

## POST-CONSTRUCTION OPERATIONS

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### **Revision History:**

1998-10-06	Added Summary
2000-03-28	Revised according to ESO recommendations.
2000-11-30	Irrelevant cost information removed.
2001-02-07	Minor editorial correction [DTE]

### **SUMMARY**

The operating centers for the ALMA will be the instrument itself at the 5,000 m (16,400 ft) site on the Llano de Chajnantor in the Andes mountains near 23E S latitude, the principal operations support facility (OSF) in the nearby village of San Pedro de Atacama at an altitude of 2,450 m (8,040 ft), an administrative support facility in Santiago, and various technical laboratories of ALMA members in the United States and Europe. While a few management personnel should live in San Pedro de Atacama, we expect most of the Chilean support staff will commute from other Chilean communities on a rotating work period basis. Despite the plans described here, we believe that the actual mode of operations will evolve over time as the ALMA staff gains experience operating in Chile.

#### 1. INTRODUCTION

Operating a complex, synthesis radio telescope in Chile will be a new experience. Large optical astronomical observatories have successfully operated in Chile for decades, and the new Very Large Telescope (VLT) is now under construction in Region II. Our operating plan results from the collective experience of these optical observatories and from the experience of synthesis radio telescopes in the United States and Europe.

The plan described below is necessarily tentative. It presumes an operating mode that will take time to perfect. It presumes that ALMA shall be able to find employees willing to live and work in northern Chile, which depends upon the Chilean economy there at the time the ALMA is hiring and in the ambience of the ALMA work environment. To succeed, the ALMA operations management must be analytical, flexible, creative, and willing to build on the experience of the optical observatories. We believe it essential that the ALMA staff in Chile -- that is, the local staff -- should schedule, manage, and operate the radio telescope rather than officials located far away in the United States or Europe.

Chapter 16 above, Site Development, describes the physical plant we believe is necessary to operate the ALMA. These chapters are linked.

#### 2. CONCEPT

The ALMA will operate somewhat like the Very Long Baseline Array (VLBA) headquartered in Socorro, New Mexico. It will be a "service" instrument, observing without astronomers present at the operations center. Astronomers need not travel to Chile to observe, although they may choose to do so. Rather, this observing mode will free them from *having* to travel to the ALMA to observe. In addition, service observing will give the local staff the freedom to juggle observing programs to match the current receiver status and atmospheric transparency. Such a mode requires the ALMA to provide astronomers with the capability to monitor the observing over the Internet, so as to make program changes when necessary.

## 2.1. Operating Centers

ALMA operations will require three locales in Chile, supplemented by several in the United States and Europe. The instrument itself will be situated on the Llano de Chajnantor, a geologic “bench” at an altitude of 5,000 m (16,500 ft) in the Andes mountains east of the village of San Pedro de Atacama. The operations center will be located near this village because of its proximity and its lower altitude of 2,450 m (8,040 ft). Finally, a small administrative and business office must be located in the capitol of Chile, Santiago, to process duty-free imports, to accommodate high-level administration, to maintain contacts with the national government, and to provide a research environment for the scientific support staff. Sites in the United States and Europe will oversee long-term technical development as well as offer high-level technical support when necessary.

Similar to the Very Large Array (VLA) in New Mexico, the principal operating center of the ALMA may change with time. San Pedro de Atacama is a small village (population 1,000) with few amenities other than those required to support its tourist industry. Few employee’s families will want to live there for a long term, especially those with school-age children. As the ALMA evolves into stable operations, we believe it likely that some aspects of its operations will move to a larger community -- probably, Santiago -- with more amenities. Such changes could make long-term employment attractive to skilled professionals. The modern fiber-optic telephone network now being installed in Chile should easily facilitate this relocation. In this case, the San Pedro de Atacama facilities will become principally a maintenance facility similar to the VLA facilities on the Plains of San Augustin in New Mexico.

## 2.2. Character of Chilean Operations

### 2.2.1. Management

Management decisions should be local ones. The ALMA director in Chile should make all decisions involving operations in Chile. All employees in Chile should report to the ALMA director, regardless of whether they are “permanent” Chilean hires or ones “borrowed” from related organizations. The sponsoring organizations, the NRAO, ESO, and others, should confine their involvement with the ALMA in an oversight role such as financial support, selection (but not scheduling) of observing proposals, and general policies.

### 2.2.2. Salaries and benefits

As far as possible, employee salaries and benefits should be “consistent” among all ALMA employees regardless of their place of hire. By the time the ALMA moves into full operation, we expect that Chilean professional salaries will be competitive with the world market. This salary consistency would include the job classifications and the salary steps within them. Exceptions would be temporary employees “borrowed” from other organizations. Because of continuing financial commitments at home, these temporary employees would require larger compensation.. “Benefits” would include medical insurance, pension contributions, educational allowances, housing, and travel allowances where appropriate. Such benefits as well as work rules should be in strict accordance with Chilean law regardless of the eventual diplomatic or international status of the ALMA organization.

