintenance visits begin at \$80 per day for each of five people on a five-day visit. This totals \$2K per visit, with one visit in 2011 and three per year thereafter.

**14. Routine Maintenance and Hardware Upkeep.** The routine maintenance is calculated as 10% of the total capital outlay for replacement parts, lab equipment, and heavy equipment. This is assumed to proceed in step with the first installations of equipment and fiber at each station. There are two stations started in 2008, three in 2009, and three in 2010. The appropriate fraction of eight stations is incremented each year, with a total of \$145K assumed as in EVLA Memo #52.

## 2.3 Personnel Costs

**15. Southern Field Group.** Two new FTEs will be required for the Southern field group. It is assumed that these will be involved in construction in 2008, and transition to the operations budget in 2009. Wages and benefits are assumed to amount to \$130K per year. Most overhead for these individuals is included in specific costs itemized above (e.g., power and facilities). An estimated 6% overhead is added to account for management, secretarial, and other support in Socorro. This is half the projected rate to be charged to ALMA, because the facilities-related costs are covered directly elsewhere in the budget.

**16. Overtime.** Overtime costs for the Southern Field Group amount to \$14K per year, beginning in 2009.

**17. Electronics Division.** An additional 9 FTEs, including one engineer, seven technicians, and a drafter are assumed to be part of the Electronics Division. There will be a transition of personnel from construction to operations to fill these posts, beginning in 2009 and ending in 2012, when the last antenna comes on line. A linear increase with an increment of 25% of the total per year is assumed, ending with \$503K in wages and benefits. An overhead of 12% is added to the wages and benefits for facilities, management, secretarial and administrative

support (e.g., purchasing), and supplies. This overhead is consistent with the projected rate to be charged to ALMA.

**18. Engineering Services Division.** A total of 7 FTEs is required, mostly antenna mechanics and technicians. A transition similar to the Electronics Division is expected, and a 12% overhead is added. Note that EVLA Memo #52 estimates a cost of \$305K for wages and benefits, but this appears to be an underestimate. A more realistic estimate of the wage rates for the job classifications listed in that memo results in a cost of \$384K for wages and benefits, with the 12% overhead bringing the total cost to \$432K

**19. Education and Public Outreach.** A total of 2.0 FTEs is predicted here, at a final cost of \$106K in wages and benefits, plus a 12% overhead bringing the total to \$119K. These FTEs are predicted to begin on the operations budget in mid-2009.

**20. Programming Support.** No increment is required beyond that from EVLA Phase 1.

## 2.4 Other Operations Costs

**21. MkV disks.** The annual replacement of three disk packs per year is assumed, at \$1.2K per disk pack. This will begin in 2010, when a significant contribution to VLBA operations will occur, with an additional increment of one disk pack per year as these operations ramp up.

**22. Computer Equipment.** Depreciation of computer equipment is assumed to amount to \$10K per year in full operations. It is assumed that this ramps up at a steady rate from 2008 to a final value in 2011.

**23. Laptop Depreciation.** Each of six field group technicians is assumed to have an inexpensive \$1K laptop for home and travel use, with depreciation in three years. Full depreciation is assumed to begin in 2010, when the three two-person field groups are operational for a subset of the antennas in their region.

## 2.5 Operational Savings

**24. Operator Shuttle.** The operator shuttle to the VLA is assumed to be eliminated after the complete merger of the VLA and VLBA operations groups. This will not occur until 2012, with a savings of \$20K.

**25. Array Operations.** There will be a savings of 7 FTEs in array operations when the VLBA correlator is eliminated and the array operations groups of the VLA and VLBA are merged. We assume a reduction of 3 FTEs in the VLBA correlator group in 2011, with the remainder occurring in 2012. A typical savings of \$40K in wages and benefits is assumed for each person. In addition, a 20% savings in overhead is assumed for each person.

Table 1. Incremental Operations Costs (in thousands of dollars) of EVLA-2					
Item	2008	2009	2010	2011	2012
<b><u>Field Group</u></b>					
1. Vehicle Depreciation	8.5	12.8	17	17	17
2. Fuel Costs	5.5	8.3	11	11	11
3. Vehicle Maintenance	2.5	3.8	5	5	5
4. Vehicle Insurance	5	7.5	10	10	10
5. Southern Facilities	12	12	12	12	12
6. Electricity, Phones	13	65	104	104	104
7. Water	0.3	1.3	2	2	2
8. Fiber	103.7	295.4	633.8	698.2	698.2
9. Road Grading	1	3	4	4	4
<i>Subtotal</i>	<i>151.5</i>	<i>409.1</i>	<i>798.8</i>	<i>863.2</i>	<i>863.2</i>
<b><u>Maintenance</u></b>					
10. Per Diem	0	0	0	1	3
11. Mileage	0	0	0	0.3	1
12. Fuel Costs	0	0	0	0.3	1
13. Overnight Accommodations	0	0	0	2	6
14. Routine Upkeep	36.3	90.6	145	145	145
<i>Subtotal</i>	<i>36.3</i>	<i>90.6</i>	<i>145</i>	<i>148.6</i>	<i>156</i>
<b><u>Personnel</u></b>					
15. Southern Field Group	0	138	138	138	138
16. Overtime	0	14	14	14	14
17. Electronics Division	0	140.8	281.5	422.3	563
18. Engineering Services Division	0	107.5	215	322.5	430
19. EPO	0	59.5	119	119	119
20. Programming Support	0	0	0	0	0
<i>Subtotal</i>	<i>0</i>	<i>459.8</i>	<i>767.5</i>	<i>1015.8</i>	<i>1264.0</i>
<b><u>Other Costs</u></b>					
21. MkV Disks	0	0	1.2	2.4	3.6
22. Computer Equipment	2.5	5	7.5	10	10
23. Laptop Depreciation	0	0	2	2	2
<i>Subtotal</i>	<i>2.5</i>	<i>5</i>	<i>10.7</i>	<i>14.4</i>	<i>15.6</i>
<b><u>Operational Savings</u></b>					
24. Operator Shuttle	0	0	0	0	(20)
25. Array Operations	0	0	0	(144)	(336)
<i>Subtotal</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>(144)</i>	<i>(356)</i>
<b>GRAND TOTAL</b>	<b>190.3</b>	<b>959.5</b>	<b>1722.0</b>	<b>1898.0</b>	<b>1942.8</b>

Table 2. Incremental Operations Costs of EVLA-1 (in K\$)					
Item	2008	2009	2010	2011	2012
Electricity	50	150	200	200	200
<b>GRAND TOTAL</b>	<b>50</b>	<b>150</b>	<b>200</b>	<b>200</b>	<b>200</b>