### 2.2.3. Contracting support services

As is customary in the Chilean mining industry, the ALMA should contract for commercial services when they are available. For example, Chile has several large companies that provide food service to remote locations. The employer need only supply a kitchen and dining room, and specify the variety and quality of the food to be served. This situation also applies to medical

services, housekeeping services, payroll, security, and vehicle leasing and maintenance. The ALMA should actually hire only those employees unavailable or inappropriate to obtain from commercial service companies, such as management and administrative personnel, support scientists, engineers, programmers, and telescope mechanics. Not only is this system flexible and cost-effective through competition, but it also frees the ALMA management to expand or contract services as needed without impacting long-term ALMA employees.

### 3. STAFFING

#### 3.1. Sistema de Turno employment for the ALMA and its Operations Center

To operate the ALMA in Chile, *all* consultants recommend a rotating shift system known in Chile as the “Sistema de Turno” for staffing the operations center and the maintenance of the ALMA itself. In Chile the Turno system is used by all international observatories and most mining operations. It complies with Chilean labor laws.

Turno work arrangements include a range of schedules. Variations are common. A construction project in a remote area east of Iquique operates on a two week “on” and a 10 days “off” system. ESO uses two schedules: known as “5/2” and “8/6.” The “5/2” schedule is appropriate for office staff. The work begins at 3PM on Monday, consists of 9.5-hour days Tuesday through Thursday, and ends at 1PM on Friday. The “8/6” schedule is more appropriate for skills needed every day. It provides approximately 88 work hours over a two week period. It begins at 3PM on day 1, consists of 9.5 hours each on days 2 through 7, and ends at 1PM on day 8. Sunday is compensated at 1.75 x the basic rate. Replacement personnel overlap on days 1 and 8. Customarily, the employer provides room, board and transportation to and from an urban assembly point.

An effective Turno system must be appropriate to the specific operation of the ALMA. This system is not appropriate for highest level management people who need to be continually available. It is also inappropriate for employees responsible for creating new systems or equipment. However, it works well for many office positions and for “interchangeable” personnel like telescope operators and maintenance people who must be available seven days a week, 24 hours a day. There is extra cost involved. ESO statistics show that the “8/6” arrangement requires about 2.4 employees for every Turno position to ensure overlap and continuity.

Given the difficulties of staffing a location like San Pedro de Atacama, the Turno system may prove to be the only practical solution.

To accommodate a Turno system, the ALMA would need to provide dormitories at its operations center near San Pedro de Atacama. Our advisors recommend that the dormitories be sized so that each Turno-employee could have the same room and the same bed each visit. In this way, that employee could leave personal effects in the room and could decorate the room to suit his or her preferences.

The ALMA should establish pickup points for Turno employees only in Calama and Antofagasta, at first. Region II has a network of modern, commercial buses linking its cities. Some of these buses serve San Pedro de Atacama more than once daily and, of these, a few continue on the Paso de Jama road into Argentina. The principle would be that commuting employees need to get themselves to the collection points by the most appropriate means and at their own expense.

Professional employees would either live in San Pedro and take substantial holidays as compensation for long hours on the job, or commute from elsewhere in Chile with some of the commuting time being considered working time.

### 3.2. Support offices in Santiago

The Santiago offices would not require a Turno system, nor would one be appropriate to their function. Because of the added expense and inefficiency of commuting to and from San Pedro de Atacama, all positions not required in SpdA should be located in Santiago. These would include certain senior administrative management, contract and procurement personnel, accounting functions, and an import/export office.

Effective supply for ALMA will require an import/export office in Santiago. The Chilean Foreign Ministry (Ministerio de Relaciones Exteriores) in Santiago must process all papers for duty-free imports regardless of which Chilean port is used. Furthermore, even after 30 years of operating in Chile from La Serena, the CTIO has chosen to use only ports of entry near Santiago even though the city of La Serena is contiguous with the port of Coquimbo. The CTIO has found that the high traffic levels at the Valparaiso seaport and the Santiago International Airport give the widest opportunities for shipping. Equally important, they have found that, in most cases, these ports are less expensive to use than the port of Coquimbo even though the Santiago goods must be trucked to and from La Serena. The same situation may apply to Antofagasta – the closest port to ALMA.

The Santiago facilities would also include offices for support astronomers. ESO experience has shown that their support scientists had little success conducting research while at the ESO observatory at La Silla. Yet, opportunities to conduct research is essential to retaining quality astronomers. Therefore, ESO instituted schedules for their support astronomers of a week at La Silla, a week in Santiago, and a week off – or some variation on this theme. This system has worked well, and ALMA should adopt it.

The roles of the Santiago office may change with time. As ALMA operations mature, it may be possible to withdraw all but essential operations support from San Pedro de Atacama to Santiago. Specialized support staff would then fly to SpdA (Calama) when needed. This could save money without impacting the reliability of ALMA.